Comhairle Contae Fhine Gall
Fingal County Council

Broadmeadow Way Proposed Greenway
Between Malahide Demesne and
Newbridge Demesne

Natura Impact Statement in Support of Appropriate Assessment

May 2019

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1.0 Introduction

1.1 Background

1.1.1 Fingal County Council proposes to develop the Broadmeadow Way, a new greenway (shared footpath and cycleway) between Malahide Demesne and Newbridge Demesne via the railway causeway across the Malahide Estuary. The proposed greenway would be c. 6km in length. Much of the proposed greenway follows existing pathways and roads.

1.1.2 The development of a cycling and walking greenway facility linking Malahide Demesne and Newbridge Demesne is considered by Fingal County Council to be a critical link in the development of a high quality coastal amenity route extending from Sutton and Howth in the south to the county boundary north of Balbriggan. It would connect Malahide and Donabate and facilitate easy access to a greater number of people within Fingal between the two villages and all the services which they offer, including the two existing regional parks at Malahide Demesne and Newbridge Demesne. The development of this coastal public amenity has the widespread support of the relevant regional, county and local area plans. The explicit support in statutory planning documents underlines the broad consensus and wide public interest in such a greenway. In particular, the provision of the Broadmeadow Way greenway has been an explicit objective of Fingal County Council for over a decade.

1.1.3 This Natura Impact Statement and a separate Environmental Impact Assessment Report have been prepared in support of this scheme. The site location and site setting are presented in Figure 1.1 to Figure 1.4. The general relationship between the proposed greenway and the Malahide Estuary SAC/SPA is shown respectively in Figure 1.5 and Figure 1.6. For detail see Design Drawings in Appendix 1.

1.2 Need for the Scheme

1.2.1 The application for consent from An Bord Pleanála is being made pursuant to the Planning and Development Acts 2000, as amended (PDA 2000), specifically:

- Development by a Local Authority requiring: Environmental Impact Assessment (Part X of PDA 2000); Appropriate Assessment (Part XAB of PDA 2000); Local Authority own development (Part XI of PDA 2000)
  - Environmental Impact Assessment: Section 172(1) of the PDA 2000 read with section 172(1A)(a) of the PDA 2000 and section 175(2) of the PDA 2000
  - Appropriate Assessment: Section 177S(2)(h) of the PDA 2000 and section 177AE(2) of the PDA 2000.

1.2.2 The project also proposes developments on the foreshore and as such the following is also applicable:

- Local Authority foreshore development (section 226 of Part XV of PDA 2000)
  - Environmental Impact Assessment: Section 172(1) of the PDA 2000 read with section 172(1A)(a) of the PDA 2000 and section 226(1) of the PDA 2000
  - Appropriate Assessment: Section 177S(2)(h) of the PDA 2000.

1.2.3 As a Local Authority own development, the project was Screened for the Requirement for EIA in accordance with Article 120 of the Planning and Development Regulations 2001, as amended (PDR 2001) for Sub-threshold Environmental Impact Assessment Report (EIAR), and with regard to the criteria set out in Schedule 7 and the information required as set out in Schedule 7A of the PDR 2001.

1.2.4 In accordance with Article 120(1) of the PDR 2001, the Screening for the requirement for EIA concluded that there is significant and realistic doubt in regard to the likelihood of significant effects on the environment arising from the proposed development, and having reviewed the criteria set out in Schedule 7 and the information specified in Schedule 7A of the PDR 2001, determined that the development would be likely to have such effects and required the preparation of an EIAR in respect of the development.

Fingal County Development Plan 2017-2023

1.2.5 A coastal walk is a long-standing objective of Fingal County Council. The County Development Plans 2011-2017 and 2017-2023[1] fully support the development of a greenway between Malahide and Donabate called the Broadmeadow Way.

Map Objective 39

1.2.6 Seek the provision of a public walkway/cycleway on land west side of the train line in Donabate and along the existing embankment across the Malahide Estuary, in consultation with Iarnród Éireann within the lifespan of the Development Plan.

Map Objective 43

1.2.7 Completion of the Broadmeadow Way between Malahide and Donabate to be prioritised during the lifetime of the Development Plan.

Objective MT13

1.2.8 Promote walking and cycling as efficient, healthy, and environmentally-friendly modes of transport by securing the development of a network of direct, comfortable, convenient and safe cycle routes and footpaths, particularly in urban areas.

Objective MT14

1.2.9 The Council will work in co-operation with the NTA and adjoining Local Authorities to implement the *Greater Dublin Area Cycle Network Plan* subject to detailed engineering design and the mitigation measures presented in the SEA and Natura Impact Statement accompanying the NTA Plan.

Objective GI28

1.2.10 Provide attractive and safe routes linking key green space sites, parks and open spaces and other foci such as cultural sites and heritage assets as an integral part of new green infrastructure provision, where appropriate and feasible.

[1] Fingal County Council (March 2017). Fingal Development Plan 2017-2023. http://www.fingalcoco.ie/ planning-and- buildings/ development-plans-and-consultations/fingaldevelopmentplan2017-2023/.

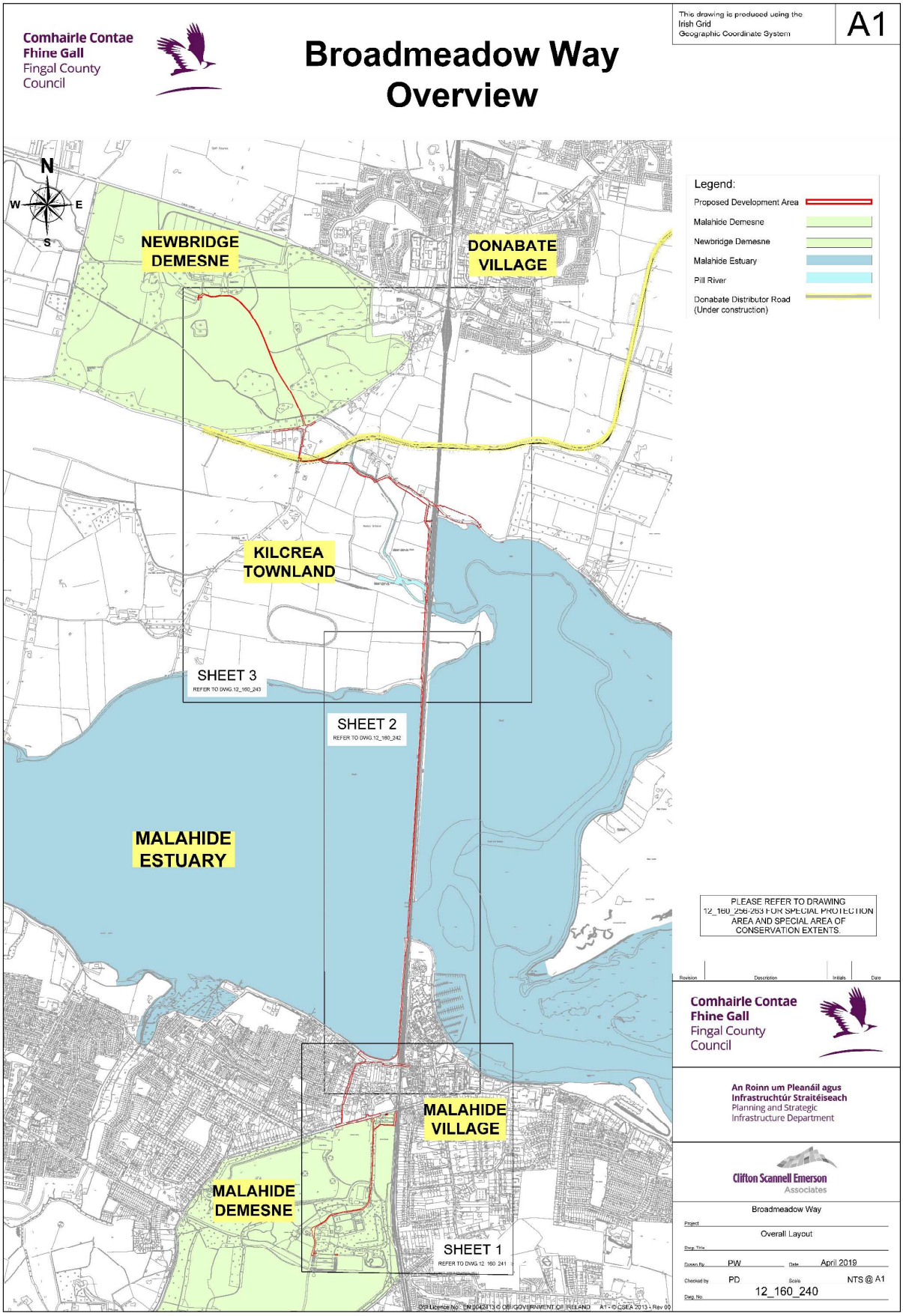

Figure 1.1. Site Location and General Site Setting – Overview.

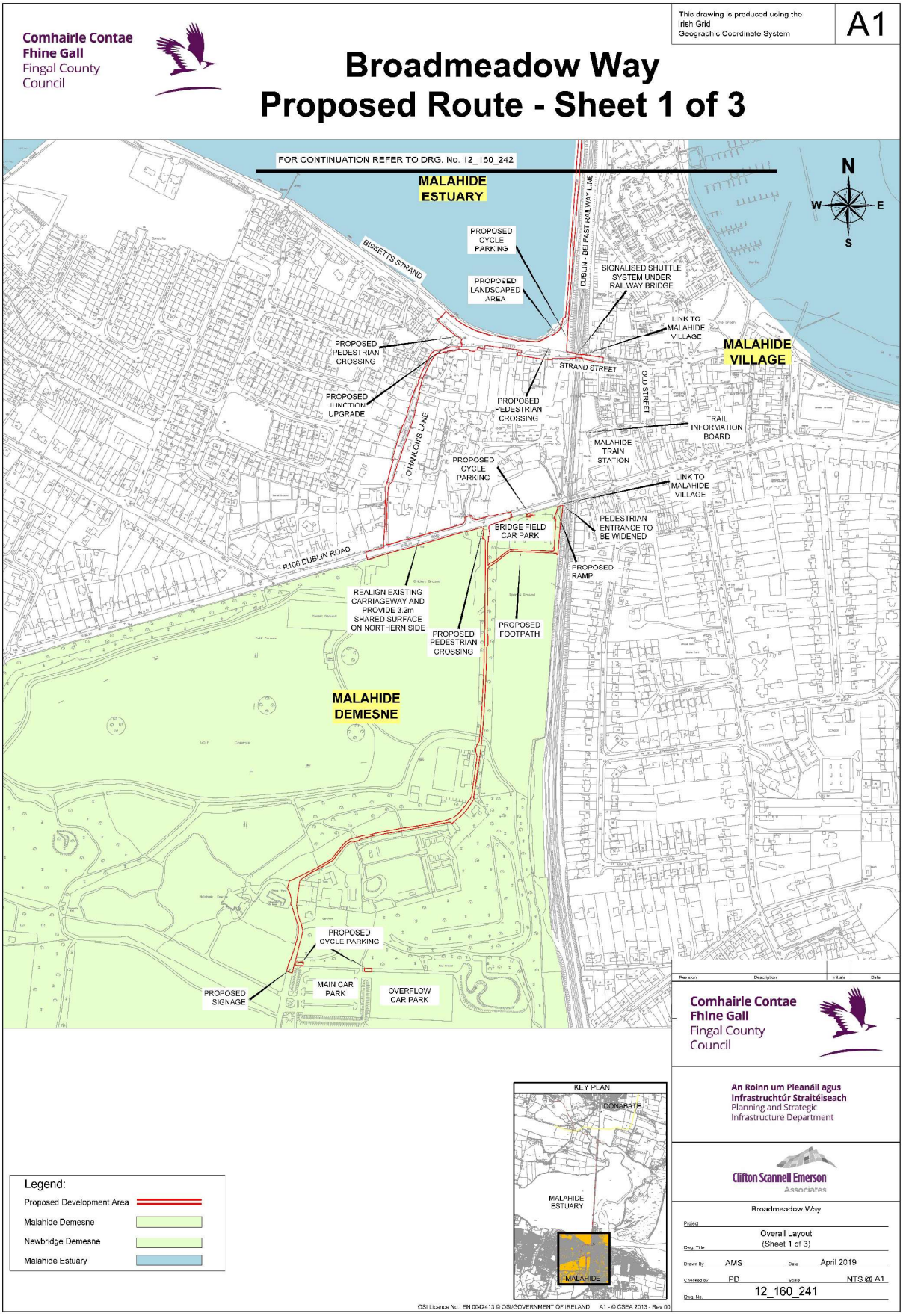

Figure 1.2. Site Location and General Site Setting – Sheet 1 of 3.

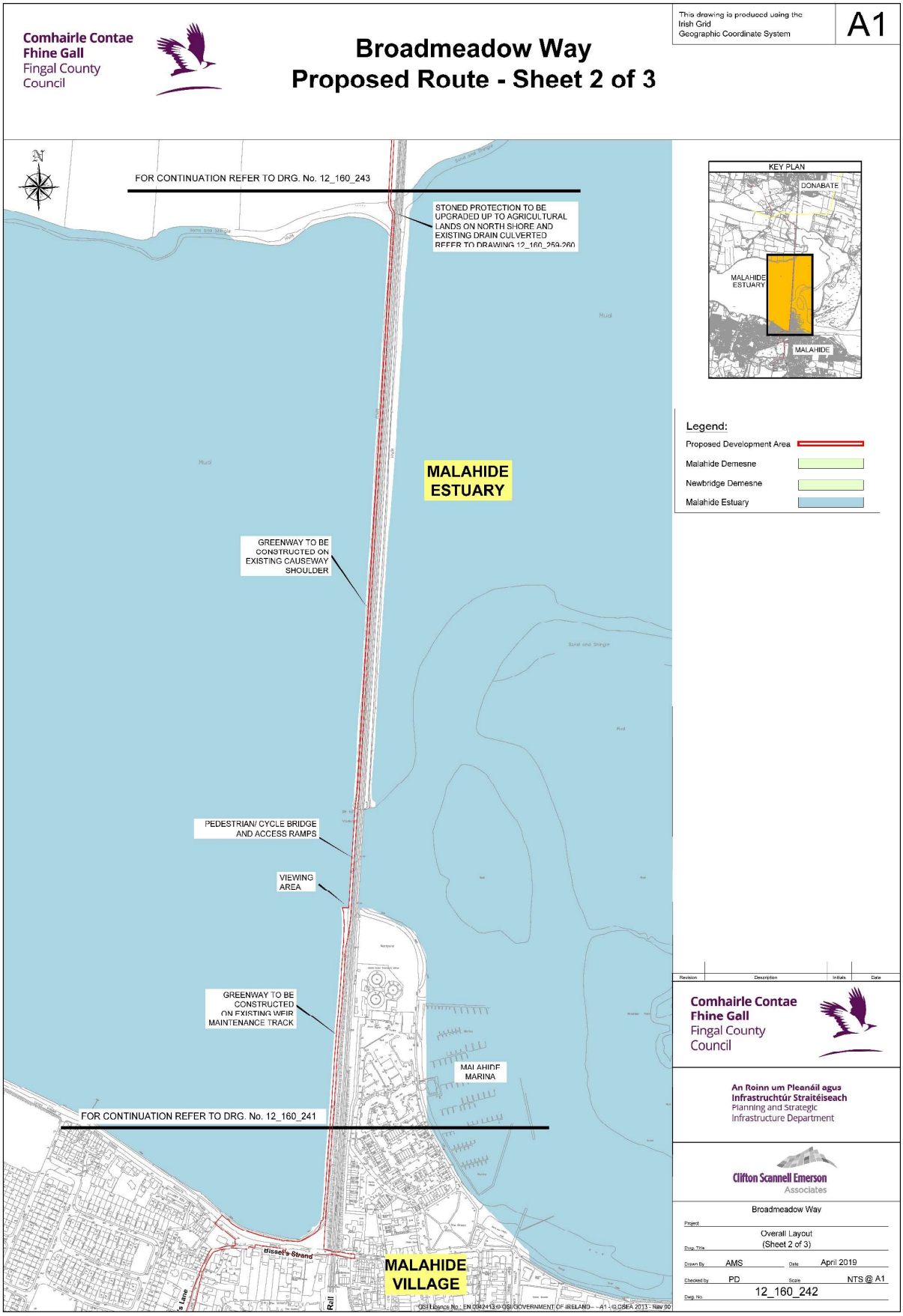

Figure 1.3. Site Location and General Site Setting – Sheet 2 of 3.

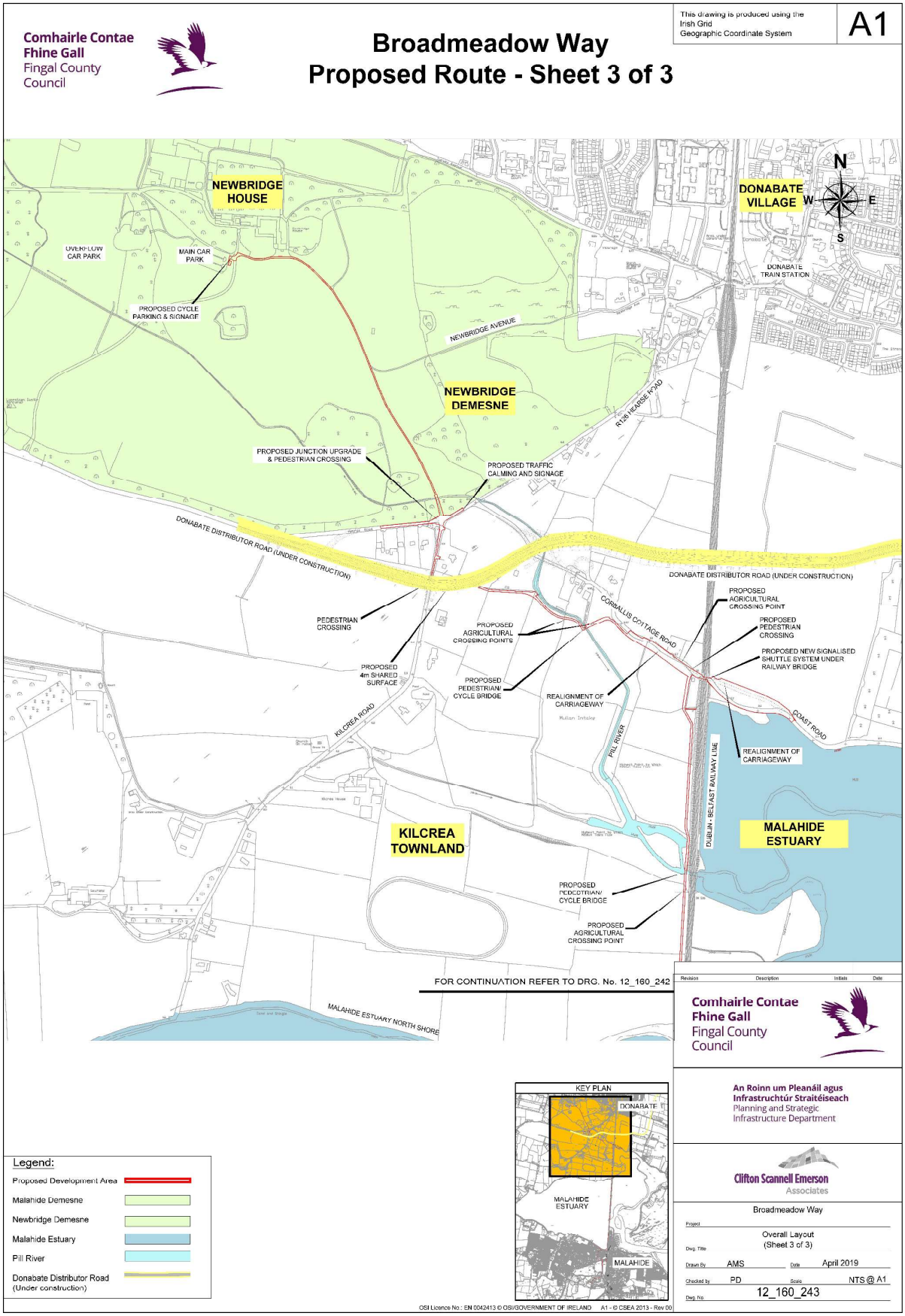

Figure 1.4. Site Location and General Site Setting – Sheet 3 of 3.

1.3 Need for Appropriate Assessment

1.3.1 The Birds and Habitats Directives (Council Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (the Birds Directive)[2] and Council Directive 92 /43 /EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive)[3]) require Ireland to establish protected sites as part of a European wide network of sites (the Natura 2000 network – which are known in Ireland as European sites[4]) for habitats and species that are of international importance for conservation. In Ireland, European sites include Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). SACs are selected for habitats listed on Annex I of the Habitats Directive (including priority types which are in danger of disappearance) and species listed on Annex II. SPAs are selected for bird species (listed on Annex I of the Birds Directive), regularly occurring populations of migratory bird species (such as ducks, geese and waders), and areas of international importance for migratory birds. The specified habitats and species for which each SAC and SPA is selected correspond to the qualifying interests (in the case of SACs) or special conservation interest species (in the case of SPAs) for the sites, for which conservation objectives are developed.

1.3.2 Article 6(3) of the EU Habitats Directive (92/43/EEC and as amended) states that: "Any plan or project not directly connected with or necessary to the management of the [European] site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives." Such an assessment is known as an Appropriate Assessment (AA).

1.3.3 Further guidance on AA is provided by the European Commission (2000, 2001, 2007 and 2018) and the Department of the Environment, Heritage and Local Government (DEHLG) (2010):

- European Commission (2000) *Managing Natura 2000 sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC*;
- 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*;
- European Commission (2007) *Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC: Clarification of the concepts of: Alternative solutions, Imperative*

[2] For further information on the Birds Directive refer to:
http://ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm

[3] For further information on the Habitats Directive refer to:
http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm

[4] Natura 2000 sites are defined under the Habitats Directive (Article 3) as 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, and special protection areas, classified by Member States pursuant to the Birds Directive (79 /409 /EEC). The aim of the Natura 2000 network is to aid the long-term survival of Europe's most valuable and threatened species and habitats. In Ireland these sites are designed as European sites - defined under the Planning Acts and/or Birds and Habitats Regulations as (a) a candidate site of community importance, (b) a site of community importance, (c) a candidate special area of conservation, (d) a special area of conservation, (e) a candidate special protection area, or (f) a special protection area. They are commonly referred to in Ireland as Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).

reasons of overriding public interest, Compensatory Measures, Overall Coherence, Opinion of the Commission;

- European Commission (2018) *Managing Natura 2000 sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC*; and
- Department of the Environmental Heritage and Local Government (2010). *Appropriate Assessment of Plans and Projects in Ireland. Guidance for Planning Authorities.*

1.3.4 The proposed development crosses the Malahide Estuary SPA (site code 004025) and Malahide Estuary SAC (site 000205) (see Figure 1.5 and Figure 1.6).

1.3.5 The proposed development has the potential to cause disturbance to birds in the SPA, during construction, by users of the greenway, and the potential to temporarily elevate water levels in the inner estuary[5] SAC during works to the weir to facilitate construction access. The scheme is therefore subject to Appropriate Assessment as described below.

Stage 1: Screening

1.3.6 The Appropriate Assessment process begins with Stage 1 - Screening to determine if a plan or project is likely to have a significant effect on a European site; see Figure 1.7 for a summary of the steps involved in completing an Appropriate Assessment.

1.3.7 The first stage is to determine if the plan is directly connected with or necessary for the site's management for nature conservation. If the answer is no, it must be determined if the plan is likely to have significant effects on European site(s). If the answer to the latter is yes, then the assessment advances to Stage 2 (see Figure 1.7). Stage 1 screening involves the identification of the plan or project objectives, and a review of alternative methods to achieving the objectives where appropriate.

1.3.8 The AA screening begins with identification of European sites that could potentially be affected by the project; in this instance all European sites within the environs of the project have been identified. This is followed by collation of information relating to these sites. Such information is principally obtained from the National Parks and Wildlife Service (NPWS) of the Department of Arts, Heritage and the Gaeltacht (DAHG). The primary sources of information on European sites are the:

- Conservation Objectives report for the site;
- Standard Natura 2000 data forms;
- Site synopses; and
- Site boundaries.

1.3.9 All of the above can be obtained from the NPWS, while site boundaries can be viewed on the NPWS webpage (http://npws.ie/mapsanddata/); site boundaries can also be downloaded as shapefiles.[6]

1.3.10 Where negative impacts on a European site cannot be discounted the assessment must proceed to Stage 2. The entire assessment procedure is shown in Figure 1.7.

[5] "Inner estuary" refers to the estuary located to the west of the Dublin-Belfast railway line. "Outer estuary" refers to the estuary located to the east of the railway line.

[6] All site information and associated shapefiles were downloaded from www.npws.ie on 2nd May 2013.

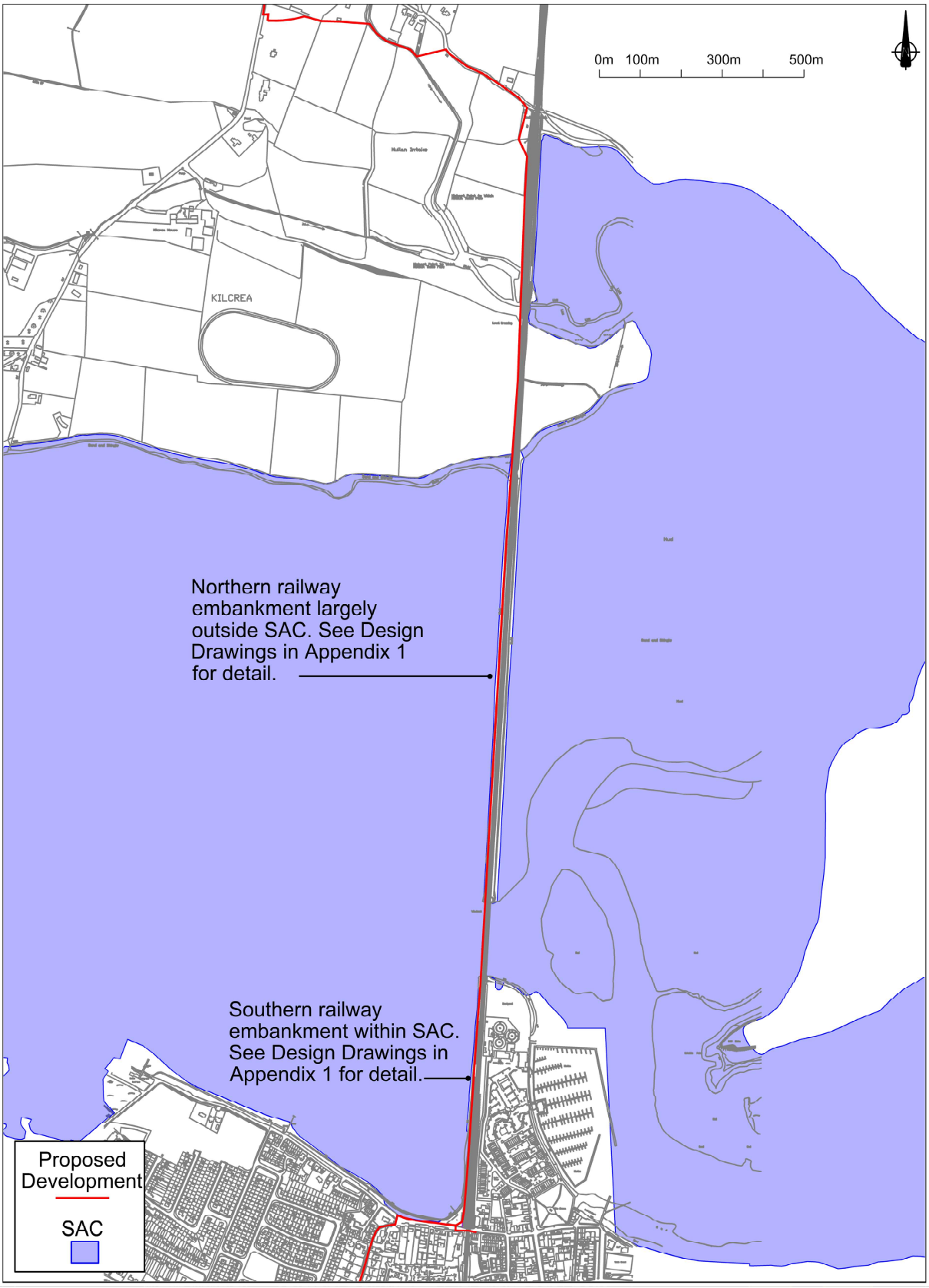

Figure 1.5. Malahide Estuary SAC and the Proposed Development. For detail see Design Drawings in Appendix 1.

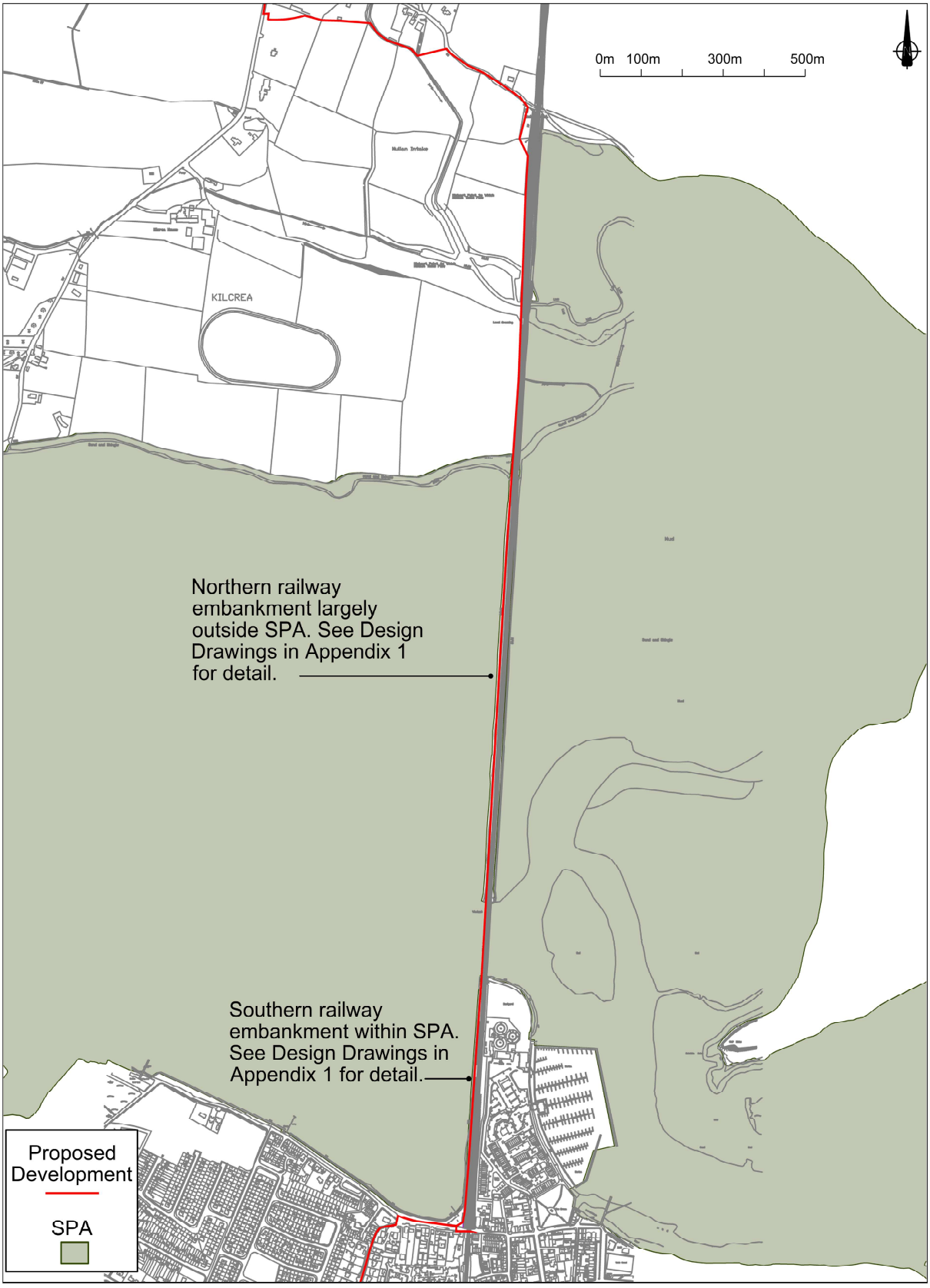

Figure 1.6. Malahide Estuary SPA and the Proposed Development. For detail see Design Drawings in Appendix 1.

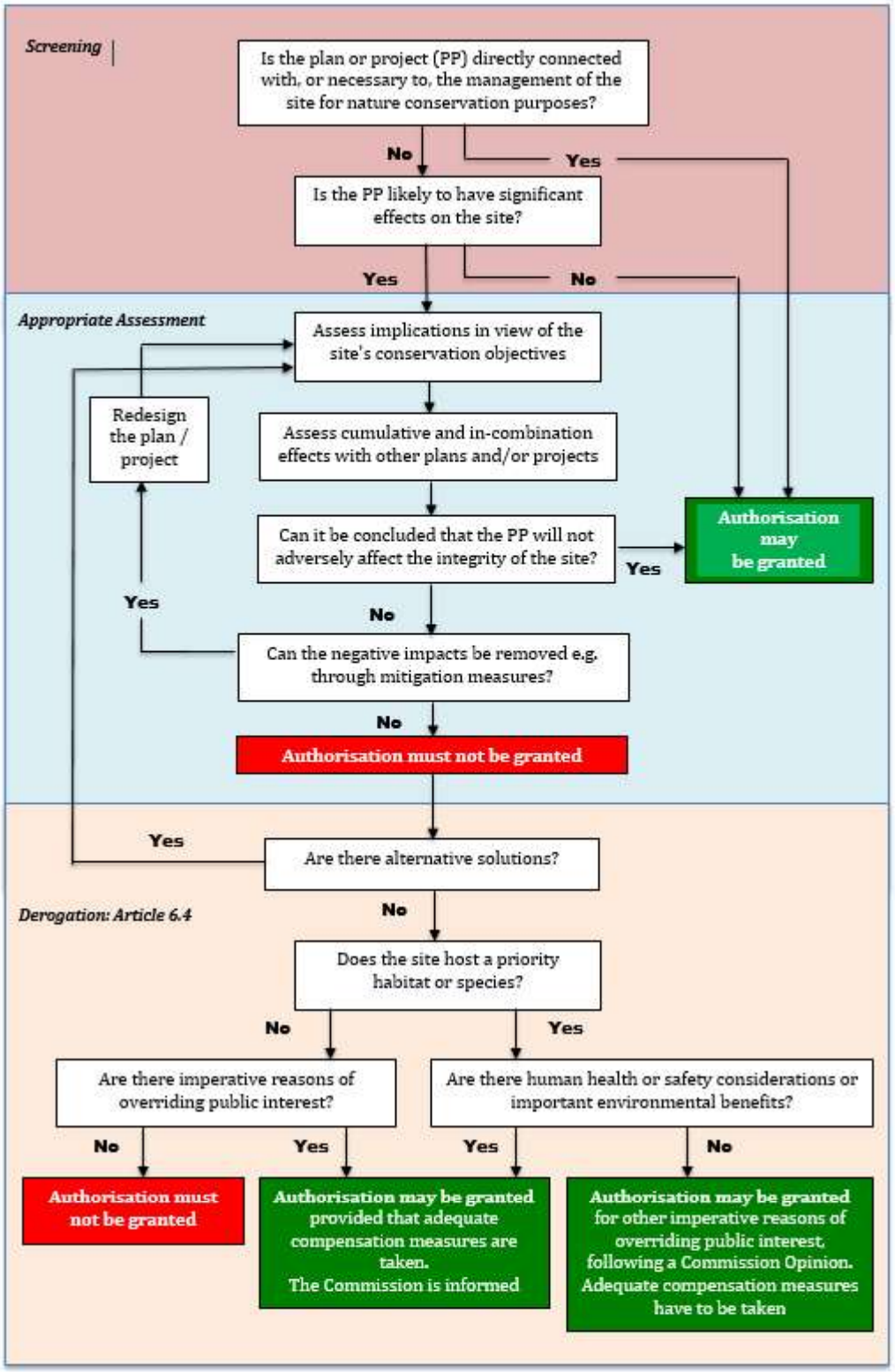

Figure 1.7. Consideration of Plans and Projects Affecting Natura 2000 Sites from Annex II from *Managing NATURA 2000 Sites - The provisions of Article 6 of the 'Habitats' Directive 92/43/CEE* (European Communities, 2018).

Stage 2: Appropriate Assessment

1.3.11 If the screening process identifies that significant negative effects cannot be ruled out the study progresses to Stage 2, at which point a detailed, targeted assessment of the nature and potential significance of direct and indirect impacts arising from the proposed plan or project must be completed. Stage 2 is the Appropriate Assessment proper to determine whether the plan or project would adversely affect the integrity of any European sites. An assessment of cumulative impacts must be carried out. Mitigation measures must be proposed to eliminate potential impacts. If it can be concluded that there will no adverse impacts on the integrity of any European site, the project can proceed for approval.

1.4 Data Sources and Qualifications

- Ecological Field Surveys 2011-2019 including botanical, aquatic, mammal, bat, and bird surveys in the vicinity of the proposed greenway.
- Summer and Winter bird survey reports of lands surrounding the Malahide Estuary carried out for Fingal County Council (Roe & Lovatt, 2009).
- Winter bird survey of Malahide Estuary & surrounding lands carried out for Fingal County Council (Lewis & Butler, 2017).
- Avian surveys of Malahide Estuary 2009-2011 (Mayes 2010, 2011).
- Bird surveys of Malahide Estuary by Ecology Ireland in the Winter of 2017/2018 (surveys led by Dr. Olivia Crowe).
- Mammal surveys of the lands at Kilcrea, including deployment of mammal trail cameras and a passive bat detector in May-June 2018.
- Environmental Report on the Remedial Works on the Malahide Viaduct (CHE, 2010).
- I-WeBS subsite counts and BirdWatch Ireland site synopses (Crowe, 2005).
- GIS data on designated conservation sites (www.npws.ie).
- Site synopses and conservation objectives for European sites (www.npws.ie).
- Online web-resources, e.g. www.biodiversityireland.ie; http://data.nbn.org.uk/imt/.
- DoEHLG (2009). Appropriate Assessment of plans and projects in Ireland - Guidance for Planning Authorities.
- Fingal County Council (2009). Malahide Waste Water Discharge Licence Application. Application Register No. D0021-01. Appropriate Assessment. July 2009.
- Fingal County Council (2009). Swords Waste Water Discharge Licence Application. Application Register No. D0024-01. Appropriate Assessment. July 2009.
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- McCorry, M. (2007). Saltmarsh Monitoring Project 2006 – Summary Report. An unpublished report for the National Parks & Wildlife Service, Department of Environment, Heritage and Local Government, Dublin.

- McKeogh, Eamonn and Bekic, Damir (2010.) Malahide Viaduct Reinstatement: Technical Paper 1 - Collapse Mechanism and Initial Emergency Works. Flood Study Group University College Cork, May 2010.
- McKeogh, Eamonn and Bekic, Damir (2010). Malahide Viaduct Reinstatement: Technical Paper 2 - Physical Models. Flood Study Group University College Cork, May 2010.
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- McKeogh, Eamonn and Bekic, Damir (2010). Malahide Viaduct Reinstatement: Technical Paper 5 - Final Design and Performance Simulations. Flood Study Group University College Cork, July 2010.
- McKeogh, Eamonn and Bekic, Damir (2011). Malahide Viaduct Reinstatement: New Design Weir - Computer modelling for Environmental Analyses. Flood Study Group University College Cork.
- McKeogh, Eamonn and Bekic, Damir (2012). Monitoring of Malahide Viaduct - Report on water level recordings. Flood Study Group University College Cork.
- NPWS (2013). 6.2.2 Malahide Estuary SAC (site code 000205) Conservation Objectives Supporting Document – Coastal Habitats (Version 1 – May 2013).

1.4.1 Other sources of material include:

- Fingal County Council (2010). Fingal Biodiversity Action Plan, 2010-2015.
- Fingal County Council (2010). Fingal Development Plan, 2017-2023.
- Fingal County Council (2010). Fingal Heritage Plan, 2017-2023.

1.4.2 The appropriate assessment screening and Natura report was prepared by:

Discipline	Years of Experience	Consultant	Qualifications
Aquatic Environment	30+	Ger Morgan	BSc, MSc
Biodiversity: Birds & Mammals	20+	Gavin Fennessy	BSc, PhD, MIEEM, MESAI
Biodiversity: Terrestrial Habitat	25+	Mary O'Connor	BSc(Hons), PhD
Project Management and Co-ordination	30+	Michael O'Sullivan	BSc(Hons), MSc(cum laude), Dip EIA Mgt, HDip Env Eng, DLAW, BCL(Hons), MIEMA, CEnv

1.4.3 Gerard Morgan is a graduate of University College Cork with a BSc in Zoology and MSc in Freshwater Ecology. He has managed the Aquatic Services Unit, a UCC-based environmental consultancy specialising in aquatic systems since 1986. He has over 30 years of experience in ecological consultancy, specialising on water quality impacts in freshwater, estuarine and marine habitats of a wide range of infrastructural projects including roads, bridges, airports, pipelines and port and harbour constructions among

others. He has also specialised in protected species surveys including fish, lampreys and pearl mussels, and marine and estuarine fish surveys. He is a specialist in marine and freshwater algal surveys and identifications in rivers and lakes and marine environments. He is recognised by the EPA as a practitioner of the Q-value biotic index system. His clients include the EPA, Teagasc, Cork County Council, Port Authorities and large environmental and engineering consultancies and industry. He has acted as an expert witness at many oral hearings.

1.4.4 Gavin Fennessy is a field ecologist and project manager with over 20 years of experience in environmental consultancy. He is a Director and Principal Ecologist with Ecology Ireland Wildlife Consultants Ltd. which he established in 2011. He has provided expert ecology services for a wide variety of projects including planning and development of overhead powerlines, pylons, wind farms, grid connections, pipelines and other large infrastructural developments. Gavin is especially experienced in the design, preparation and reporting on bird and mammal surveys. He is an experienced Expert Witness having provided testimony to several Bord Pleanála Oral Hearings. He is an expert in bird collision risk and is a retained ornithological consultant at Dublin Airport. He is a full member of CIEEM and is an invited member of the Irish CIEEM Policy Group. Gavin has lectured to a number of undergraduate and post-graduate courses at University College Cork on ecological impact assessment techniques and conservation legislation.

1.4.5 Mary O'Connor is a qualified botanical ecologist with a special interest in habitat assessment. Her Ph.D. involved the detailed investigation of vegetation distribution, eco-hydrology, geochemistry and vegetation mapping of the Roundstone Bog Complex in Connemara, within the Connemara Bog Complex SAC. She has worked as an independent ecologist since 1998 and has gained extensive experience working on ecological assessment projects for the public and private sectors. She has worked on projects related to coastal protection and has extensive experience working in riparian and estuarine habitats.

1.4.6 Michael O'Sullivan has worked full time as a project director of major multidisciplinary conservation and infrastructural environmental management projects throughout Ireland over the past 30 years. He provides environmental, conservation and planning advice for industry and government alike. He assembles specialist consultant environmental teams tailored to individual project needs. Michael is professionally qualified in the disciplines of science, engineering and law, and has over 30 years' experience as an environmental project manager. He is also a Chartered Environmentalist and a full member of IEMA. His full-time experience has been focused on the co-ordination, collation and production of environmental impact reports (EIAR) and Natura impact statements (NIS) in support of Appropriate Assessment.

2.0 Scheme Description

2.1 Constraints and Route Options

2.1.1 Baseline environmental information and key constraints for the study area are identified in an Environmental Constraints Report (2018). An Environmental Route Options Report was also prepared (2018).

2.1.2 The study area of c. 12km^2 is as outlined in red in Figure 2.1 below. The key parts of the study area include Malahide Demesne, Malahide village, the railway causeway across Malahide Estuary, Kilcrea townland, and Newbridge Demesne. Each of these parts has been described appropriately in the Constraints Report for each of the environmental constraint elements.

2.2 Engineering and Environmental Considerations

2.2.1 A separate Environmental Impact Assessment Report (EIAR) has been prepared in support of this scheme on behalf of Fingal County Council to support a planning application to An Bord Pleanála. The EIAR was prepared using the *Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR)* (EPA, 2017), and *Draft Advice Notes for Preparing Environmental Impact Statements* (EPA, 2015).

2.2.2 The EIAR is presented in four volumes:

- Volume 1 – Non-Technical Summary.
- Volume 2 – EIAR Main Text.
- Volume 3 – EIAR Drawings and Figures.
- Volume 4A – EIAR Appendix 1.
- Volume 4B – EIAR Appendix 2.
- Volume 4C – EIAR Appendices 3-18.

2.2.3 The EIAR is laid out in sections which consider the subject areas of environmental impact assessment, such as:

(a) Policy Background and Alternatives.
(b) Project Description.
(c) Traffic and Transportation.
(d) Population and Human Health.
(e) Biodiversity.
(f) Land and Soil.
(g) Water.
(h) Air and Climate.
(i) Noise and Vibration.
(j) Material Assets.
(k) Archaeology and Cultural Heritage.
(l) Architectural Heritage.
(m) Landscape.
(n) Interaction between the factors referred to in points (c) to (m).

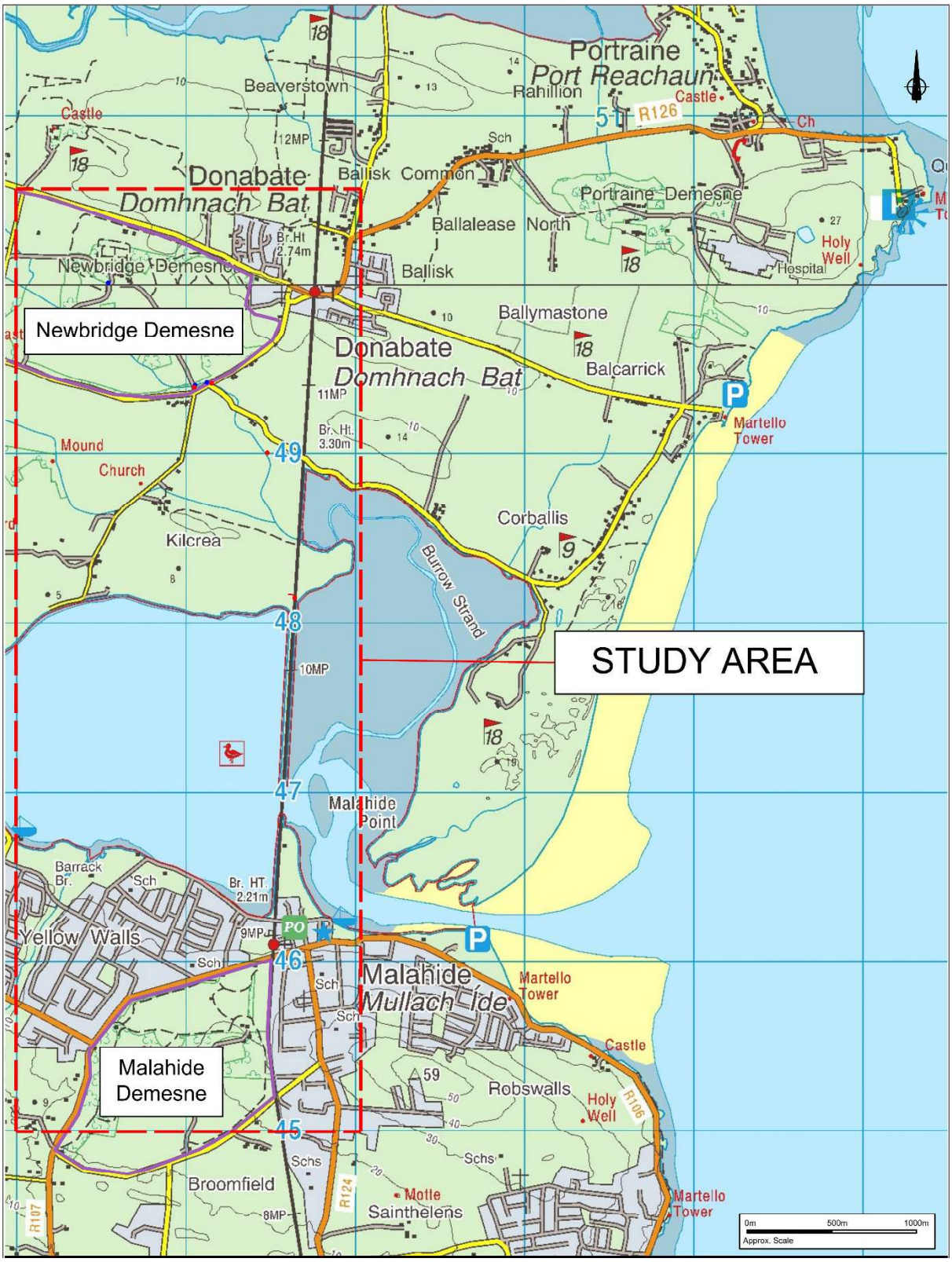

Figure 2.1. Broadmeadow Way Study Area.

2.3 Stakeholder Consultation

2.3.1 As part of the process for the construction of the proposed development, Fingal County Council hosted a public consultation in February and March 2014, at which the proposed development was presented for discussion and comment to the public. Statutory consultees together with local interest groups in Malahide, Donabate and Swords were contacted and notified of the event. The exhibition was open to the public from 14th February 2014 to 14th March 2014 inclusive and ran concurrently in three venues:

- Malahide Public Library.
- Donabate/Portrane Community Centre.
- Fingal County Hall.

2.3.2 Representatives of Fingal County Council, design staff from Clifton Scannell Emerson Associates Ltd, and environmental specialists from Creagh House Environmental Ltd were in attendance during open evenings on 25th February in Malahide and on 5th March in Donabate.

2.3.3 Public display drawings showing the route options and the emerging preferred route were on display at all three locations. A public consultation brochure and questionnaire was also available.

2.3.4 One hundred and one questionnaires were returned to Fingal County Council by the stated deadline of 28th March 2014. In addition, 30 written submissions were received from interested parties.

2.4 Main Elements of Scheme

2.4.1 The proposed development would extend from the grounds of Malahide Demesne to the R106 Dublin Road, O'Hanlon's Lane and Bissets Strand in Malahide, cross Malahide Estuary, cross the agricultural land at Kilcrea and terminate at Newbridge Demesne, Donabate. A section of the proposed development would utilise the existing weir maintenance access track on the western railway embankment between Bissets Strand and the weir estuary, a new cycle/footpath bridge adjacent to the existing railway bridge, and the shoulder of the western embankment of the northern railway causeway. The proposed development would continue close to the western margin of the railway line through the townland of Kilcrea. Aside from road surfaces, much of the proposed greenway base is already in place by way of the weir maintenance access track, which runs from Bissets Strand to the southern abutment of the railway bridge, the shoulder of the northern causeway to the northern estuary bank, and an access track from the River Pill to the Corballis Cottages Road (see detailed design drawings of the proposed scheme in Appendix 1).

2.4.2 The proposed development will include the following:

- Use of c. 900m of existing pathways within Malahide Demesne, extending from the main car park located southeast of Malahide Castle to the Hogan's Gate entrance on the R106 Dublin Road, including new route signage and bicycle parking facilities.
- Approximately 140m of new footpath construction at Bridgefield car park and new ramp/access upgrade works at the existing pedestrian entrance leading to the R106 Dublin Road.

- Reconfiguration of c. 220m of the R106 Dublin Road between Bridgefield car park and O'Hanlon's Lane to facilitate the provision of a new off-road shared pedestrian and cyclist facility along the northern side of the road, and a new signal-controlled crossing.
- Approximately 135m of road resurfacing, 230m of shared surface road markings, signage and boundary hedge trimming along O'Hanlon's Lane.
- The reconfiguration of the junction of Bissets Strand and O'Hanlon's Lane.
- Two signal-controlled crossings and new traffic signals at the railway bridge on Bissets Strand.
- The construction of approximately 260m of off-road shared pedestrian and cyclist facilities and associated landscaping and ancillary works on Bissets Strand.
- Works to facilitate a new greenway some 615m in length along the existing weir maintenance access track on the western embankment of the Dublin-Belfast railway causeway, extending north from Bissets Strand into Malahide Estuary, to include new surfacing, fencing, boundary walls, local stone fill, route lighting and signage, and a viewing area.
- Provision of a new 12-span pedestrian/cycleway bridge deck of approximately 180m in length on the existing piers located alongside the Dublin-Belfast railway bridge situated on the weir in Malahide Estuary.
- Works to facilitate a new greenway of approximately 1,000m in length along the shoulder of the western embankment of the Dublin-Belfast railway causeway, from the railway bridge on the weir in Malahide Estuary extending as far as the northern shoreline of Malahide Estuary at Kilcrea, to include new surfacing, fencing, boundary walls, local stone fill, route lighting and signage.
- Provision of c. 910m of new greenway along the western side of the Dublin-Belfast railway through agricultural lands in Kilcrea on the north side of the estuary, between the northern shore of Malahide Estuary and the L-6165-0 Coast Road/Corballis Road, with works to include new surfacing, fencing, route lighting and signage, and a new three span bridge over the Pill River of 50m in length constructed in timber and concrete.
- Provision of c. 230m of new greenway along the southern side of the L-6165-0 Coast Road/Corballis Road, Kilcrea to include to include surfacing, fencing, route lighting and signage.
- Upgrading and re-alignment along c. 450m of the L-6165-0 Coast Road/Corballis Road adjacent to the Dublin-Belfast railway bridge, including the installation of signal-controlled pedestrian and cyclist crossing points.
- Provision of c. 370m of new greenway, including a single span (12m) bridge crossing, constructed in concrete and timber, of the Pill River through agricultural lands in Kilcrea and along the southern bank of the Pill River.
- Crossing of the newly constructed Donabate Distributor Road and the pedestrian lights for same.
- Resurfacing works along c. 140m of the existing L-6135-0 Kilcrea Road north to the R126 Hearse Road.
- Reconfiguration of the junction of the L-6135-0 Kilcrea Lane and the R126 Hearse Road to facilitate pedestrian and cyclist access to Newbridge Demesne.

- Use of approximately c. 900m of existing pathways including new route signage and bicycle parking at Newbridge Demesne.
- Ancillary works along the route including drainage works, provision of fencing, boundary treatments, agricultural accesses, noise barrier (close to the Donabate Distributor Road), public lighting, landscaping and other minor works.

2.4.3 The proposed greenway will typically be c. 4m in width, other than sections where the proposed greenway is utilising existing public roads, tracks and pathways. It will be finished with a macadam surfacing to ensure comfort and safety for cyclists, pedestrians and mobility-impaired users. The route will utilise existing paths at Malahide Demesne and Newbridge Demesne. A 2.4m high security fence will line the eastern edge of the proposed greenway where it runs adjacent to the Dublin-Belfast railway line, to prevent access to the railway. This security fence will be put in place by Irish Rail in advance of any proposed development work on the greenway to ensure the safety of the railway line.

2.4.4 Permanent fencing will prevent egress to the agricultural lands and small number of residential properties at Kilcrea and to the northern shore of Malahide Estuary. The project will not involve a connection to the eastern embankment of the railway line at any point. Where not already provided, low-level illumination will be provided along the scheme for user comfort and safety.

2.4.5 Any works adjacent to the foreshore line (high water mark) require statutory permission by way of an application to the OPW for a foreshore licence or foreshore lease prior to any work progressing. The proposed development crosses the foreshore line in a number of locations along the railway causeway and across the Pill River. Fingal County Council will seek, in parallel with the planning application, a foreshore lease for these works, via their specialist consultants.

2.4.6 For ease and clarity of reporting and assessment the project has been divided into six sections as follows:

- Section 1 – Malahide Demesne.
- Section 2 – R106 Dublin Road, Malahide.
- Section 3 – R106 Dublin Road to Bissets Strand.
- Section 4 – Bissets Strand to the North Shore of Malahide Estuary.
- Section 5 – North Shore of Malahide Estuary to R126 Hearse Road.
- Section 6 – Newbridge Demesne.

2.4.7 Expanded descriptive commentary on Sections 3, 4 and 5 is provided below.

2.5 Section 3 – R106 Dublin Road to Bissets Strand

2.5.1 O'Hanlon's Lane is a cul-de-sac with bollards installed mid-way to restrict general through traffic. There are 14 existing entrances onto this section of O'Hanlon's Lane. O'Hanlon's Lane comprises of:

- 140m of 3.5m wide pedestrian, cyclist and vehicular shared street;
- 110m of 7.5m wide cyclist and vehicular shared street with footpaths on both sides;
- 100m of 5m wide pedestrian, cyclist and vehicular shared street;
- driveway entrances to private residential properties at various locations.

2.5.2 Users of the proposed development will be directed along O'Hanlon's Lane as the volume and speed of vehicular traffic at this location is low, due to the residential nature of the road, and narrow road widths.

2.5.3 There are a number of sections where the width available to traffic is restricted by hedge growth from private properties onto the public road. It is proposed to trim such hedges which impede upon O'Hanlon's Lane to maximise the available width (see Design Drawing 12–160–254 in Appendix 1).

2.5.4 Where the road widens to 7.5m it is proposed to use the existing footpath for pedestrians, and cyclists would share the carriageway with vehicles. No major civil infrastructure interventions are proposed here and works to this section will include appropriate signage and road markings as required.

2.5.5 It is proposed to resurface the narrow northern part of the lane as there is some damage to the existing road surface here. It is also proposed to install road markings and signage, in accordance with the *National Cycle Manual* (NTA, June 2011).

2.5.6 It is proposed to upgrade and realign the junction of O'Hanlon's Lane and Bissets Strand (see Design Drawing 12–160–256 in Appendix 1).

2.5.7 The existing junction layout is relatively wide here (13m wide at the narrowest location) with no facilities for pedestrians or cyclists. There are a number of private entrances including the entrance to St. Ive's apartments utilising this junction.

2.5.8 The southern kerb line is proposed to be realigned to reduce the carriageway width to 6.5m wide, allow the formation of a new entrance and provide space to construct new pedestrian and cyclist facilities, including a controlled crossing (see Design Drawing 12–160–256 in Appendix 1).

2.5.9 A new controlled crossing will be installed on Bissets Strand Road to access the green area on the northern side of Bissets Strand Road. It is also proposed to extend the existing car park facilities on the northern side of Bissets Strand Road.

2.5.10 The proposed development will continue east along the green area by way of a new shared surface to be constructed on the existing roadside grass verge, as far as the existing Irish Rail compound where a new landscaped area will be provided. This will include various surface types and finishes including raised planting areas, seating, cycle parking, signage and fencing/railing and will be a viewing area for the proposed greenway. These works link with the Malahide Public Realm Strategy proposals as incorporated into the 2017-2023 Fingal County Development Plan. An access point which includes a dropped kerb is proposed to allow access for emergency and railway maintenance vehicles at this location as shown on Design Drawing 12–160–256 (see Appendix 1).

2.6 Section 4 – Bissets Strand to the North Shore of Malahide Estuary

2.6.1 This section of the proposed greenway extends from the south shore to the north shore of Malahide Estuary along the west side of the existing railway causeway that carries the main Dublin-Belfast rail line.

2.6.2 In advance of any works, security fencing will be installed by Irish Rail along the entire length of this section (minimum 3m from the existing railway tracks). This will separate the proposed development from the railway tracks.

2.6.3 A protective stone wall (c. 1.4m high) will be provided on the western side of the proposed greenway across the estuary. This will also minimise any potential effect upon birds in the estuary.

2.6.4 The proposed development will run north from a proposed new urban landscaped area at Bissets Strand, along the existing weir maintenance track which is used by Irish Rail for access to inspect and maintain the railway viaduct. This is located at the bottom of the rail embankment, running parallel to the west side of the railway tracks. The access will be maintained for Irish Rail requirements and will also allow emergency vehicles access along the length of the proposed greenway. A removable bollard will be provided at the start of this section to restrict unauthorised vehicle access.

2.6.5 The proposed greenway and wall will be constructed on top of the existing surface (with no excavation of the existing causeway) to the levels specified in the design drawings (see Appendix 1). The greenway will be sloped toward the railway embankment to allow for surface drainage into the causeway rock armour. The full width of the existing weir maintenance access track will be utilised to provide the maximum width along this section (with a minimum width of 4m).

2.6.6 The proposed development includes a new 180m-long pedestrian/cycle bridge that will run parallel to the existing railway viaduct. The new bridge will be a 12-span concrete bridge structure located on existing piers with the bridge soffit at a minimum of 3.8mOD above the high spring water level of 2.1mOD that flows across the weir at this location. It will provide a 4m wide shared path as shown on Design Drawing 12–160–258 (see Appendix 1). It includes ramps at both ends to tie into the proposed development along the causeway.

2.6.7 A viewing area will be provided on the southern side of the pedestrian bridge which will include seating. A section of removable/demountable fencing will also be provided at this location to allow Irish Rail access to the weir for inspection and maintenance purposes.

2.6.8 North of the bridge, the proposed development continues along the top of the existing causeway at approximately the same level as the railway tracks with the stone wall 1.4m protective barrier to the west and security fencing on the east (railway) side. This stoned area was installed by Irish Rail to protect the existing causeway. The proposed development will be constructed on top of the existing armour shoulder (with no excavation of the existing causeway) to the proposed levels as shown in the design drawings (see Appendix 1). The greenway will be sloped toward the railway embankment to allow for surface drainage into the causeway rock armour. The full width of the remainder of the causeway will be utilised to provide the maximum width along this section (with a minimum width of 3m).

2.6.9 The existing raised stone area stops short of the north shore of Malahide Estuary. It is proposed to continue the proposed greenway at the same level as the railway tracks as far as the agricultural lands on the north shore of the estuary by extending the rock armour as far as the raised agricultural lands on the north shore of the estuary.

2.6.10 There is an existing drainage ditch at this location that will be culverted under the proposed extended rock armour.

2.7 Section 5 – North Shore of Malahide Estuary to R126 Hearse Road

2.7.1 The proposed development continues north through agricultural lands. At first it runs parallel to the railway tracks on the western side of an existing hedge and drainage ditch as far as the Pill River. It will be 4m wide with a timber post and rail fence on both sides at this location.

2.7.2 There is an existing agricultural railway crossing as shown on Design Drawing 12–160–261 (see Appendix 1). A corresponding agricultural crossing of the proposed greenway will be provided at this location to allow access to the agricultural lands to the eastern side of the railway line.

2.7.3 The proposed development crosses the Pill River with a new 50m span bridge (Bridge No. 1) to be constructed using concrete bridge piers and steel beam structure, wooden clad, as shown on Design Drawing 12–160–261 (see Appendix 1). Parapets will be provided on both sides of the bridge and includes ramps at both ends to link to the proposed greenway north and south of the proposed bridge and to take account of the difference in existing ground levels.

2.7.4 The concrete piers will be exposed concrete finish with a cladding detail. The steel structure will be treated for long life span and low maintenance by using both galvanising and painting. The surface finish will be a suitable non-slip finish.

2.7.5 A viewing area will be provided at this location by widening the northern ramp structure.

2.7.6 The proposed development will be constructed on top of the existing railway maintenance access track to the required levels north of the River Pill. The existing ditch at the bottom of the railway embankment to the east of the proposed greenway will be maintained.

2.7.7 The route continues north to Corballis Cottages Road and diverts around the boundary of a private dwelling. A boundary treatment will be provided here including suitable landscaping and post and wire fencing.

Link to Donabate Village

2.7.8 The upgrade works required at Corballis Cottages Road will allow for a potential future link to Donabate Village. The construction of the link into Donabate Village will be carried out as part of the development of zoned lands within the Local Area Plan for Donabate.

2.7.9 It is proposed to realign a section of the Corballis Cottages Road on both sides of the existing railway bridge and provide a signalised shuttle system at the railway underbridge. This will include the reduction of the width of the existing carriageway to a single lane and the provision of a 2m wide path under the railway bridge.

2.7.10 The shuttle system is required at this location as the existing underbridge widths are insufficient to safely accommodate pedestrians and cyclists alongside two-way vehicular traffic. The realignment will also provide adequate sight distances under the bridge which are currently not available.

2.7.11 The proposed signalised shuttle system at the underbridge would improve cyclist safety. The signals will operate at an on-demand basis for both cyclists and vehicles.

2.7.12 Controlled crossings would be provided on both sides of the railway bridge providing a safe route for pedestrians.

2.7.13 Existing roadside hedging would be removed and replaced as required.

2.7.14 The proposed greenway development continues west inside the existing hedgerow on the southern side of the realigned Corballis Cottages Road through agricultural lands inside the new hedging and fencing. The existing agricultural entrances from the public road will be maintained providing an agricultural crossing point across the proposed development and sufficient space for a vehicle to pull off the road safely.

2.7.15 The proposed development progresses in a southwest direction towards the southern side of a private dwelling and farm buildings through open agricultural lands with post and rail fencing with sheep wire on both sides. Access to the agricultural lands on both sides of the proposed greenway will be maintained.

2.7.16 The proposed development crosses the Pill River again where a proposed 12m span pedestrian/cycle bridge (Bridge No. 2) is proposed. The bridge will be constructed using steel beam structure, wooden clad, as shown on Design Drawings 12-160-240 to 12-160-268 (see Appendix 1).

2.7.17 The proposed development runs along the southern side of the private dwelling and farm buildings through agricultural lands. The proposed development is separated from the dwelling by the existing hedgerow and watercourse.

2.7.18 There is an agricultural entrance between the farm buildings and the agricultural lands to the south which will be maintained. New boundary treatments and landscaping will be installed.

2.7.19 The proposed development continues on the southern side of an existing private property fence line and hedgerow through agricultural lands towards Kilcrea Road. New boundary treatments and landscaping will be installed.

2.7.20 The proposed development continues on the southern side of an existing property fence line and hedgerow parallel to the boundary of a private dwelling and continues to the Donabate Distributor Road (under construction). The proposed development will parallel the Donabate Distributor Road along a widened section of footpath and cycle way on the southern side of the road until the junction with the Kilcrea Road where a pedestrian crossing will be installed as part of the road construction works.

2.7.21 The proposed development joins the Kilcrea Road from the pedestrian crossing and continues along the Kilcrea Road running north as far as the junction with the Hearse Road on the western side of Kilcrea Road. Kilcrea Road will be a cul-de-sac with no through access for traffic as shown on the drawings (see Appendix 1). Kilcrea Road serves only one private dwelling, so traffic speeds and volumes are sufficiently low to allow this road to become a shared surface for access to the house and for cyclists and walkers. It is proposed to resurface this section of the Kilcrea Road as the existing surface is poor and also to install road markings and signage in accordance with the National Cycle Manual (June 2011).

2.7.22 The junction of Kilcrea Road and R126 Hearse Road will be upgraded. This will include the realignment of the existing kerb line southwards and re-grading of the existing junction and the provision of a new controlled crossing. The realignment will include relaying a new kerb on the northern side of the junction and the tightening of the entrance radii onto Kilcrea Road to provide the required sightlines at this location (see Design Drawing 12–160–266 in Appendix 1). It also includes scarifying the existing surface and relaying a new wearing course, adjustment to the existing drainage system, proposed new line markings and signage and public lighting at this junction.

2.7.23 Advance notice of the proposed new crossing on either side of the junction on the Hearse Road by way of a new kerb, signage and public lighting, will slow traffic as it approaches the junction and give warning of the controlled crossing. This section of road currently has a speed limit of 60kph. It is proposed to extend the existing 50kph speed limit which presently extends from Donabate Village to 100 metres before the Corballis Cottages junction, to include the revised junction at Kilcrea Road.

2.8 Construction

2.8.1 The proposed development will be c. 4m in width, other than sections where the development utilises existing public roads, tracks and pathways. It will be finished with a macadam surfacing to ensure comfort and safety for cyclists, pedestrians and mobility-impaired users. The route will utilise existing paths at Malahide Demesne and Newbridge Demesne. A 2.4m high security fence will line the eastern edge of the proposed greenway where it runs adjacent to the Dublin-Belfast railway line, to prevent access to the railway. This security fence will be put in place by Irish Rail in advance of any proposed development work on the greenway to ensure the safety of the railway line.

2.8.2 Two site construction compounds are proposed. One at Bissets Strand and one south of Corballis Cottages Road (see Design Drawings 12-160-246 and 12-160-247 in Appendix 1). The environmental controls associated with these compounds are outlined in Section 2.12-Construction Environmental Management Plan (CEMP).

Broadmeadow Way Bridge

2.8.3 Two spans of the railway viaduct collapsed on the 21st August 2009. The spans were re-constructed and the line was re-opened on the 16th November that year.

2.8.4 The eleven masonry piers and the two abutments of the railway viaduct across Malahide Estuary are constructed on top of a stone weir, which was constructed off the original sea bed. The integrity of the weir is essential for the structural stability of the railway viaduct. The integrity of the weir is also important in maintaining the existing status of the inner estuary, its habitats and species.

2.8.5 Scouring of the weir had caused the collapse of the two spans. Initial repairs were carried out to make the weir safe and re-open the railway line. Over the following two years significant strengthening works on the weir were then carried out.

2.8.6 The following works are required to complete development of the proposed greenway and the provision of the pedestrian bridge: temporary enabling works to the weir to facilitate access to the worksite; minor works to the concrete piers; the installation of precast concrete capping padstones on each pier; the installation of precast concrete bridge deck beams; construction of an approach ramp to the north and south of the bridge; and finishing-off works, including railings, lighting, and surfacing.

2.8.7 Each of these elements is considered separately below and is presented in the order in which the works will be carried out.

Site Access and Work Site Areas

2.8.8 A weir maintenance access track, extending north from Bissets Strand to the southern abutment of the railway viaduct, was constructed in September 2009 to allow for remedial and maintenance works necessary to the weir and viaduct. The access track was constructed of stone fill material, bounded by rock armour along the water's edge. The finished road level is at an elevation of approximately 2.1m OD, approximately 4.0m below track level and slightly above the high spring tide level. It is proposed to use this existing access track to draw plant, equipment and materials to the worksite.

2.8.9 It is proposed that the site compound will be located at the entrance to the Irish Rail lands at Bissets Strand. The site compound and boundary are shown in Design Drawings 12-160-246 and 12-160-247 in Appendix 1.

Enabling Works – Temporary Alterations to the Weir

2.8.10 The weir will be used as a means of access across the estuary to each of the 12 spans. Temporary alterations to the weir crest are necessary to facilitate the movement of plant and equipment across the top of the weir.

2.8.11 The weir crest has been constructed to facilitate the tidal flow and to ensure that the maximum flows and velocities are channelled to the centre of each of the 12 spans. The channel crest and trough levels are 1.00m OD and 0.60m OD respectively, the weir level being 400mm lower at the centre span position in the channel troughs.

2.8.12 The tidal range at Malahide is approximately 4.8m, from a spring high tide of 2.1m OD to a spring low tide of -2.7m OD. (Derived from Dublin Port Tide Tables with typical high and low spring tides of 4.6m and 0.2m Chart Datum respectively.)

2.8.13 It is proposed to temporarily raise the weir crest level across each ope to 1.15m OD. This will result in slightly elevated water levels (at low water) in the inner Malahide Estuary for a period of eight weeks maximum. This will have a temporary effect of reducing the inter-tidal exposure of the mud-flats area at the western end of the estuary. (Refer to report by Dr E McKeogh of Fluvio R&D Limited: "Malahide Viaduct Reinstatement, Temporary Works, Computer modelling for Environmental Analyses", July 2015 (see Appendix 5)).

Preparation Works to Footbridge Piers

2.8.14 With the temporary weir crest in place, the *in situ* steel reinforcement projecting from the top of each existing greenway bridge pier will be removed. The exposed ends of the piers will be coated with a protective coating before new precast concrete capping padstones are placed on top of the piers, laid on a mortar bed. The precast capping padstones will be transported and installed using an excavator travelling across the weir. When the capping padstones have been placed, grouted stainless steel dowel bars will be installed to structurally connect them to the concrete piers.

Installation of Footbridge Deck and the Northern Ramp

2.8.15 The new footbridge deck will be constructed using precast bridge deck spans laid on the existing concrete piers. This, for reasons of economy and speed but also to minimise works carried out over water.

2.8.16 All pre-cast concrete units required for the new footbridge will be cast off-site in a manufacturer's yard and transported to the site as and when required.

2.8.17 The installation of the precast bridge deck units is constrained by two separate factors, the safety requirements of Irish Rail and the tidal effect

2.8.18 Works in the vicinity of any railway line will be managed in such a manner that there is no risk to railway operations or infrastructure. Consequently, the lifting-in of precast units using a crane would be restricted to night time working, when trains are not operating, and the track can be taken under possession by the Irish Rail Engineer. Night time track possession on this line is only available for 4.5 hours on Monday to Friday nights and 6.0 hours on Saturday nights.

2.8.19 The tidal range will restrict the movement of plant and equipment to those periods when the tide is sufficiently low to permit vehicles to cross the weir. In periods of high spring tide, the inner estuary is filled and there is insufficient time for the water to flow back out to sea before the incoming tide fills the inner estuary again. The effect is that there is nearly always water flowing across the weir during the period of spring tides.

2.8.20 Combining the requirement for track possessions with this tidal constraint means that night time possessions might not coincide with low tide conditions. Consequently, to deal with these constraints a self-propelled multiaxle transporter (SPMT) will be used rather than a crane to lift-in the bridge deck units as they can be placed in this manner without risk to the railway. As a result, there will be no requirement for track possessions at night and work may be carried out during the day. Refer to Drawing No. SADS-16-BROAD-PRE-003 which describes the operation of the SPMT (see Appendix 1).

2.8.21 The installation sequence will involve using a mobile crane to load the bridge deck unit onto the transporter at Bissets Strand. The SPMT will travel along the weir maintenance track and across the weir to place each of the pre-cast bridge deck units into position.

2.8.22 The works will progress from north to south. The weir will be re-profiled sequentially to match the existing V-shaped channel profile as the bridge deck spans are fitted into place.

Construction of Southern Approach Ramp

2.8.23 The work on the southern causeway ramp will not involve any works over the water. The proposed ramp will comprise of two retaining walls (refer to Drawing No. SADS-16-BROAD-PRE-004 in Appendix 1). Both walls will be constructed using off-site precast concrete units to minimise the on-site works.

2.8.24 The works will commence with local foundation excavation of the existing railway embankment and causeway followed by preparation of the formation level for the pre-cast retaining wall units. Forty-four precast concrete units will be offloaded from the delivery truck and lifted in to position using a crane.

2.8.25 It will be necessary to construct the outer retaining wall first. As the precast wall units are lifted into position, backfilling of the wall with imported granular fill material will commence. Once all of the outer retaining wall precast units are installed and backfilled, the inner wall will then be lifted into place and backfilled when complete.

Transportation Requirements

2.8.26 The construction of the footbridge will necessitate the importation of c. 1,500 tonnes of stone, approximately 75 truck loads, to alter the surface profile of the weir. The material will comprise 900 tonnes of 150mm/100mm clean stone to fill the V-shaped channels and 600 tonnes of 50mm clean stone surface finish material over the length of the weir. There will be no requirement to disturb the installed rock armour forming the weir.

2.8.27 This material will be sourced from a licensed facility and transported to the site over a five-day period. Due to the height and width restriction at the railway over-bridge on Bissets Strand these trucks will be routed via Yellow Walls Road and Sea Road to the works site.

2.8.28 On completion of the bridge construction all 1,500 tonnes of this imported material will be removed from site and the weir profile will be restored to its present profile and level. The existing weir stone will not be disturbed when the excess material is being removed.

2.8.29 The following is a schedule of transportation needs:

- 1500 tonnes of stone;
- 75 lorries of stone fill drawn in to the site at the commencement of the works, taking five days to lay all stone. Maximum of 15 lorries per day;
- 12 pre-cast capping padstones;
- 6 lorries will be used to transport the padstones to site. Maximum of 2 lorries per day;
- 13 pre-cast bridge deck units, starting with Span 1(A);
- 13 lorries will be used to transport the units to site. Maximum of 3 lorries per day;
- 18 pre-cast outer retaining walls;
- 9 lorries will be used to transport the retaining wall units to site. Maximum of 3 lorries per day;
- 26 pre-cast inner retaining walls;
- 13 lorries will be used to transport the retaining wall units to site. Maximum of 3 lorries per day.
- The maximum number of lorries/trucks to site will be when the stone fill is being drawn in to the site, 15 lorries each day for five days. There will be no other materials drawn in to the site during these five days. After that the maximum number of lorries to site on any day will be 3 per day as the pre-cast concrete units are drawn to site.

Duration of Activity

2.8.30 It is planned that all of these construction works will be completed in 16 weeks. The works being carried out directly over the water will be completed in eight weeks. In the first week of the eight-week period the weir will be levelled off. By the end of the eight weeks the weir crest will have been restored to its original profile. It is planned that the works will be carried out between May and September. The on-site works will include placing the stone fill in the weir, erecting pre-cast bridge deck units, constructing the northern and southern ramps, removing the stone fill and re-profiling the weir, erecting handrails, lighting, surfacing, etc.

Bridge Design

2.8.31 The Broadmeadow Way bridge is designed for pedestrian/cycle loading with an allowance for occasional vehicular traffic (emergency ambulance access and minor maintenance works).

2.9 Malahide Works

2.9.1 There are three separate work areas on the Malahide section of the proposed greenway:

- Works in Malahide Demesne, the R106 Dublin Road and the south end of O'Hanlon's Lane.
- Works at the north end of O'Hanlon's Lane, Bissets Strand Road and the public area.
- Works to the weir maintenance access track on the southern railway causeway.

2.9.2 It is proposed to locate a site compound, vehicle compound and welfare facilities at the fenced area beside the Bissets Strand Bridge (see Design Drawings 12-160-246 in Appendix 1). This area is used by Irish Rail for maintenance works to railway structures on the causeway. It will also be used by the works main contractor for the construction of the pedestrian bridge and other works scheduled for the Malahide area. The area is stoned and will require minimum upgrade works for the temporary site setup. Access to the area is restricted due to the height and width restrictions at the railway over-bridge adjacent to the site. Consequently, all deliveries to the works will be routed via Yellow Walls Road and Sea Road.

2.9.3 Deliveries to the work areas and the site compound will be regulated to a 'just in time' delivery schedule. The contractor will operate a 'rolling' timescale for the works in each area. This will minimise the possibility of accidental discharges into the area and will also allow the contractor to optimise the utilisation of the site compound.

Resource Requirements

2.9.4 The construction of the Malahide section of the works will be divided into three distinct sections of work, though there will be significant cross over in terms of men and machinery dependant on the different work stages. The anticipated quantities of the import and export materials is presented in the table below. All construction wastes arising will be recycled and re-used as appropriate to the scheme. Any residual waste arising will be disposed of by licensed contractor.

2.9.5 The surface of the greenway will be in dense bitumen macadam (DBM). On the southern railway causeway this will be installed on a prepared formation of compacted stone (clause 804) (c. 100/150mm) laid onto the existing stone fill. Two layers of bitumen (total 100/150mm) will be placed on the prepared stone using a mini paviour. The causeway stone wall (of limestone rubble) will be laid on a 100mm bed of concrete on a compacted layer of stone. Greenway surface works will follow completion of wall construction.

2.9.6 Batch loads of concrete will be delivered, on an as needed basis, to concrete storage silos in each construction compound. Small batch concrete loads will be delivered to specific construction locations by mini dumper.

Table 2.1 Materials Arising and Required.

	Works in Malahide Demesne, Bridgefield Car Park and the R106 and including the South End of O'Hanlon's Lane	Works at the North End of O'Hanlon's Lane, Bissets Strand Road and the Public Area	Works to the Maintenance Access Track to Construct the Proposed Greenway and Wall Along this Section
Excavation			
Subsoil	37.5m^3	200m^3	0m^3
Tarmac	75m^3	0m^3	0m^3
Footpaths and kerbs	550m^3	0m^3	0m^3
Importation			
Stone fill	460m^3	200m^3	1450m^3
Tarmac	150m^3	80m^3	500m^3
Concrete	40m^3	-	115m^3
Wall stone	-	-	500m^3

Transportation Requirements

2.9.7 Deliveries to site will be on a 'just in time' basis. This will ensure a minimum number of deliveries in any one day which will reduce the traffic impact during the construction period. The assessment of vehicular movements has been carried out on this section of the works as 'one project', notwithstanding the fact that it is unlikely that the same work process will occur at two different areas at the same time, i.e. the contractor is unlikely to schedule concrete pours in two different areas at the same time.

2.9.8 There will be a requirement to transport the following materials to site during the construction period.

Table 2.2 Delivery Type and Number of Trucks.

Delivery Type	Number of Trucks
Hardcore	145 trucks
Tarmac	70 trucks
Concrete	20 trucks
Wall Stone	25 trucks

2.9.9 There will be a requirement to transport materials off site during the construction period. All excess material will be disposed of to a suitable licensed facility.

Table 2.3 Removal Type and Number of Trucks.

Removal Type	Number of Trucks
Subsoil	16/20 trucks
Hardcore	2 trucks
Vegetation	2 trucks
Tarmac	40 trucks

2.9.10 The maximum number of deliveries to site will be for the tarmac finish to the carriageway on the R106. The construction of this road will be phased to allow for continuous access to Malahide village. Deliveries, temporary road closures and construction activity will be subject to compliance with the relevant statutory processes

and approval from the operations department of Fingal County Council. These restrictions and work practices will be part of an application to the Council by the contractor for construction licences and will be monitored and overseen on an ongoing basis by the consultant/local authority.

2.9.11 The remainder of the removal/deliveries will be spread evenly over the contract period (see below). The concrete required for the construction of the walls for the new ramp in Bridgefield car park will be no greater than two deliveries (16m^3) in any one pour. Similar deliveries will be required for the installation of the foundations for the wall along the causeway.

2.9.12 Hardcore quantities for the construction of the proposed greenway on Bissets Strand will likely be no more than 10 deliveries in any one day.

Duration of Activity

Table 2.4 Duration of Activity – R106.

R106 and Associated Areas	Duration
Commencement and set up	2 weeks
R106 construction works (slow because of the traffic volumes, traffic management and possible restrictions on working hours)	12 weeks
Construction of ramp and greenway in Bridgefield car park (concurrent with R106)	6 weeks
Total construction time	14 weeks

Table 2.5 Duration of Activity – Bissets Strand.

Bissets Strand	Duration
Commencement and set up	2 weeks
Works to Bissets Strand Road	6 weeks
Works to weir maintenance track (causeway wall and greenway)	12 weeks
Construction of landscape area (Bissets Strand)	6 weeks
Completion of works (lining and signing, etc)	2 weeks

2.9.13 There will be an overlap of the works on the R106 and the Bissets Strand area which will shorten the total time for the works in this area by four to six weeks, giving a total time from commencement to completion for the works in Malahide of c. 28 weeks. Works will not be weather dependant and the contractor will continue with the construction of each area with the same crew working in different areas as required.

2.10 Donabate Works

2.10.1 There are five separate work areas on the Donabate side of the project.

- Upgrade of the section of the Corballis Cottages Road at the railway bridge.
- Construction of the bridge (no. 1) at the Pill River.
- Construction of the proposed greenway along the existing northern railway causeway.
- Construction of the proposed greenway in the agricultural lands at Kilcrea including bridge no. 2 across the Pill River.
- Works at the entrance to Newbridge Demesne and Kilcrea Road.

2.10.2 The main site compound, vehicle compound and welfare facilities will be located at the open area beside the Corballis Cottages railway bridge (see Design Drawings 12-160-247 in Appendix 1). This area has a stoned access track parallel to the railway line as far as the Pill River.

2.10.3 The surface of the greenway will be in dense bitumen macadam (DBM). On the northern railway causeway this will be installed on a prepared formation of compacted stone (clause 804) (c. 100/150mm) laid onto the existing stone fill. Two layers of bitumen (total 100/150mm) will be placed on the prepared stone using a mini paviour. The causeway stone wall (of limestone rubble) will be laid on a 100mm bed of concrete on a compacted layer of stone. Greenway surface works will follow completion of wall construction.

2.10.4 Works on the north side of the River Pill will be accessed from the Corballis Cottages Road. Works on the south side of River Pill will be accessed from Bissets Strand. Crossing of the River Pill is not proposed as part of these construction works.

2.10.5 Batch loads of concrete will be delivered, on an as needed basis, to concrete storage silos in each construction compound. Small batch concrete loads will be delivered to specific construction locations by mini dumper.

2.10.6 For much of the scheme in Kilcrea the contractor will only remove topsoil along the line of the new greenway. This topsoil will be re-used within the scheme. There will be a small amount of subsoil arising from the installation of fencing posts. This subsoil will be taken off site as it is removed to a licensed waste facility. There will be a minimum requirement (less than 100m^3) for temporary storage of subsoil/topsoil on site within site compounds.

2.10.7 Surplus topsoil removed from the agricultural lands at Kilcrea will be stockpiled and re-used in the construction of a grassland area on the old line of the Corballis Cottages Road to the east of the railway road bridge.

2.10.8 The proposed Pill River bridge immediately west of the railway embankment (bridge no. 1) is a three-span timber bridge (see Design Drawing 12-160-261 in Volume 3 for plan and section layouts). The bridge is to be laid at a slope of 1/34 from a concrete abutment at the existing ground level on the south side of the river to a concrete abutment at a marginally raised level on the north side of the river and onto two concrete piers built off a piled base between the abutments. The abutments will be built in concrete on the existing ground. These abutments will be constructed from reinforced concrete, one each side of the river, with holding down bolts for the steel bridge support beams. Concrete pours, concrete delivery and related construction methodology will be agreed with the contractor. Attention will be paid to the support and integrity of form work to avoid leakages or spills of concrete during the pouring process (see also CEMP in Section 2.12).

2.10.9 The construction of the piers on the south side will be on a piled base with the piers constructed from reinforced concrete. None of these piers will be within the wetted width of the Pill River and the flow of the river will not be obstructed at any time during the construction process. Construction access will be from the south side for the specialist contractor to install the steel driven piles and this temporary access will be used by the piling contractor and by the main contractor to install the concrete piers. The platform for the piling rig will be made of clean crushed rock with the base ringed by silt fences to minimise any wash-out of fines or sediment during the piling. The disturbed area will be reinstated on completion. The piers will be built off the piles with

holding down bolts for the steel bridge support beams. Concrete pours, concrete delivery and related construction methodologies will be part of the procedure agreed with the contractor to mitigate any possibility of spillage or contamination of the local environment. Particular attention will be paid to the support and integrity of form work in order to avoid leakages or spills of concrete during the pouring process.

2.10.10 On completion of the construction of the piers and the abutments, the main contractor will commence the construction of the bridge deck. Steel bridge beams will be installed using a small hoist. A timber bridge deck will be placed directly onto the steel beams. The design of the fixings for the timber members will be agreed with the main contractor prior to commencement. The construction of this bridge deck will not entail the use of concrete (see also CEMP in Section 2.12).

2.10.11 Bridge no. 2 crossing the Pill (12m) will be formed using concrete abutments on each side of the stream spanned with a wooden clad steel beam deck. The abutments will be formed one at a time with a four faced concrete finish. On completion, the bridge deck will be installed onto the abutments using a small crane.

2.10.12 The contractor's construction methodology will require the use of precast elements where practical; the use of secondary protection shuttering for concrete pours; all pours to be carried out in dry weather conditions; and that all trucks be cleaned prior to leaving respective depots. The contractor will be required to use experienced operators for the work; provide an appropriate level of continuous monitoring during any concrete pours by experienced management; and have method statements approved by the client prior to commencing works. Works will be carried out using recommendations from current guidance and relevant codes of practise.

2.10.13 Construction works will also require a method statement from the main contractor to include:

- Netting under all work areas to ensure that no construction materials fall from the work area into the estuary.
- No fuel fill of any machinery allowed in the work area. All machinery to be filled in designated construction compounds.
- Existing flora and fauna to be protected from damage at all times.
- Reinstatement of any access routes to be agreed prior to commencement.
- All work practises to be part of the construction method statement agreed prior to commencing construction (see also CEMP in Section 2.12).

Resource Requirements

2.10.14 The construction of the Donabate section of the works will be divided into five distinct sections of work, though there will be significant cross over in terms of men and machinery dependant on the different work stages.

Table 2.6 Resource Requirements Excavation and Importation.

	Works to Upgrade the Section of the Corballis Cottages Road, Construction of the Bridge at the Pill River, and Construction of the Greenway along the Railway Causeway
Excavation	
Subsoil	750m^3
Hardcore/Stone	1,050m^3
Tarmac	750m^3
Vegetation	50m^3
Importation	
Hardcore	3,775m^3
Tarmac	1,250m^3
Concrete	550m^3
Wall stone	850m^3

Transportation Requirements

2.10.15 Deliveries to site will be on an 'as needed' basis. The assessment of vehicular movements has been carried out as 'one project', notwithstanding that it is unlikely that the same work process will occur at two different areas.

2.10.16 Access to the site compound and to the site will be via the Hearse Road and the Corballis Cottages Road. The Hearse Road is the main access to Donabate Village and has the ability to carry the additional traffic generated by this section of the project. The Corballis Cottages Road is a narrow country road with poor sight lines in areas but has the capacity for the additional traffic generated by this project. Because of the narrow nature of the road, restrictions will be placed on the contractor in relation to large deliveries, particularly deliveries of bridge beams for the construction of the Pill River bridge and the like. The timing of these deliveries will be agreed with the road section of Fingal County Council as part of the approvals for access prior to the commencement of the project.

2.10.17 There will be a requirement to transport the following materials to site during the construction period.

Table 2.7 Delivery Type and Number of Trucks.

Delivery Type	**Number of Trucks**
Hardcore	250 trucks
Tarmac	85 trucks
Concrete	70 trucks
Wall Stone	60 trucks

2.10.18 There will be a requirement to transport the following materials off site during the construction period. All excess material will be disposed of to a suitable licensed facility.

Table 2.8 Removal Type and Number of Trucks.

Removal Type	**Number of Trucks**
Subsoil	50 trucks
Hardcore	70 trucks
Vegetation	5 trucks
Tarmac	50 trucks

Table 2.9 Resource Requirements Excavation and Importation.

	Works to Construct the Proposed Greenway in the Agricultural Lands, Works at the Entrance to Newbridge Demesne and Kilcrea Road
Excavation	
Subsoil	50m^3
Hardcore/Stone	70m^3
Tarmac	60m^3
Vegetation	15m^3
Importation	
Hardcore	2,000m^3
Tarmac	800m^3

2.10.19 Deliveries for the construction of the proposed greenway in the agricultural lands will be from two directions: off the Kilcrea Road (or Donabate Distributor Road if completed) and off the Corballis Cottages Road. It is unlikely that this section of the work will commence until the other major sections of work are completed.

2.10.20 There will be a requirement to transport the following materials to/from site during the construction period.

Table 2.10 Delivery Type and Number of Trucks.

Delivery Type	Number of Trucks
Hardcore	140 trucks
Tarmac	10 trucks
Concrete	70 trucks

Table 2.11 Removal Type and Number of Trucks.

Removal Type	Number of Trucks
Subsoil	4 trucks
Hardcore	5 trucks
Vegetation	2 trucks
Tarmac	4 trucks

Duration of Activity

Table 2.12 Duration of Activity – Corballis Cottages Road and Associated Areas.

Corballis Cottages Road and Associated Areas	Duration
Upgrade of the section of the Corballis Cottages Road	12 weeks
Construction of the bridge at the Pill River	14 weeks
Construction of the proposed greenway along the railway causeway	12 weeks
Construction of the proposed greenway in the agricultural lands	6 weeks
Works at the entrance to Newbridge Demesne and Kilcrea Road	4 weeks
Completion of works (lining and signing etc)	2 weeks

2.10.21 There will be an overlap of the works on the Corballis Cottages Road, the Pill River bridge and the construction of the bridge across the causeway which will shorten the total time for the works in this area. The total time from commencement to completion for the works in Donabate is estimated at 28 weeks. The construction of the proposed greenway in the agricultural lands and the upgrade works at the entrance to Newbridge Demesne

and the Kilcrea Road upgrade works will be carried out using two smaller crews with very little overlap.

2.10.22 None of the works will be weather dependant and the contractor will progress the construction of each area with the same crew working in different areas as required.

2.11 Project Schedule

2.11.1 See Table 2.13 below for overall scheduling of works.

Table 2.13 Overall Scheduling of Works.

	Week No.																											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Broadmeadow Way Bridge																												
Weir reprofiling works																												
Erection of precast units																												
Removal of fill and geotextile for weir																												
Bridge completion works																												
Donabate																												
Upgrade of the section of the Corballis Cottages Road																												
Construction of two bridges at the Pill River																												
Construction of the proposed greenway along railway causeway																												
Construction of the proposed greenway in the agricultural lands																												
Works at entrance to Newbridge Demesne & Kilcrea Road																												
Completion of works (lining and signing etc)																												
Malahide – R106 and Associated Areas																												
Commencement and set up																												
R106 construction works																												
Construction of ramp & greenway in Bridgefield car park																												
Malahide – Bissets Strand																												
Commencement and set up																												
Works to Bissets Strand Road																												
Works to weir maintenance track																												
Construction of landscape area (Bissets Strand)																												
Completion of works (lining and signing, etc)																												

2.12 Construction Environmental Management Plan (CEMP)

2.12.1 A preliminary construction environmental management plan (CEMP) has been prepared to manage the impacts of construction activities associated with the development project (see Table 2.14 below). Fourteen sub-plans will be implemented by the appointed project contractor. Details of the proposed construction methodology are provided in Section 2.8 to Section 2.10 above.

Table 2.14 Sub-Plans for Managing Construction Activities.

Reference	Procedure
CEMP-1	Site Environmental Training and Awareness Procedure.
CEMP-2	Environmental Emergency Response Plan.
CEMP-3	Concrete Control Procedure.
CEMP-4	Fuel and Oil Management Plan.
CEMP-5	Protection of Water Resources.
CEMP-6	Construction Traffic Management Plan.
CEMP-7	Management of Excavation, Spoil, Demolition.
CEMP-8	Waste Management Plan.
CEMP-9	Construction Noise Management Plan.
CEMP-10	Construction Dust Management Plan.
CEMP-11	Materials Handling and Storage Plan.
CEMP-12	Monitoring and Auditing Procedure.
CEMP-13	Environmental Accidents, Incidents and Corrective Actions Procedure.

2.12.2 The construction environmental management plan sets out the principles to be adhered to and outlines measures that will be implemented during the construction of the proposed development to ensure that potential environmental impacts and disturbance will be minimised or eliminated.

2.12.3 It will be the contractor's responsibility to update and add (where required) specific control measures relevant to the environmental management plan and procedures. The control measures will be amended by improvement with regards to environmental protection and will take cognisance of additional environmental commitments arising from planning conditions or technical investigations carried out as part of the pre-construction stage.

2.12.4 Fingal County Council will oversee the process through appointment of the contractor, resident engineer staff and oversight from the planning and strategic infrastructure project team.

Sub-Plans for Managing Construction Activities

CEMP-1: Site Environmental Training and Awareness Procedure

2.12.5 An initial site environmental induction and ongoing training will be provided to communicate the main provisions of this environmental plan to all site personnel.

2.12.6 Two-way communication will be encouraged to promote a culture of environmental protection.

2.12.7 The following outlines the information which must be communicated to site staff:

- Environmental procedures of the CEMP.
- Environmental buffers and exclusion zones.
- Housekeeping of materials and waste storage areas.
- Environmental emergency response plan.
- Environmental training records are to be retained in the site office.

CEMP-2: Environmental Emergency Response Plan

2.12.8 In the event of an environmental emergency, all personnel will react quickly and adhere to this procedure (to be finalised by contractor). The following outlines the information, on the types of emergency, which must be communicated to site staff:

- Release of hazardous substance – fuel or oil spill.
- Concrete spill or release of concrete.
- Flood event – extreme rainfall or sea level event.
- Environmental buffers and exclusion zones breach.
- Housekeeping of materials and waste storage areas breach.
- Stop work orders due to environmental issue or concern (e.g. threat to ecological feature).
- Fire on site (cross reference site safety emergency plan as appropriate).

CEMP-3: Concrete Control Procedure

2.12.9 Concrete will be used for wall and fence foundations, wall forming structures and grouting of precast concrete units. The following measures will be implemented to prevent concrete entering watercourses:

- Batch loads of concrete will be delivered, on an as needed basis, to the concrete storage silos in each of the construction compounds.
- Small batch concrete loads will be delivered to the specific construction locations by mini dumper.
- Trucks that deliver concrete to site will be washed out at the supplier's facilities and not on site.
- A designated trained operator experienced in working with concrete will be employed during concrete pouring from storage silos.
- Concrete pours at the River Pill bridge crossings (no. 1 and no. 2) will only be conducted in dry weather and subject to secondary protection (see also Section 2.10).

CEMP-4: Fuel and Oil Management Plan

2.12.10 The appointed contractor will implement a fuel management plan which will incorporate the following elements:

- Mobile bowsers, tanks and drums stored in a secure, impermeable storage area, away from drains and open water in the construction compounds.
- Fuel containers stored within a secondary containment system, e.g. bund for static tanks or a drip tray for mobile stores in the construction compounds.

- Ancillary equipment such as hoses, pipes contained within the bund.
- Taps, nozzles or valves fitted with a lock system.
- Fuel and oil stores including tanks and drums regularly inspected for leaks and signs of damage.
- Designated trained operators authorised to refuel plant on site, and emergency spill kits present at equipment for all refuelling events.
- Procedures and contingency plans set up to deal with emergency accidents or spills.
- Emergency spill kit with oil boom, absorbers, etc kept on site in the event of an accidental spill.

CEMP-5: Protection of Water Resources

(A) SILT

- Excavations: Water will be prevented from entering local excavations by way of cut-off drains. Personnel and/or plant will not disturb water in a local excavation. The means of dewatering excavations in the event there is ingress will include settlement tanks or a silt buster stream if required to ensure that any dewaterings do not increase background suspended solids levels in the environment.
- Spoil heaps: Small (<100m^3) topsoil/subsoil heaps will be located, protected and stabilised in the contractor compounds in a way that will avoid the risk of contamination of drainage systems and local watercourses.
- Site roads will be kept free from dust and mud deposits. In dry weather dust suppression measures will be utilised.
- Dealing with very silty water: Water containing silt will not be pumped directly into watercourses or surface water drains. Adequate provision for dealing with very silty water will be put in place (see “Excavations” above).

(B) CONCRETE

2.12.11 In the event of a spillage on site, the material will be contained (using an absorbent material such as sand or soil or commercially available booms). All spillages will be reported to the project manager who will inform the relevant authorities in the event of a significant occurrence.

(C) DELIVERIES

- Special care will be taken during deliveries, especially when fuels and hazardous materials are being handled.
- All liquid deliveries will be supervised by a responsible person to ensure that (1) storage tank levels are checked before delivery to prevent overfilling and (2) the product is delivered to the correct tank.
- Contingency plans will be agreed and suitable materials available to deal with any incident.
- All employees will be briefed on the actions required in the event of a spillage.
- Spillages will be recorded and advised to the project manager who will inform local authorities if they deem it significant.

(D) REFUELLING

- Mobile plant will be refuelled in the construction compounds, on an impermeable surface away from any drains or watercourses. A spill kit will be available at this location.
- Hoses and valves will be checked regularly for signs of wear and turned off and securely locked when not in use.
- Generators, diesel pumps and similar equipment will be placed on drip trays to collect minor spillages. These will be checked regularly, and any accumulated oil removed for disposal.

(E) STORAGE

- All fuel, oil and chemical storage will be sited on an impervious base within a bund and secured within the construction compounds.
- The base and bund walls will be impermeable to the material stored and of an adequate capacity.
- Leaking or empty oil drums will be removed from the site immediately and disposed of via a licensed waste disposal contractor.
- The contents of any tank will be clearly marked on the tank, and a notice displayed requiring that valves and hoses be locked when not in use.
- All valves and hoses will be protected from vandalism and unauthorised interference and turned off and securely locked when not in use.
- Any tanks or drums will be stored in a secure container or compound, which is to be kept locked when not in use.
- Bowsers will be stored within site security compounds when not in use.

CEMP-6: Construction Traffic Management Plan

2.12.12 The appointed contractor will prepare a detailed traffic management plan in response to the requirements set out in this plan and prior to the works commencing.

- The plan will include provision for liaison with the community, the local authority and the Gardaí where required.
- Details of site access and any site traffic rules will be identified, including security, parking, loading, unloading, and required speed.
- Details of equipment delivery will be provided.
- Site operating hours (including delivery) to be outlined.

CEMP-7: Management of Excavation and Spoil

2.12.13 For the management of excavation and spoil, the contractor will:

- Erect all protective fencing.
- Implement the surface water management plan (including the installation of drainage infrastructure) prior to excavation and include areas dedicated to spoil storage with the drainage infrastructure.

- Ensure all spoil and excavated materials will be stored in the construction compounds.
- Ensure stockpiles and adjacent features of drainage infrastructure will be monitored and maintained appropriately.
- Ensure that all suitable topsoil and subsoil excavated at Kilcrea is re-used in new habitat creation at Corballis Cottages Road.

CEMP-8: Waste Management Plan

2.12.14 The following wastes may be generated during the construction of the project:

- Construction waste (materials, concrete, stonework, blockwork, timber, steel, etc.)
- Waste fuels; oil/diesel.
- Paper/cardboard.
- Non-hazardous office and canteen waste.
- Wastewater from office and welfare facilities.

2.12.15 Wastes will be segregated and stored in allocated tanks, bins, skips or areas within the construction compounds. The appointed contractor will finalise all storage areas and employ licensed contractors for the appropriate waste collections. The appointed contractor will ensure all permits and licences are in place and maintain relevant copies in the site office. Wastewater from holding tanks will be collected by an appropriate licensed contractor. Construction materials will be stored and managed in a way which promotes waste minimisation, including segregating materials for re-use.

CEMP-9: Construction Noise Management Plan

2.12.16 The appointed contractor will ensure that impacts from noise are minimised. The following measures will be communicated to all staff on site:

- All plant and machinery will be maintained to ensure noise emissions are negated and in line with relevant standards.
- Construction personnel will not leave plant and machinery running unnecessarily or operating outside of agreed operational hours.

CEMP-10: Construction Dust Management Plan

2.12.17 The appointed contractor will ensure that impact from dust is minimised. The following measures will be communicated to all staff on site:

- All plant and machinery will be maintained to ensure that dust and air emissions are negated and in line with relevant standards.
- Construction personnel will not leave any plant and machinery running unnecessarily or operating outside of agreed operational hours.
- Aggregate of not less than 5mm grade will be used in construction materials for the on-site road network.
- Dust suppression measures will be implemented in prolonged, dry and windy periods.

CEMP-11: Materials Handling and Storage Plan

2.12.18 The appointed contractor will ensure that the handling of materials and their storage meets regulatory and site requirements.

2.12.19 The plan will include:

- Layout proposal for the construction compounds including the location of contractor cabins, site offices, storage containers and open-air laydown areas.
- Adherence to safety and storage of equipment and materials.
- Safe transfer and placement of equipment in accordance with approved handling methods, and will be subject to a method statement.

CEMP-12: Monitoring and Auditing Procedure

2.12.20 Checklists for daily environmental monitoring will include (but are not limited to) confirmation that fuel is stored appropriately, that management rules are adhered to, all environmental buffers are maintained, sediment and erosion control measures of the surface water management plan are in place and functioning.

2.12.21 All environmental records, including completed checklists, will be retained at the site office.

CEMP-13: Environmental Accidents, Incidents and Corrective Actions Procedure

2.12.22 Environmental accidents and incidents occurring on site during the works will be reported, recorded and investigated. Corrective actions will be put in place and expeditiously closed out.

2.12.23 This procedure will be updated (by the appointed contractor) to include the relevant personnel responsibilities and reporting structure and the finalised procedure will be communicated to all personnel.

2.12.24 Environmental accidents and incidents may include but are not limited to:

- Accidents involving a spill of fuel or concrete from delivery truck (emergency response required).
- Spills of fuel and oil (minor).
- Waste or rubbish not in dedicated waste areas.
- Breach of any buffers (archaeological, ecological, watercourse).
- Failure of any control measures (e.g. silt fences collapsed in a storm).
- Unplanned vehicle movement off the access tracks.
- Unplanned vehicle movement within a buffer zone.

3.0 Receiving Environment

3.1 Introduction

3.1.1 This chapter considers the baseline ecological conditions as pertain to Malahide Estuary, with reference to the proposed development. Ecological topics include terrestrial and aquatic habitats, and detailed species surveys for birds, mammals and bats.

3.2 Habitats

Data and Methodology

3.2.1 Site visits to identify the habitat and floral composition of the site were made over the period 2012-2019. The site was evaluated according to the methodology outlined by TII (formerly NRA) 2009. The ecological value of the site was assessed for the most part as low value, locally important, i.e. comprised principally of artificial or highly modified habitats with low species diversity and low wildlife value. Areas of habitat within a designated European Site, Malahide Estuary SAC, are evaluated as of international importance. Some smaller areas of habitat are defined as high value and moderate value, locally important, i.e. areas of the site containing some natural or semi-natural habitat in the study area.

Rare or Protected Flora

3.2.2 There are a number of known rare and protected plant species records from the 10km square in the vicinity of the proposed development. These include historic records dating from the late nineteenth century as well as some more recent records.

3.2.3 These include:

- Basil Thyme (*Acinos arvensis*) recorded from Portmarnock in 1840, 1893 and 1903;
- Lesser Centaury (*Centaurium pulchellum*) recorded from Portmarnock Point in 1991;
- Red Hemp Nettle (*Galeopsis angustifolia*) recorded from Donabate in 1902 and from Malahide in 1794;
- Meadow Barley (*Hordeum secalinum*) recorded from Portmarnock in 1866 and 1991;
- Oyster Plant (*Mertensia maritima*) from an unknown location in 1831;
- Round Prickly-headed Poppy (*Papaver hybridum*) recorded from Baldoyle to Portmarnock in 1836 and 1892, from Portmarnock in 1894, and from Malahide in 1985;
- Tufted Salt-marsh Grass (*Puccinellia fasciculata*) recorded from Baldoyle in 1990 and 1993;
- Meadow Saxifrage (*Saxifraga granulata*) recorded from Baldoyle to Portmarnock in 1824 and 1890, and from Baldoyle Racecourse in 1885 and 1902;
- Annual Knawel (*Scleranthus annuus*) recorded from Baldoyle in 1846;
- Hairy Violet (*Viola hirta*) recorded from Feltrim Hill in 1869 and 1904, from Portmarnock in 1869 and 1989 and from Baldoyle in 1895.

3.2.4 Notwithstanding, there are currently no known records of any rare or protected flora from the railway causeway or weir at Malahide (NPWS database records); neither was any rare, protected or scarce plant species found within the site during the walkover surveys (Curtis & McGough, 1988; Whilde, 1993; Neff, 1996-2000).

3.2.5 Over time, with the ingress of blown sand and sediments which have lodged in the interstices of the stonework, parts of the railway embankment have been colonised by plants from the surrounding areas. This is reflected in a mix of species, which includes ruderal communities, terrestrial grassland, and maritime species associated with salt marsh and sand dunes. The northern railway causeway is bounded to both the east and west by the open waters of the Malahide Estuary and is sheltered from the Irish Sea to the east by the sand hills of Corballis, on which the Island Golf Course has been developed. The railway track on the southern embankment is bounded to the east by large marina and housing development which adjoins a stone wall to the east of the track and to the west by the open waters of the Malahide Estuary.

3.2.6 None of the vegetation present conforms to any of the EU Annex II habitat types for which the adjacent Malahide Estuary SAC has been designated. It is noted that the reconstruction of the weir, the placing of the weir maintenance access track nor armouring of the northeastern causeway did not directly impact upon any floral species or protected habitats. Since installation these areas have been recolonised by a variety of plants. No species protected under the Flora Protection Order 2015 has been recorded from the footprint of the proposed development.

Baseline Data

Section 4 – Railway Causeway

3.2.7 The habitats of the site are principally dominated by artificial constructions, the causeway/trackway being the most obvious. This habitat type is defined under the Fossitt (2000) habitat type (Sea walls, piers and jetties CC1). This coastal construction which abuts the railway causeway to the east and the impounded estuary to the west also supports areas of regenerating and regenerated habitat such as Recolonising bare ground ED3, Dry meadows and grassy verges GS2 and Scrub WS1. All these habitats show species indicative of disturbance and have a maritime element (see Table 3.1 below).

3.2.8 The habitats of the site are summarised below:

- Sea Walls, Piers and Jetties CC1*:* At Bissets Strand the weir maintenance access track and adjacent rock armour support species typical of maritime rocky shores Sea Beet (*Beta vulgaris*), Stags head Plantain (*Plantago coronopus*), Sea Plantain (*P. maritima*), Sea Mayweed (*Tripleurospermum maritimum*), Silverweed (*Potentilla anserina*), Red Fescue grass (*Festuca rubra*), Curly Dock (*Rumex crispus*), and Cleavers (*Galium aparine*). Together with alien species typical of ports and harbours such as Ribbed Melilot (*Melilotus officinalis*). This habitat type defined by Fossitt (2000) is used for all coastal constructions that are partially or totally inundated by sea water at high tide, or subject to wetting by sea spray or wave splash. It includes sea walls, piers, jetties, slipways, causeways and other structures associated with ports and docks in urban or rural areas.

- Mosaic Spoil and Bare Ground ED2/Recolonising Bare Ground ED3*:* Areas of the site which have not yet become fully revegetated after weir reconstruction (2009) but where some revegetation is in evidence comprises a mosaic of Spoil and bare ground ED2/Recolonising bare ground ED3. Vegetation cover varies from almost bare to greater than 50% cover in some areas. Most of the typical colonisers are ruderals, or weed plants. Species include some species indicative of the maritime habitat such

as Stags head Plantain (*Plantago coronopus*), Sea Plantain (*P. maritima*), Sea Mayweed (*Tripleurospermum maritimum*). Other common species include Silverweed (*Potentilla anserina*), Greater Plantain (*P. major*), Curly Dock (*Rumex crispus*), Colt's Foot (*Tussilago farfara*), Clover species (*Trifolium* spp.), Cudweed (*Gnaphilum uliginosusm*), Nettle (*Urtica dioica*), Dandelion (*Taraxacum* spp.), willow-herbs (*Epilobium* spp.) and ragworts (*Senecio* spp.). Grasses are also present and include Red Fescue (*Festuca rubra*), False Oat-grass (*Arrhenatherum elatius*) and Cock's-foot (*Dactylis glomerata*) but are not dominant in the barer areas.

- Dry Meadows and Grassy Verges GS2*:* Along the fringes of the bare ground areas of grassy verge occur dominated by tall, coarse and tussocky grasses such as False Oat-grass (*Arrhenatherum elatius*) and Cock's-foot (*Dactylis glomerata*) with red fescue and common couch grass also common. The broadleaved herb component is characterised by a range of species that either grow tall, such as Hogweed (*Heracleum sphondylium*), Common Knapweed (*Centaurea nigra*), Meadow Vetchling (*Lathyrus pratensis*) and Silverweed. Grassy verges may support other smaller broadleaved herbs such as Creeping Cinquefoil (*Potentilla reptans*) and clovers (*Trifolium* spp.). The maritime influence at the site is in evidence with the occurrence of Common Fleabane (*Pulicaria dysenterica*) and Sea Mayweed (*Tripleurospermum maritimum*). Occasional Reeds (*Phragmites australis*) occur at the fringe of this vegetation along drainage channels near entrance to causeway.

- Scrub WS1*:* Fringes of the higher established railway embankment have become overgrown with brambles. Common components include spinose plants such as Bramble (*Rubus fruticosu*s agg.) and Gorse (*Ulex europaeus*) with occasional Hawthorn (*Crataegus monogyna*) and some stunted trees, in particular the weedy sycamore. Along the fringes of the scrub and amongst the limestone rock armour an abundance of the introduced species Red Valerian (*Centranthus ruber*) occurs. The habitat grades to Dry meadows and grassy verges GS2 along the fringes of the scrub.

Table 3.1 Habitat Types and Conservation Value Along Route of the Proposed Greenway at the Railway Causeway – Vicinity of Development.

Habitat Type	Conservation Value
Sea Walls, Piers and Jetties CC1	Low
Mosaic Spoil and Bare Ground ED2/Recolonising Bare Ground ED3	Low
Dry Meadows and Grassy Verges GS2	Moderate
Scrub (WS1)	Low-Moderate

Section 5 – Kilcrea

3.2.9 The principal conservation interest of the site lies in areas of the site subject to periodic inundation by brackish or freshwater. These include a narrow strip of Shingle and Gravel Shores (LS1) and a small area of Saltmarsh Marsh-Wet Grassland (CM2/GS4) and a Tidal Channel (CW2) on the most downstream part of the River Pill adjacent to the railway embankment. These CM2/GS4/CWS habitats, west of the railway embankment, are separated from the intertidal habitats of the outer estuary by way of a non-return flap on the outlet carried beneath the railway line. These habitats are representative of habitats annexed under Annex I of the EU Natural Habitats Directive. Tidal channels correspond approximately to the annexed habitat 'estuaries (1130)' and Saltmarsh Marsh-Wet Grassland (CM2/GS4) corresponds to 'Atlantic salt meadows (*Glauco-*

Puccinellietalia maritimae) (1330)' and the shingle shore to the annexed habitat 'perennial vegetation of stony banks (1220)' (see Table 3.2 below).

3.2.10 These habitats provide feeding habitat for a variety of birdlife in particular wader species such as Curlew and Oystercatcher. The habitats are linked to the adjacent Malahide SAC but with the exception of a very small area of Shingle and Gravel Shores (LS1) are outside the SAC. The habitats outside the SAC are of high value local significance (see habitat plan in Figure 3.1).

HEDGEROWS WL1 – KILCREA

3.2.11 The hedgerows that occur along the field margins in Kilcrea are generally good examples of their habitat types supporting a variety of shrub and tree species and providing a network of wildlife corridors at the site.

3.2.12 Hedgerows here are typical of the general locality and are very much dominated by Hawthorn (*Crataegus monogyna*) and some Elder (*Sambucus nigra*). In addition, Blackthorn (*Prunus spinosa*), Gorse (*Ulex europaeus*), Holly (*Ilex aquifolium*), Dog-rose (*Rosa canina*), Bramble (*Rubus fruticosus* agg.), and willows (*Salix* spp.). The hedgerows also support climbing plants such as Ivy (*Hedera helix*), Honeysuckle (*Lonicera periclymenum*), Hedge Bindweed (*Calystegia sepium*), Cleavers (*Galium aparine*) and Bush Vetch (*Vicia sepium*). Tall grasses occurring along the hedgerow fringe, include False Oat grass (*Arrhenatherum elatius*), and Cock's-foot grass (*Dactylis glomerata*). The Harts Tongue Fern (*Phyllitis scolopendrium*) is also common at the base of the hedgerows. This habitat is not protected but is of some conservation value locally providing habitat for passerine bird species and small mammals.

3.2.13 Some introduced species also occur as occasional plantation species in the hedgerow along the route. These include Butterfly bush (*Buddleja davidii*) and Fuchsia (*Fuchsia magellanica*).

HEDGEROWS WL1/SCRUB WS1 – CORBALLIS COTTAGES ROAD

3.2.14 Species composition varies very little along the route, however short sections of exotic planted hedgerow species are found in the vicinity of dwelling houses where the dominant species are exotics such as New Zealand Privet (*Griselinia littoralis*), Red-flowering Currant (*Ribes sanguineum*) and Periwinkle (*Vinca minor*). However in general along the Corballis Cottages Road, hedgerows commonly support a high proportion of native spinose plants such as Hawthorn (*Crataegus monogyna*), Blackthorn (Prunus spinosa), Dog-rose (*Rosa canina*) or Bramble (*Rubus fruticosus* agg.), in addition to many other trees and shrubs including, for example, Ash (*Fraxinus excelsior*), Sycamore (*Acer pseudoplatanus*), Hazel (*Corylus avellana*), Elder (*Sambucus nigra*), Common Privet (*Lingustrum vulgare*) and Willows (*Salix* spp.). The hedgerows also support plants such as Ivy (*Hedera helix*), Hedge Bindweed (*Calystegia sepium*), Cleavers (*Galium aparine*) and Bush Vetch (*Vicia sepium*). Tall grasses, including False Brome (*Brachypodium sylvaticum*), ferns, and woodland herbs. The fringes of the established railway embankment have become overgrown with bramble scrub (WS1). Common components include spinose plants such as Bramble (*Rubus fruticosus* agg.) and Gorse (*Ulex europaeus*) with occasional Hawthorn (*Crataegus monogyna*) and some stunted trees in particular the weedy sycamore. Along the fringes of the scrub and amounts the limestone rock armour an abundance of the introduced species Red Valerian (*Centranthus ruber*) occurs. The habitat grades to Dry meadows and grassy verges GS2 along the fringes of the WS1 scrub.

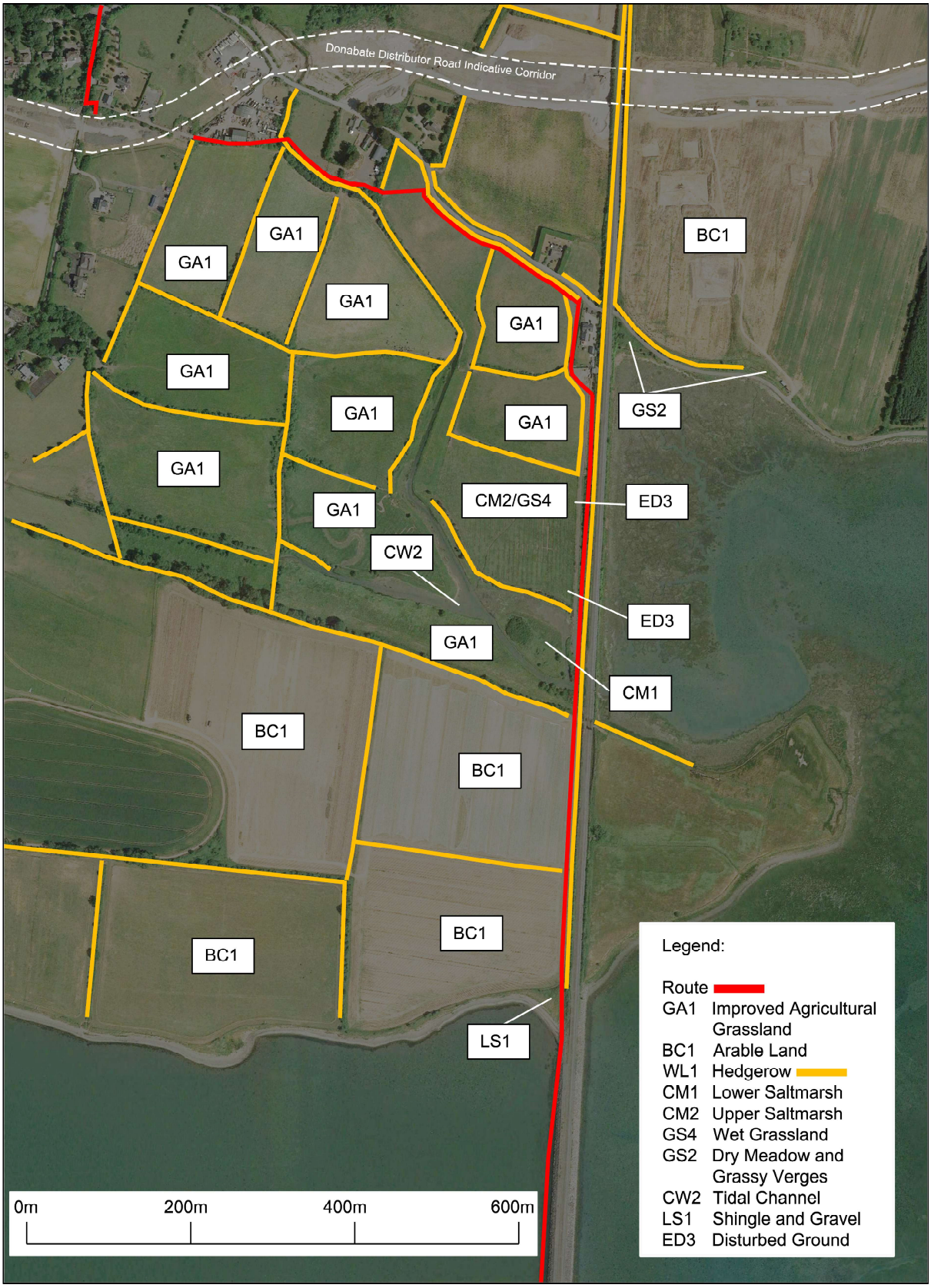

Figure 3.1 Habitat Map at Kilcrea.

IMPROVED AGRICULTURAL HABITATS (GA1 AND BC1)

3.2.15 Improved agricultural habitats, i.e. areas of improved Agricultural Grassland (GA1) and Arable Crops (BC1), along the proposed greenway route are not of high conservation importance. The improved grassland fields support the ubiquitous species assemblage of Rye-grasses (*Lolium* spp.), clovers (*Trifolium repens, T. repens*) and Yorkshire-fog grass (*Holcus lanatus*). Among the more frequently occurring 'agricultural' herbs are Dandelion (*Taraxacum* spp.), Creeping Buttercup (*Ranunculus repens*), plantains (*Plantago* spp.), Nettle (*Urtica dioica*), thistles (*Cirsium arvense, C. vulgare*) and docks (*Rumex* spp.). A large cereal field (BC1) also occurs along the route.

SCRUB WS1

3.2.16 Gorse scrub occurs in patches along the proposed greenway route. This scrub is dominated by European Gorse (*Ulex europaeus*), which gives almost total shade and thus suppresses the growth of ground flora species beneath. Other scrub species, which occur in the gorse scrub, include Hawthorn (*Crataegus monogyna*), Blackthorn (*Prunus spinosa*), Elder (*Sambucus nigra*), Bramble (*Rubus fruticosu*s agg.), Willow *(Salix repens*) and the potentially invasive exotics Butterfly Bush *(Buddleja davidii*) and Travellers Joy (*Clematis vitalba*).

DRY MEADOWS AND GRASSY VERGES GS2 – KILCREA

3.2.17 Along the trackside fringes, along field boundaries and in some areas of light grazing the habitat Dry Meadow/Grassy Verge is encountered. This habitat is dominated by the tussocky grasses False Oat-grass (*Arrhenatherum elatius*) and Cock's-foot grass (*Dactylis glomerata*). Other grasses include Couch grass (*Elymus repens*), Timothy grass (*Phleum pratense*), Yorkshire-fog (*Holcus lanatus*), Smooth Meadow-grass (*Poa pratensis*), and occasionally Red fescue (*Festuca rubra*). The tussock grass (*Deschapsia caespitosa*) and Creeping bent grass (*Agrostis stolonifera*) occur occasionally in damper patches. The herb component is dominated by tall species such as Hogweed (*Heracleum sphondylium*), Nettle (*Urtica dioica*), Yarrow (*Achillea millefolium*), Ox eye daisy (*Leucanthemum vulgare*) and Common Knapweed (*Centaurea nigra*). Scrambling plants also occur commonly in the grassy margin and include Bush Vetch (*Vicia sepium*), Meadow Vetchling (*Lathyrus pratensis*) and Hedge Bindweed (*Calystegia sepium*). Grassy verges may support other smaller broadleaved herbs such as Creeping Cinquefoil (*Potentilla reptans*), Silverweed (*P. anserina*) and clovers (*Trifolium* spp.). Other species found in the grassy verge habitat along the railway embankment include Hedge Woundwort (*Stachys sylvatica*), willow herb species (*Epilobium hirsutum*), chickweeds (*Stellaria* spp.), and yellow compositae (*Hieracium* spp. *Hypochoeris radicata, Taraxacum officinale* inter alia). The agricultural weeds Sow thistles (*Sonchus* spp.), Ragwort (*Senecio jacobaea*) and Groundsel (*S. vulgaris*) are also abundant and of note is some Oxford Ragwort (*Senecio squalidus*) occurring in more disturbed patches. Indicators of the proximity of the coastal influence at the site is indicated by the occurrence of species such as Carrot (*Daucus carota*), Fleabane (*Pulicaria dysenterica*) and Teasel (*Dipsacus fullonum*).

3.2.18 The occasional occurrence of rush and sedge species such as the Rushes *Juncus effuses, J. inflexus, J. acutiflorus,* and *J. articulatus,* and sedges *Carex nigra* and *C. otrubae* etc. indicated the damp nature of the grassy verge habitat at the site.

DRY MEADOWS AND GRASSY VERGES GS2 – CORBALLIS COTTAGES ROAD

3.2.19 Along the roadside verges, along the field margins and associated with developing scrub at the site the habitat Dry meadows and grassy verges GS2 occurs on its own or in mosaic with scrub. Here the habitat is dominated by grasses and associated tall herbs. The habitat supports a high proportion of tall, coarse and tussocky grasses False Oat-grass (*Arrhenatherum elatius*) and Cock's-foot (*Dactylis glomerata*). Other grasses include Timothy grass (*Phleum pratense*), Meadow Foxtail (*Alopecurus pratensis*), Yorkshire-fog (*Holcus lanatus*), Smooth Meadow-grass (*Poa pratensis*) and Red Fescue (*Festuca rubra*). The broadleaved herb component is characterised by a range of species: Hogweed (*Heracleum sphondylium*), Nettle (*Urtica dioica*), Common Knapweed (*Centaurea nigra*), Ox Eye Daisy (*Leucanthemum vulgare*), Silverweed (*Potentilla anserina*), Cow parsley (*Anthriscus sylvestris*), Alexanders (*Smyrnium olustrum*), Cleavers (*Galium aparine*), Bush Vetch (*Vicia sepium*), and Clovers (*Trifolium* spp.). Grassy verges may support other smaller broadleaved herbs such as Creeping Cinquefoil (*Potentilla reptans)* and clovers (*Trifolium* spp.). The maritime influence at the site is in evidence with the occurrence of Common Fleabane (*Pulicaria dysenterica*) and Sea Mayweed (*Tripleurospermum maritimum*). Occasional Reeds (*Phragmites australis*) occur at the fringe of this vegetation along drainage channels near entrance to the causeway. On the fringes of this vegetation some garden escapes can also be found such as Hoary Stock (*Matthiola incana*) and Sweet Alyssum (*Lobularia maritima*). Woodland fringe species also occur in the verges and include Ivy (*Hedera helix*), Herb Robert (*Geranium robertianum*), and the grass *Brachypodium sylvaticum*. An exotic woody species growing in the grassy verge in the Corballis Cottages Road area includes Periwinkle (*Vinca minor*).

SALTMARSH MARSH-WET GRASSLAND (CM2/GS4)

3.2.20 This vegetation community is characteristic of permanently moist and sometimes inundated meadows and typically occurs on periodically tidally flooded sites as is the case here. At the site the vegetation bordering the tidal channels is transitional to a lower salt marsh community classifiable within the *Elymo-Rumicion crispi* (Westhoff and Den Held 1969) described below. Transitional areas of the meadow contain species representative of both the *Holco-Juncetum effusi* and the *Elymo-Rumicion crispi*.

3.2.21 The low-lying part of the meadow supports an area of brackish Atlantic salt meadow which is transitional to the fresh water rush pasture of the higher ground or Upper saltmarsh CM2. This community may be best described as representative community of the *Elymo-Rumicion crispi* (Westhoff and Den Held 1969) and appears to be a community closely related to the *Festuca rubra-Agrostis stolonifera-Potentilla anserina* grassland (Rodwell 1992). This community may be considered as a 'high marsh' CM2 community which is tolerant of brackish conditions but is not tolerant of inundation by highly saline waters. The community supports a sward of Red Fescue (*Festuca rubra*) (a typical upper salt-marsh species) with Creeping Bent (*Agrostis stolonifera*), Curled Dock (*Rumex crispus*), and Silverweed (*Potentilla anserina*). The community contains a frequency of salt-marsh species such as Orache (*Atriplex hastata*), Saltmarsh Rush (*Juncus gerardi*), Sea Milkwort (*Glaux maritima*), Sea Blite (*Suaeda maritima*), more normally associated with species assemblages of the *Glauco-Puccinellietali*a or alliance representative of typical Atlantic salt-meadows, Silverweed (*Potentilla anserina*), Common couch grass (*Elymus repens*) and Sea arrow grass (*Triglochin maritimum*). There are also occasional records for Marsh Willowherb (*E. palustris*), and the sedges (*Carex otrubae* and *C. distans*) associated with this vegetation community.

3.2.22 Where the brackish influence becomes lesser the grassy sward supports Fleabane (*Pulicaria dysenterica*), Marsh Horsetail (*Equisetum fluviatile*), Creeping Buttercup (*Ranunculus repens*), Lesser Spearwort (*R. flammula*) Red Bartsia (*Odontites verna*), Forget-me-not (*Myosotis scorpioides*), and Curled Dock (*Rumex crispus*). Rushes are an important component of the flora of the surrounding wet grassland GS4 which is transitional to a grassland where Hard Rush (*Juncus inflexsus*) is dominant. Grasses (*Agrostis stolonifera, Holcus lanatus, Anthoxanthum odoratum, Elymus repens, Poa pratensis* and *Festuca rubra*) make up the sward in damper areas. The associated forbs of damp areas include Chickweeds (*Stellaria* spp.), Mouse-eared Chickweed (*Cerastium fontanum*), Silverweed (*Potentilla anserina*), Marsh Willowherb (*Epilobium palustre*), Sorrel (*Rumex acetosa*), Marsh Ragwort (*Jacobaea aquatica*), Lesser Spearwort (*Ranunculus flammula*), Creeping Buttercup (*R. repens*), Clovers (*Trifolium* spp.), Greater Bird's foot (*Lotus uliginosus*), Fleabane (*Pulicaria dysenterica*), Curly Dock (*Rumex crispus*), Fool's water-cress (*Apium nodilflorum*), Ladies Smock (*Cardamine pratensis*), Mint (*Mentha aquatica*), Marsh Bedstraw (*Galium palustre*), and Meadowsweet (*Filipendula ulmaria*). Sea Club-rush *(Bolboschoenus maritimus*), and sedges (*Carex otrubae, C. nigra* and *C. distans*) occur scattered through this vegetation. This community is also classifiable within the *Holco-Juncetum effusi* (Page 1980), rush-pasture.

3.2.23 In drier areas the following grass species become abundant: False oat grass (*Arrhenatherum elatius*), Couch grass (*Elymus* repens) and Cock's foot grass (*Dactylis glomerata*). Associated forbs include Willowherb (*Epilobium hirsutum*), and Ragwort (*Senecio jacobaea*) classifiable within the dry meadow habitat (GS2).

3.2.24 There is correspondence between this category and the annexed habitats, 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae) (1330)'.

TIDAL CHANNEL CW2

3.2.25 Canalised sections of channel occur at the site. These channels run alongside the railway embankment at the site. These drains and channels have a tidal influence at the site and so support tall emergents such as Sea club rush (*Bolboschoenus maritimus*) and up channel with lesser tidal influence species such as Water-cress (*Rorippa nasturtium-aquaticum*), the sedge *C. riparia* and Reed canary grass (*Phalaris arundinace*a) occur.

3.2.26 Bordering the lower channel species associated with saltmarsh habitat occur, i.e. Sea Blite (*Suaeda maritima*), the Common Saltmarsh Grass (*Puccinellia maritima*), and Cord grass (*Spartina* sp.). Other widespread species are Sea milkwort (*Glaux maritima*), Thrift (*Armeria maritima*), Common scurvy grass (*Cochlearia officinalis*), Orache (*Atriplex* species), Autumnal hawkbit (*Leontodon autumnalis*), Greater sea-spurrey (*Spergularia media*), Sea Aster (*Aster tripolium*) Sea plantain (*Plantago maritima*), Red fescue (*Festuca rubra*), and Sea arrow grass (*Triglochin maritimum*).

SHINGLE AND GRAVEL SHORES LS1

3.2.27 A small area of strandline occurs at the fringe of the Malahide Estuary characterised by open communities of terrestrial vascular plants including Annual Sea-blite (*Suaeda maritima*), oraches (*Atriplex* spp.), Sea Beet (*Beta vulgaris*), Sea Mayweed (*Tripleurospermum maritimum*), Herb-robert (*Geranium robertianum*) and Cleavers (*Galium aparine*). Species such as sow thistles, hogweed dandelions and ragworts are also common.

3.2.28 Links with Annex I: This category may contain examples of the annexed habitat, 'annual vegetation of drift lines (1210)'.

DISTURBED GROUND (RECOLONISING BARE GROUND ED3)

3.2.29 As with most transport infrastructure intermittent work along the trackway and in the vicinity of the trackway causes disturbance to the ground. Here typical species assemblages include Nettle (*Urtica dioica*), Docks (*Rumex* spp.), Colt's Foot (*Tussilago farfara),* Butterbur, Buttercups (*Ranunculus repens*), Nettle (*Urtica dioica*), Bindweed (*Calystegia sepium*), Dandelion (*Taraxacum* spp.), Willow-herbs (*Epilobium* spp.) and ragworts (*Senecio* spp.). Grasse (*Arrhenatherum elatius, Elymus repens, Dactylis glomerata*) are also present. *Brassica* species are also common.

3.2.30 Alien exotic plants are often associated with such areas of disturbance adjacent to railway lines, e.g. wild liquorice.

3.2.31 A number of agricultural fields are intensively managed and cultivated for the production of arable crops, i.e. cereals (wheat, barley). These fields demonstrate a very managed use of herbicides and clean seed leading to a species poor crop without many natural weed species.

Table 3.2 Habitat Types and Conservation Value Along Route of the Proposed Greenway at Kilcrea/Corballis.

Habitat Type	Conservation Value
Hedgerows (WL1)	Moderate
Improved Agriculture Habitats (GA1/BC1)	Low
Scrub (WS1)	Moderate
Dry Meadows and Grassy Verges (GS2)	Moderate
Saltmarsh Marsh-Wet Grassland (CM2/GS4)	High
Tidal Channel (CW2)	High
Shingle and Gravel Shores (LS1)	High
Disturbed Ground (ED3)	Low

3.3 Birds and Mammals

Data and Methodology

3.3.1 A desktop review was undertaken of available sources of species of fauna occurring in the vicinity of the route of the proposed greenway, including NPWS historical records of protected species and records held by the National Biodiversity Data Centre (www.biodiversityireland.ie). This desktop review was used to determine what rare or protected species have been previously recorded in the relevant grid square (O24) The terrestrial habitats north of the estuary, at Kilcrea, are made up of improved grassland, and tillage with some areas of rank grassland. The Pill River, which flows through lands at Kilcrea, joins the outer estuary east of the railway embankment. Particular data sources used in this appraisal of the baseline ecology along the terrestrial parts of the proposed greenway include:

- Ecological Field Surveys 2011-2014: field surveys conducted from July 2011 to March 2014, including detailed mammal surveys, bat surveys, bird surveys in the vicinity of the proposed greenway.
- Summer and Winter bird survey reports of lands surrounding the Malahide Estuary carried out for Fingal County Council (Roe & Lovatt, 2009).
- Winter bird survey of Malahide Estuary & surrounding lands carried out for Fingal County Council (Lewis & Butler, 2017).

- Avian surveys of Malahide Estuary 2009-2011 (Mayes 2010, 2011).
- Bird surveys of Malahide Estuary by Ecology Ireland in the Winter of 2017/2018 – surveys led by Dr. Olivia Crowe.
- Mammal surveys of the lands at Kilcrea, including deployment of mammal trail cameras and a passive bat detector in May-June 2018.
- Natura Impact Statement on the Remedial Works on the Malahide Viaduct (CHE, 2010).
- I-WeBS subsite counts and BirdWatch Ireland site synopses (Crowe, 2005).
- GIS data on designated conservation sites (www.npws.ie).
- Site synopses and conservation objectives for European sites (www.npws.ie).
- Online web-resources, e.g. www.biodiversityireland.ie; http://data.nbn.org.uk/imt/.

Overall Estuary Bird Data

3.3.2 This chapter provides detail on the overall estuary counts as well as analysing the bird species diversity and abundance of the inner and outer estuary. Table 3.3 below outlines the peak numbers of the bird species recorded at Malahide Estuary from July 2011 to March 2012. Table 3.4 below details the peak numbers of the birds recorded at Malahide Estuary from October 2012 to March 2013 and Table 3.5 below shows the peak numbers of birds recorded in the area from October 2013 to March 2014.

JULY 2011 TO MARCH 2012

3.3.3 In total, 53 species and four additional species groups were observed in Malahide Estuary during this survey period. The most abundant species recorded at the site were Light-bellied Brent Geese (*Branta bernicla hrota*), Lapwing (*Vanellus vanellus*), Golden Plover (*Pluvialis apricaria*) and Oystercatcher (*Haematopos ostralegus*). Fifteen species were present on all 17 surveys between July 2011 and March 2012, with only seven species recorded on a single survey occasion. The majority of species were frequently recorded throughout this survey period with 34 of the 57 taxa present on 9 or more of the 17 survey visits.

3.3.4 Two species were recorded with peak numbers in excess of the threshold for international importance from July 2011 to March 2012: Light-bellied Brent Geese and Black-tailed Godwit (*Limosa limosa*) (Table 3.3 below). In addition, six further species were present in nationally important numbers during this survey period: Shelduck (*Tadorna tadorna*), Red Breasted Merganser (*Mergus serrator*), Redshank (*Tringa totanus*), Pintail (*Anas acuta*), Oystercatcher and Greenshank (*Tringa nebularia*).

3.3.5 Malahide Estuary is one of Ireland's most important wintering sites for Light-bellied Brent Geese (Crowe, 2005; Boland & Crowe, 2012) with winter peaks of approximately 2,000 individuals recorded annually. Black-tailed Godwits were also recorded internationally important peak numbers (478; Table 3.3 below). The site has held internationally important numbers of this species in the past (1996/97-2000/01) but has been demoted in status to national importance for Black-tailed Godwits in recent years (Boland & Crowe, 2012).

Table 3.3 The peak and median counts for each of the taxa observed at Malahide Estuary from July 2011 to March 2012 is shown in this table. The table also shows the threshold for National and International Importance from Boland & Crowe (2012).

Common Name	Scientific Name	Peak Count	Median	Nat. Imp.	Intl. Imp.
Bar-tailed Godwit	*Limosa lapponica*	74	30	160	1200
Black-headed Gull	*Larus ridibundus*	891	448		20000
Black-tailed Godwit[I]	*Limosa limosa*	478	185	140	470
Buzzard	*Buteo buteo*	2	0		
Common Guillemot	*Uria aalge*	1	0		
Common Gull	*Larus canus*	243	53		16000
Common Sandpiper	*Actitis hypoleucos*	1	0		17500
Cormorant	*Phalocrocorax carbo*	46	15	140	1200
Curlew	*Numenius arquata*	539	238	550	8500
Dunlin	*Calidris alpina*	685	174	880	13300
Godwit species		277	3		
Golden Plover	*Pluvialis apricaria*	1501	61	1700	9300
Goldeneye	*Bucephala clangula*	23	0	95	11500
Great Black-backed Gull	*Larus marinus*	62	16		4800
Great-crested Grebe	*Podiceps cristatus*	46	16	55	3600
Greenshank[N]	*Tringa nebularia*	25	9	20	2300
Grey Heron	*Ardea cinerea*	18	12	30	2700
Grey Plover	*Pluvialis squatarola*	28	3	65	2500
Gull species		3	0		
Herring Gull	*Larus argentatus*	106	71		5900
Hooded Crow	*Corvus cornix*	18	6		
Iceland Gull	*Larus glaucoides*	1	0		2000
Kestrel	*Falco tinnunculus*	1	0		
Knot	*Calidris canutus*	51	2	190	4500
Lapwing	*Vanellus vanellus*	1587	298	2100	20000
Lesser Black-backed Gull	*Larus fuscus*	31	6		4500
Light-bellied Brent Goose[I]	*Branta bernicla hrota*	1971	395	260	260
Little Egret	*Egretta garzetta*	23	3		1300
Little Grebe	*Tachybaptus ruficollis*	19	1	25	4000
Mallard	*Anas platyrhynchos*	155	97	380	2000
Mediterranean Gull	*Larus melanocephalus*	1	0		6600
Moorhen	*Gallinula chloropus*	6	2	20	20000
Mute Swan	*Cygnus olor*	82	53	110	
Oystercatcher[N]	*Haematopus ostralegus*	1371	507	680	10200
Pintail[N]	*Anas acuta*	39	1	20	600
Red Kite	*Milvus milvus*	2	0	n/a	n/a
Red-breasted Merganser[N]	*Mergus serrator*	118	4	35	1700
Redshank[N]	*Tringa totanus*	517	272	310	3900
Ring-Billed Gull	*Larus delawarensis*	1	0		20000
Ringed Plover	*Charadrius hiaticula*	43	10	150	730
Ruff	*Philomachus pugnax*	4	0		12500
Sanderling	*Calidris alba*	3	0	65	1200
Sandwich Tern	*Sterna sandvicensis*	88	0		
Scaup	*Aythya marila*	1	0	45	3100
Shag	*Phalacrocorax aristotelis*	26	0		2000
Shelduck[N]	*Tadorna tadorna*	335	115	150	3000
Shoveler	*Anas clypeata*	8	0	25	400
Small Wader sp.		2	0		

Common Name	Scientific Name	Peak Count	Median	Nat. Imp.	Intl. Imp.
Snipe	*Gallinago gallinago*	2	0		20000
Sparrowhawk	*Accipiter nisus*	1	0		
Starling	*Sturnus vulgaris*	20	0		
Teal	*Anas crecca*	66	10	450	5000
Tern species		3	0		
Tufted duck	*Aythya fuligula*	48	0	370	12000
Turnstone	*Arenaria interpres*	55	29	120	1500
Whimbrel	*Numenius phaeopus*	20	0		6800
Wigeon	*Anas penelope*	115	26	820	15000

I – Internationally Important Numbers; N – Nationally Important Numbers.

Table 3.4 The peak and median counts for each of the taxa observed at Malahide Estuary from October 2012 to March 2013 is shown in this table. As above, this table also shows the threshold for National and International Importance from Boland & Crowe (2012).

Common Name	Scientific Name	Peak Count	Median	Nat. Imp.	Intl. Imp.
Bar-tailed Godwit[N]	*Limosa lapponica*	233	62	160	1200
Black-headed Gull	*Larus ridibundus*	707	331		20000
Black-tailed Godwit[N]	*Limosa limosa*	447	218	140	470
Buzzard	*Buteo buteo*	2	0		
Common Guillemot	*Uria aalge*	1	0		
Common Gull	*Larus canus*	155	60		16000
Cormorant[N]	*Phalocrocorax carbo*	200	11	140	1200
Curlew	*Numenius arquata*	402	214	550	8500
Dunlin	*Calidris alpina*	309	150	880	13300
Godwit species		80	1		
Golden Plover	*Pluvialis apricaria*	1110	319	1700	9300
Goldeneye	*Bucephala clangula*	28	13	95	11500
Great Black-backed Gull	*Larus marinus*	56	23		4800
Great-crested Grebe	*Podiceps cristatus*	26	12	55	3600
Greenshank	*Tringa nebularia*	14	7	20	2300
Grey Heron	*Ardea cinerea*	23	15	30	2700
Grey Plover	*Pluvialis squatarola*	58	29	65	2500
Gull species		20	0		
Herring Gull	*Larus argentatus*	64	40		5900
Hooded Crow	*Corvus cornix*	14	6		
Iceland Gull	*Larus glaucoides*	1	0		2000
Jack Snipe	*Lymnocryptes minimus*	1	0		
Knot	*Calidris canutus*	38	12	190	4500
Lapwing	*Vanellus vanellus*	998	802	2100	20000
Lesser Black-backed Gull	*Larus fuscus*	25	12		4500
Light-bellied Brent Goose[I]	*Branta bernicla hrota*	1270	534	260	260
Little Egret	*Egretta garzetta*	11	5		1300
Little Grebe	*Tachybaptus ruficollis*	9	5	25	4000
Little Gull	*Larus minutus*	1	0		1230
Mallard	*Anas platyrhynchos*	107	76	380	2000
Moorhen	*Gallinula chloropus*	3	2	20	20000
Mute Swan	*Cygnus olor*	77	49	110	
Oystercatcher	*Haematopus ostralegus*	534	394	680	10200
Pintail[N]	*Anas acuta*	38	4	20	600
Red Kite	*Milvus milvus*	2	0	n/a	n/a
Red-breasted Merganser[N]	*Mergus serrator*	63	36	35	1700

Common Name	Scientific Name	Peak Count	Median	Nat. Imp.	Intl. Imp.
Redshank[N]	*Tringa totanus*	440	233	310	3900
Red-throated Diver	*Gavia stellata*	1	0	20	3000
Ringed Plover	*Charadrius hiaticula*	63	26	150	730
Ruff	*Philomachus pugnax*	2	0		12500
Sanderling	*Calidris alba*	6	0	65	1200
Sandwich Tern	*Sterna sandvicensis*	5	0		
Shag	*Phalacrocorax aristotelis*	18	0		2000
Shelduck[N]	*Tadorna tadorna*	268	150	150	3000
Shoveler	*Anas clypeata*	4	0	25	400
Small Wader sp.		6	0		
Snipe	*Gallinago gallinago*	1	0		20000
Sparrowhawk	*Accipiter nisus*	1	0		
Teal	*Anas crecca*	51	22	450	5000
Tufted duck	*Aythya fuligula*	9	0	370	12000
Turnstone	*Arenaria interpres*	59	27	120	1500
Water Rail	*Rallus aquaticus*	1	0		
Whimbrel	*Numenius phaeopus*	30	0		6800
Wigeon	*Anas penelope*	99	49	820	15000

I – Internationally Important Numbers; N – Nationally Important Numbers.

Table 3.5 The peak and median counts for each of the taxa observed at Malahide Estuary from October 2013 to March 2014 is shown in this table. As above, this table also shows the threshold for National and International Importance from Boland & Crowe (2012).

Common Name	Scientific Name	Peak Count	Median	Nat. Imp.	Intl. Imp.
Bar-tailed Godwit[N]	*Limosa lapponica*	161	12.5	160	1200
Black-headed Gull	*Larus ridibundus*	1118	368.5		20000
Black-tailed Godwit[N]	*Limosa limosa*	248	119	140	470
Buzzard	*Buteo buteo*	2	0		
Common Gull	*Larus canus*	202	116.5		16000
Cormorant	*Phalocrocorax carbo*	18	5.5	140	1200
Curlew	*Numenius arquata*	289	143	550	8500
Dunlin	*Calidris alpina*	229	22	880	13300
Golden Plover[N]	*Pluvialis apricaria*	1800	22	1700	9300
Goldeneye	*Bucephala clangula*	78	21	95	11500
Great Black-backed Gull	*Larus marinus*	17	7		4800
Great-crested Grebe	*Podiceps cristatus*	43	20	55	3600
Great Northern Diver	*Gavia immer*	2	0.5	20	50
Greenshank	*Tringa nebularia*	11	5	20	2300
Grey Heron	*Ardea cinerea*	14	10.5	30	2700
Grey Plover	*Pluvialis squatarola*	6	0	65	2500
Common Guillemot	*Uria aalge*	1	0		
Herring Gull	*Larus argentatus*	79	52.5		5900
Hooded Crow	*Corvus cornix*	6	0		
Kingfisher	*Alcedo atthis*	1	0		
Knot	*Calidris canutus*	45	6.5	190	4500
Lapwing	*Vanellus vanellus*	700	358	2100	20000
Lesser Black-backed Gull	*Larus fuscus*	8	4		4500
Light-bellied Brent Goose[I]	*Branta bernicla hrota*	1618	368.5	260	260
Little Egret	*Egretta garzetta*	6	4		1300
Little Grebe[N]	*Tachybaptus ruficollis*	29	14.5	25	4000

Common Name	Scientific Name	Peak Count	Median	Nat. Imp.	Intl. Imp.
Mallard	*Anas platyrhynchos*	145	64.5	380	2000
Mute Swan	*Cygnus olor*	59	47	110	
Oystercatcher[N]	*Haematopus ostralegus*	855	477	680	10200
Pintail[N]	*Anas acuta*	35	1	20	600
Pochard	*Aythya ferina*	2	0	380	3500
Red-breasted Merganser[N]	*Mergus serrator*	117	20.5	35	1700
Redshank	*Tringa totanus*	133	74.5	310	3900
Ringed Plover	*Charadrius hiaticula*	58	3	150	730
Scaup	*Aythya marila*	2	0	45	3100
Shag	*Phalacrocorax aristotelis*	7	1.5		2000
Shelduck[N]	*Tadorna tadorna*	358	233.5	150	3000
Shoveler	*Anas clypeata*	4	2	25	400
Snipe	*Gallinago gallinago*	4	0.5		20000
Sparrowhawk	*Accipiter nisus*	2	0.5		
Teal	*Anas crecca*	319	101.5	450	5000
Turnstone	*Arenaria interpres*	25	20	120	1500
Whooper Swan	*Cygnus cygnus*	1	1	130	210
Wigeon	*Anas penelope*	161	70	820	15000

I – Internationally Important Numbers; N – Nationally Important Numbers.

3.3.7 The peak counts of Oystercatcher, Red-breasted Merganser, Redshank and Shelduck all easily exceeded the threshold for national importance. A peak count of 39 Pintail is notable – almost double the threshold for national importance. Several other species had peak counts that approached the threshold for national importance: Curlew 539 (550), Golden Plover 1501 (1700), Lapwing 1587 (2100), Dunlin 685 (880), Great Crested Grebe 46 (55) and Little Grebe 19 (25).

3.3.8 A number of birds of prey were recorded during the estuary counts. Buzzard, Kestrel and Sparrowhawk were all observed hunting over the estuary. Red Kite – part of a number released as Newbridge Demesne as part of a reintroduction plan – were observed over the estuary during one of the survey visits. A male Merlin (*Falco columbarius*) was observed hunting in fields just north of the study area on 21st February 2012. Several uncommon bird species were recorded during the estuary surveys. Iceland Gull and Ring-billed Gull are uncommon nationally and Ruff is relatively scarce even on passage.

October 2012 to March 2013

3.3.9 In all, 52 species and two additional species groups were recorded in Malahide Estuary between October 2012 and March 2013. The three most abundant species recorded were once again, Light-bellied Brent Goose, Golden Plover and Lapwing. Eighteen species were present on all 11 complete surveys carried out between October 2012 and March 2012. Nine species were recorded on a single survey occasion: Buzzard (*Buteo buteo*), Common Guillemot (*Uria aalge*), Iceland Gull (*Larus glaucoides*), Little Gull (*Larus minutus*), Red Kite (*Milvus milvus*), Red-throated Diver (*Gavia stellata*), Snipe (*Gallinago gallinago*), Sparrowhawk (*Accipter nisus*), and Water Rail (*Rallus aquaticus*). However, the majority of taxa were present across the winter months with 34 of 54 taxa recorded on seven or more of the 11 survey occasions.

3.3.10 Of the 52 species observed, only one species was recorded in internationally important numbers. Light-bellied Brent Geese were once again present well in excess of the threshold for a site of international importance (Table 3.4 above). However, the peak counts of Black-tailed Godwits recorded were just below the threshold for international importance, although numbers observed were regularly in excess of the threshold for national importance. Four of the species recorded in nationally important numbers in the previous winter were once again observed in nationally important numbers – Pintail, Red-breasted Merganser, Redshank and Shelduck. Two additional species were present in this period in nationally important numbers: Bar-tailed Godwit (*Limosa lapponica*) and Cormorant (*Phalocrocorax carbo*) (Table 3.4 above).

OCTOBER 2013 TO MARCH 2014

3.3.11 In all, 44 species were recorded in Malahide Estuary between October 2013 and March 2014. The three most abundant species recorded were once again, Light-bellied Brent Goose, Golden Plover and Black-headed Gull.

3.3.12 As in the previous winter period, only one species, Light-bellied Brent Goose, was recorded in internationally important numbers (Table 3.5 above). There were eight species recorded in nationally important numbers, including both Godwit species, Golden Plover, Little Grebe, Oystercatcher, Pintail, Red-breasted Merganser and Shelduck.

NOVEMBER 2017 TO APRIL 2018

3.3.13 Bird numbers and distributions at Malahide Estuary were monitored during the winter of 2017/2018. In total, 13 low and high-tide counts were undertaken between November 2017 and April 2018 (six high-tide and seven low-tide counts). Separate totals were collected for the inner and outer parts of the estuary (to the west and east of the embankment respectively). Additionally, separate counts were collected for the area bordering the western edge of the embankment in three distance bands (100m, 101-300m and 301–500m).

3.3.14 The total number of waterbirds recorded ranged between 1,353 (high-tide count, 08/04/18) and 5,944 (high-tide count 11/02/18). High-tide counts were higher than low-tide counts in all months other than in April. In total, 42 waterbird species were recorded, including 18 species recorded during most counts (in at least 12 out of 13 counts). Light-bellied Brent Goose was recorded in numbers of international importance and a further 14 species were recorded in numbers of national importance.

3.3.15 In total, 24 species were recorded within 500 metres of the embankment on the west side. A fairly high proportion of the diving bird species such as Red-breasted Merganser (*Mergus serrator*), Little Grebe (*Tachybaptus ruficollis*) and Great Crested Grebe (*Podiceps cristatus*) were recorded feeding within 500m of the embankment. On occasion, good numbers of Light-bellied Brent Geese and Oystercatchers were present, especially around the weir area of the embankment. There were several occasions where flocks of waders and Brent Geese were recorded in the northeast corner of the inner estuary and along the northern shoreline within 500m of the embankment.

3.3.16 When compared with other recent surveys relating to the embankment, there has been considerable interannual variation. Most notable of the trends have been the increases shown in Little Grebe and Goldeneye in the inner estuary, the decline in Light-bellied

Brent Goose in the outer estuary and increases shown in Knot, Grey Plover, Black-tailed Godwit, Shoveler and Oystercatcher in the outer estuary.

Other Data Sources

3.3.17 There are several other sources of counts of overwintering species from I-WeBS (Irish Wetland Bird Survey) reports and from data made available from NPWS. The contemporary data from the NPWS commissioned report "Collection of baseline waterbird data for Irish coastal Special Protection Areas 2011/2012" (Cummins & Crowe, 2012) is useful in providing a context for the diversity and abundance of birds recorded during the same winter period. However, the areas encompassed by both I-WeBS and BirdWatch Ireland in their Malahide Estuary counts are substantially larger than the count areas defined by Mayes (2010, 2011) and repeated in this survey. For instance, the Malahide Estuary site used by Cummins & Crowe (2012) includes several terrestrial fields and relatively large intertidal strips northeast and southeast of the areas counted in the present study. From a GIS calculation the Cummins & Crowe site is 70% larger than that defined by Mayes and used in the current study. It is also similar in area to the I-WeBS count area of Broadmeadow (Malahide) Estuary at over 940ha. The Mayes study area is similar in size to the SPA at just over 550ha.

3.3.18 I-WeBS counts also differ from the methodology used in the current study in that I-WeBS counts are carried out during periods of high water when congregations of birds at roost sites are more easily counted. Mayes (2010) used a combination of low and high water counts before deciding that low water counts provided more valuable data in her 2011 report. The current study (2011-2014) concentrated efforts in counting the inner estuary, in particular, when the tide was at its lowest on a given survey visit. The estuary was counted twice per month to take in a variety of Spring and Neap tidal states. Cummins & Crowe (2012) also concentrated effort on the low water period but they do include data collected from one high water survey.

3.3.19 Table 3.6 below shows the peak count data for bird species that have been recorded in internationally or nationally important numbers in Malahide Estuary in the recent survey seasons. For the majority of the species there is good agreement in the peak numbers reported by Cummins & Crowe (2012) and the peak counts from the concurrent 2011/2012 winter survey. For instance, Greenshank had the same peak count (25) in both studies and Pintail, Red-Breasted Merganser and Great Crested Grebes were recorded in similar numbers. As predicted by Mayes (2010 & 2011) the relatively high numbers of Great Crested Grebes observed in the inner estuary in the winter of 2009/10 may have been related to the increase in the water level following the initial weir and bridge works. Similarly, Mayes (2010) recorded relatively few Golden Plover and this number was substantially higher during the winter of 2011/12, when the water level in the inner estuary was considerably lower as a result of the second phase of the weir profiling works. Cummins & Crowe (2012) recorded a peak count of 261 Turnstone (much larger numbers than recorded in the current study). This probably reflects the presence of good numbers of feeding or roosting Turnstone in the intertidal areas counted by BirdWatch Ireland outside of the study area.

Table 3.6 Peak Count Data for Bird Species Recently Recorded in Nationally or Internationally Important Numbers in Malahide Estuary.

	I-WeBS 1996-2000	I-WeBs 2003-2008	2012 (NPWS/ BWI)[A]	2013-2014 (Overall)[B]	2012-13 (Overall)[B]	2011-12 (Overall)[B]	2009-10 & 2010-2011 (Mayes)[C]
International							
Light-bellied Brent Goose	940	1,962	1,350	1,618	1,270	1,971	937
Black-tailed Godwit	429	339	404	248	447	478	991
National							
Shelduck	423	422	280	358	268	335	405
Pintail	55	64	36	35	38	39	69
Goldeneye	170	137	58	78	28	23	85
Red-breasted Merganser	83	59	137	117	63	118	110
Great Crested Grebe	59	66	51	43	26	46	76
Oystercatcher	1,543	1,232	1,699	855	534	1,371	1,251
Golden Plover	1,281	3,206	1,900	1,800	1,110	1,501	830
Grey Plover	203	166	71	6	58	28	48
Knot	645	504	80	45	38	51	350
Dunlin	1,745	713	381	229	309	685	582
Bar-tailed Godwit	192	207	108	161	233	74	205
Redshank	583	639	390	133	440	517	728
Greenshank	48	50	25	11	14	25	26
Turnstone	144	198	261	25	59	55	38
Cormorant	126		97	18	200	46	76

A. Cummins & Crowe (2012) - Collection of baseline waterbird data for Irish coastal Special Protection Areas 2011/ 2012. BWI, Report Commissioned by NPWS.
B. Data collected by Ecology Ireland 2011-12; 2012-2013, 2013-2014.
C. Data collected in the winters of 2009-10 and 2010-2011 by Mayes & Porter.

3.3.20 As would be expected with highly mobile waterbird species there is a good deal of interannual variation between the peak numbers recorded. For several of the species this may not indicate any significant change in the numbers of birds wintering locally, merely highlight that these birds are capable of exploiting different resources at other nearby sites. For instance, Brent Geese move between intertidal and grassland areas to feed and can be observed in large numbers field-feeding during any part of the tidal cycle (pers. obs.). Mayes reported very high numbers of Black-tailed Godwit in the estuary in consecutive winters. These numbers were much higher than recorded in other surveys of the site in recent years. It is possible that these winters, both amongst the coldest winters on record, led to an influx of continental birds. Certainly, very high numbers of Black-tailed Godwits were also recorded in the winter 2010/2011 in the UK (http://www.bto.org/news-events/press-releases/mixed-fortunes-wintering-waterbirds).

3.3.21 A contemporary source of detailed winter counts of the estuary is presented in Lewis & Butler (2017). The estuarine study area was divided according to the subsites used during the NPWS Waterbird Survey Programme (NPWS 2013). One species was regularly recorded in internationally important numbers with a peak count of Light-bellied Brent Geese of 1,524 birds recorded during a low water count in the winter of 2016/2017. All of the other special conservation interest species were recorded in nationally important numbers in the survey area, apart from Golden Plover which rarely occurred in the area during the winter counts (peak count of 470 birds).

Inner Estuary Bird Data

3.3.22 The main concentration of birds in the inner estuary is around Seatown at the extreme west of the study area. A series of grassy islands at this location are important high water roosts and occasional feeding sites for several species and it is a preferred loafing and roosting area for Mute Swan and Black-headed Gull in particular. Waterbirds are fed by the public, especially at Seatown North. At low water – though substantially after low tide in the outer estuary – some intertidal mudflat becomes exposed at Seatown. The extent of the exposure is highly variable and was not always as expected from tidal models (www.easytide.co.uk). On occasions where a good deal of intertidal area became exposed the numbers of wading birds present were greatest with several thousand birds concentrated in a relatively small area.

3.3.23 The species recorded in the inner estuary are thus a mixture of diving ducks that used the eastern portion of the inner estuary and wading birds and wildfowl that were typically concentrated within a few hundred metres of Seatown.

July 2011 to March 2012

3.3.24 Table 3.7 below shows the species recorded in the inner estuary and the peak count of each species observed between July 2011 and March 2012. During this period 45 species and two additional species groups (Godwit species; Gull species) were recorded in the inner estuary. The numbers of birds recorded in the inner estuary increased considerably from October to November with peak numbers observed between November and the end of January.

3.3.25 Even within this study area which is much smaller than the I-WeBS count area (and the SPA), numbers of Brent Geese regularly exceeded internationally important Numbers with a peak count of 1,098 individuals recorded on 24th January 2012. Three additional species were observed in the inner estuary in nationally important numbers: Black-tailed Godwit, Red-Breasted Merganser and Redshank

3.3.26 Several dead and dying Mute Swans were seen throughout the winter at Seatown in the winter of 2010-2011. Feeding, particularly hand-feeding the swans at this location is popular but should be discouraged for several reasons, including public health and safety and animal welfare.

3.3.27 As shown in Figure 3.2 birds observed close to the railway embankment in the inner estuary were recorded according to the distance band in which they were first seen. The number of birds typically close to the embankment was relatively low with a peak number of 80 birds observed within 100m of the embankment on 31st July 2011 and a cumulative peak of 121 birds within 500m recorded on 16th January 2012. The daily percentage of the total number of birds recorded in the inner estuary that was found within 500m of the embankment ranged from 2-16%. During the busiest period (November-January) the birds recorded within 500m of the embankment only make up a very small percentage (<6%) of the total number of birds present in the inner estuary. Regularly recorded species within 500m of the embankment included several of the gull species and the diving ducks – Red Breasted Merganser and Great Crested Grebe. On a small number of occasions Brent Geese were recorded loafing on the water close to the northern shore within 500m of the embankment. Small numbers of Oystercatcher, Curlew and Turnstone were regularly recorded foraging along the edge of the embankment.

Table 3.7 Peak Counts of Bird Species Recorded Within the Inner Estuary at Malahide, July 2011 to March 2012.

Species	Peak Count
Bar-tailed Godwit	34
Black-headed Gull	596
Black-tailed Godwit	307
Brent Goose	1098
Buzzard	2
Common Gull	87
Common Sandpiper	1
Cormorant	10
Curlew	26
Dunlin	108
Godwit sp.	255
Golden Plover	1501
Goldeneye	23
Great Black-backed Gull	17
Great-crested Grebe	41
Greenshank	9
Grey Heron	14
Grey Plover	2
Gull species	1
Herring Gull	68
Hooded Crow	5
Iceland Gull	1
Kestrel	1
Knot	3
Lapwing	1587
Lesser Black-backed Gull	11
Little Egret	2
Little Grebe	17
Mallard	104
Moorhen	6
Mute Swan	82
Oystercatcher	83
Pintail	3
Red Kite	2
Red-breasted Merganser	71
Redshank	357
Ruff	4
Sandwich Tern	4
Scaup	1
Shag	26
Shelduck	21
Sparrowhawk	1
Starling	20
Teal	65
Tufted duck	2
Turnstone	11
Wigeon	27

OCTOBER 2012 TO MARCH 2013

3.3.28 Table 3.8 below lists the species recorded in the inner estuary and the peak count of each species observed between October 2012 and March 2013. As expected, given the more seasonally restricted survey season, the species diversity recorded was somewhat less than in the previous survey period. During this winter 38 species and one additional species group (Gull species) were recorded in the inner estuary. The peak numbers of birds in the inner estuary were recorded in February, with over 2,000 birds present on each survey occasion from early January to early March.

3.3.29 Light-bellied Brent Geese were observed in internationally important numbers within the inner estuary on several occasions and the peak numbers of Bar-tailed Godwit, Black-tailed Godwit and Red-breasted Merganser all exceeded the threshold for a site of national importance.

3.3.30 As in the previous survey period the number of birds close to the embankment was relatively low throughout the winter of 2012-2013. A peak number of 60 birds were present within 100m of the railway embankment during the surveys of the inner estuary. The cumulative peak of birds recorded within 500m of the railway embankment was 242, observed on 1st January 2013 – representing 11% of the birds present within the entire inner estuary. Regularly recorded species within 500m of the embankment once again included several of the gull species and the diving ducks – Red Breasted Merganser and Great Crested Grebe. Brent Geese were observed moving to and from the grassland south of the inner estuary, close to the Yacht Club. On occasion, small flocks of Brent Geese were observed loafing on the water within 500m of the railway embankment.

OCTOBER 2013 TO MARCH 2014

3.3.31 Table 3.9 below lists the species recorded within the inner estuary and the peak count of each species observed between October 2013 and March 2014. The diversity of birds recorded was similar to previous winters with 41 species noted during counts of the inner estuary. The peak number of birds in the inner estuary was recorded earlier than in previous winters with a total of 3,749 birds present in the inner estuary in November 2013.

3.3.32 Light-bellied Brent Geese were observed in Internationally important numbers within the inner estuary from December to February (peak count 1,215 individuals) and the peak numbers of Black-tailed Godwit, Golden Plover and Red-breasted Merganser all exceeded the threshold for a site of national importance.

3.3.33 As in the previous survey period the number of birds close to the embankment was relatively low throughout the winter of 2012-2013. A peak number of 58 birds were present within 100m of the railway embankment during the surveys of the inner estuary. The total number of birds observed within 100m of the embankment on each survey occasion ranged from 6 to 58 individuals. The cumulative seasonal peak of birds recorded within 500m of the railway embankment was 168, observed in February 2014 – representing 6% of the birds present within the entire inner estuary on that survey occasion.

3.3.34 As in previous winter seasons, the bird species regularly recorded within 500m of the embankment once again included several of the gull species and the diving ducks – Red Breasted Merganser and Great Crested Grebe. The peak count of birds within 100 metres of the embankment was largely made up of a flock of Light-bellied Brent Geese (44 individuals) recorded on the water near the northern shore of the inner estuary.

Table 3.8 Peak Counts of Bird Species Recorded Within the Inner Estuary at Malahide, October 2012 to March 2013.

Species	Peak Count
Bar-tailed Godwit	233
Black-headed Gull	342
Black-tailed Godwit	431
Brent Goose	715
Buzzard	2
Common Gull	29
Cormorant	4
Curlew	14
Dunlin	201
Golden Plover	966
Goldeneye	27
Great Black-backed Gull	34
Great-crested Grebe	24
Greenshank	6
Grey Heron	12
Grey Plover	1
Gull species	20
Herring Gull	58
Hooded Crow	3
Knot	4
Lapwing	998
Lesser Black-backed Gull	6
Little Egret	4
Little Grebe	6
Mallard	51
Moorhen	3
Mute Swan	77
Oystercatcher	357
Red Kite	1
Red-breasted Merganser	63
Redshank	214
Ringed Plover	8
Ruff	2
Shag	8
Shelduck	21
Teal	22
Tufted duck	1
Turnstone	10
Wigeon	43

Table 3.9 Peak Counts of Bird Species Recorded Within the Inner Estuary at Malahide, October 2013 to March 2014.

Species	Peak Count
Bar-tailed Godwit	6
Black-headed Gull	930
Black-tailed Godwit	214
Brent Goose	1215
Buzzard	2
Common Gull	133
Cormorant	5
Curlew	38
Dunlin	20
Golden Plover	1800
Goldeneye	78
Great Black-backed Gull	10
Great Crested Grebe	43
Great Northern Diver	2
Greenshank	11
Grey Heron	11
Grey Plover	2
Herring Gull	67
Kingfisher	1
Knot	45
Lapwing	700
Lesser Black-backed Gull	5
Little Egret	4
Little Grebe	20
Mallard	65
Moorhen	8
Mute Swan	59
Oystercatcher	95
Pochard	2
Red Breasted Merganser	100
Redshank	52
Scaup	2
Shag	5
Shelduck	43
Shoveler	2
Snipe	4
Sparrowhawk	1
Teal	157
Turnstone	15
Whooper Swan	1
Wigeon	28

WINTER 2016/2017

3.3.36 Detailed bird surveys were carried out on behalf of Fingal County Council, covering the entire SPA across the winter of 2016/2017 (Lewis & Butler 2017). The survey utilised the I-WeBS subsite count sections and in total there were six High Water and three Low Water counts of the entire area. Subsites OUL17 and OUL18 closely equate to the inner estuary survey area counted by Mayes in 2010/2011 and Ecology Ireland in 2011/2012, 2012/2013 and 2013/2014.

3.3.37 OUL17 is the inner portion of the inner estuary between Seatown and Prospect Point and OUL18 is the largely subtidal section east of Prospect Point to the railway bridge.

3.3.38 Forty-two bird species were recorded in OUL17 around Seatown. There was a peak count of Light-bellied Brent Goose in this subsite in February 2017 (787 individuals), which exceeded the threshold for International Importance. The peak count of Black-tailed Godwit (557 birds) was in excess of the threshold for National Importance. Golden Plover was exclusively recorded in this subsite during the 2016/2017 winter surveys. The winter surveys highlighted the intertidal areas as important for a range of waterbird species, with 10 of the 14 SCI species of the SPA recorded foraging in these areas. The supra-tidal areas in this subsite are also important for a fairly wide range of waterbird species, consistent with the results of previous surveys at this site.

3.3.39 The OUL18 Prospect Point subsite also included the intertidal habitat of Cave's Marsh. In total 38 bird species were recorded in this subsite, including 12 of the 14 SCI species of the SPA. None of the birds were present in this area in internationally or nationally important numbers. Goldeneye were exclusively recorded in this subsite and Great Crested Grebe and Red-breasted Mergansers were most regularly recorded in this part of the survey area. The Cave's Marsh area was the part of this subsite which accounted for many of the records of roosting waders.

NOVEMBER 2017 TO APRIL 2018

3.3.40 Bird numbers and distributions at Malahide Estuary were monitored during the winter of 2017/2018. With the exception of Light-bellied Brent Geese and Black-tailed Godwit, which occurred in internationally and nationally important numbers respectively both in the inner and outer parts of the estuary, all other species showed concentrations in one or other section. Goldeneye, Red-breasted Merganser, Little Grebe and Great Crested Grebe occurred in significant numbers in the inner estuary.

3.3.41 The exposed intertidal areas at Seatown were the most important areas for feeding waders and the area also had by far the greatest concentration of roosting birds.

Outer Estuary Bird Data

3.3.42 The outer estuary is strongly tidal and is a preferred feeding area for many species including Oystercatcher, Curlew and Dunlin. It is a large area with a variety of feeding and roosting habitats. At the southern end of the estuary the area is dominated by the marina and along the southeastern shore by recreational use (e.g. dog walkers) from Malahide.

JULY 2011 TO MARCH 2012

3.3.43 Table 3.10 below shows the peak counts of bird species recorded (49 taxa, 45 species and 4 species groups) in the outer estuary between July 2011 and March 2012. The outer estuary held internationally important numbers of Brent Geese (988) and peak counts that exceeded the threshold of national importance for six additional species: Pintail, Red-breasted Merganser, Black-tailed Godwit, Shelduck, Oystercatcher and Redshank. Two further species had peak counts which closely approached the threshold for national importance – Curlew and Greenshank. Northeast of the vantage point, close to the Island Golf Club, there were frequently mixed flocks of roosting waders. Grey Herons and Little Egret also roosted nearby amongst the taller grasses.

OCTOBER 2012 TO MARCH 2013

3.3.44 Table 3.11 below displays the peak counts of the 49 bird taxa (48 species and one species group) recorded in the outer estuary between October 2012 and March 2013. The peak count of Brent Geese (944) was well in excess of the threshold for a site of international importance. Five species were observed in numbers of national importance: Redshank (419), Shelduck (268), Black-tailed Godwit (237), Cormorant (200) and Pintail (38). Both Curlew and Oystercatcher were also present in the outer estuary in good numbers throughout the winter period.

3.3.45 Two species recorded in the outer estuary had not been observed at the site in recent winters. Jack Snipe was recorded in the outer estuary on two consecutive visits on 21st February and 4th March 2013. A single Little Gull was present in the area on 2nd January 2013.

OCTOBER 2013 TO MARCH 2014

3.3.46 Table 3.12 below displays the peak counts of the 36 species recorded in the outer estuary between October 2013 and March 2014. The peak count of Brent Geese (835) was exceeded the threshold for International Importance. Four further species were observed in numbers of National importance: Bar-tailed Godwit (161), Shelduck (315), Oystercatcher (798) and Pintail (35).

Table 3.10 Peak and Median Counts for the Bird Species Recorded in the Outer Estuary, Malahide from July 2011 to March 2012.

Species	Peak Count	Median
Bar-tailed Godwit	71	14
Black-headed Gull	544	113
Black-tailed Godwit	171	49
Brent Goose	988	295
Common Gull	234	48
Common Sandpiper	1	0
Cormorant	42	13
Curlew	536	238
Dunlin	685	165
Godwit species	55	0
Golden Plover	412	17
Goldeneye	2	0
Great Black-backed Gull	45	13
Great-crested Grebe	5	0
Greenshank	18	7
Grey Heron	12	4
Grey Plover	28	3
Guillemot	1	0
Gull species	3	0
Herring Gull	57	38
Hooded Crow	14	6
Knot	51	0
Lapwing	509	8
Lesser Black-backed Gull	28	4
Little Egret	22	2
Little Grebe	6	0
Mallard	107	45
Mediterranean Gull	1	0
Mute Swan	1	0
Oystercatcher	1344	495
Pintail	39	1
Red-breasted Merganser	88	0
Redshank	427	194
Ring-Billed Gull	1	0
Ringed Plover	43	10
Sanderling	3	0
Sandwich Tern	88	0
Shag	14	0
Shelduck	327	113
Shoveler	8	0
Small Wader	2	0
Snipe	2	0
Sparrowhawk	1	0
Teal	49	1
Tern species	3	0
Tufted duck	48	0
Turnstone	55	27
Whimbrel	20	0
Wigeon	88	26

Table 3.11 Peak and Median Counts for the Bird Species Recorded in the Outer Estuary, Malahide from October 2012 to March 2013.

Species	Max	Median
Bar-tailed Godwit	54	7
Black-headed Gull	466	90
Black-tailed Godwit	237	49
Brent Goose	944	318
Common Gull	137	32
Cormorant	200	10
Curlew	397	214
Dunlin	268	113
Godwit species	80	1
Golden Plover	179	22
Goldeneye	5	0
Great Black-backed Gull	28	18
Great-crested Grebe	2	0
Greenshank	12	3
Grey Heron	16	5
Grey Plover	9	0
Gull species	2	0
Herring Gull	64	39
Hooded Crow	14	6
Iceland Gull	1	0
Jack Snipe	1	0
Knot	38	12
Lapwing	352	169
Lesser Black-backed Gull	21	6
Little Egret	7	2
Little Grebe	4	0
Little Gull	1	0
Mallard	88	34
Oystercatcher	512	368
Pintail	38	4
Red Kite	1	0
Red-breasted Merganser	23	4
Redshank	419	202
Red-Throated Diver	1	0
Ringed Plover	55	26
Sanderling	6	0
Sandwich Tern	5	0
Shag	10	0
Shelduck	268	148
Shoveler	4	0
Small Wader	6	0
Snipe	6	0
Sparrowhawk	1	0
Teal	42	8
Tufted duck	9	0
Turnstone	57	26
Water Rail	1	0
Whimbrel	30	0
Wigeon	93	49

Table 3.12 Peak and Median Counts for the Bird Species Recorded in the Outer Estuary, Malahide from October 2013 to March 2014.

Species	Max	Median
Bar-tailed Godwit	161	17
Black-headed Gull	225	70.5
Black-tailed Godwit	125	51
Brent Goose	835	491.5
Common Gull	92	50
Cormorant	13	3
Curlew	262	138
Dunlin	229	24.5
Golden Plover	41	41
Great Black-backed Gull	8	4
Great Crested Grebe	2	1
Great Northern Diver	1	1
Greenshank	2	2
Grey Heron	7	5
Grey Plover	4	2.5
Guillemot	1	1
Herring Gull	25	10.5
Hooded Crow	6	6
Knot	16	14.5
Lapwing	83	7
Lesser Black-backed Gull	5	3
Little Egret	2	2
Little Grebe	9	3.5
Mallard	80	27
Oystercatcher	798	450.5
Pintail	35	11
Red Breasted Merganser	17	8.5
Redshank	89	48
Ringed Plover	58	30
Shag	2	1
Shelduck	315	233.5
Shoveler	4	2.5
Sparrowhawk	1	1
Teal	248	88.5
Turnstone	23	21
Wigeon	161	56.5

WINTER 2016/2017

3.3.49 The outer estuary was counted as part of the winter 2016/2017 of the Malahide Estuary and surrounding lands (Lewis & Butler 2017). The estuarine survey area included outer estuary subsites (OUL26 & OUL28) beyond the areas counted by Mayes 2010/2011 and Ecology Ireland 2011-2014. The subsites OUL23, OUL24, OUL 25 and OUL50 closely approximate the areas of the outer estuary counted by Mayes and Ecology Ireland. OUL23 is approximately 23ha in size and lies in the northern part of the outer estuary and comprise sand to muddy sand and a relatively large area of saltmarsh. A total of 30 bird species were recorded in this area with 10 of the 14 SCI species of the SPA. The peak count of Light-bellied Brent Geese (654 birds) in December 2016 exceeded the threshold for international importance and peak counts of Shelduck (500) and Black-tailed Godwit (264) exceeded the threshold for national importance. This area of the estuary was important for a range of foraging species at low water e.g. Oystercatchers and occasionally Light-bellied Brent Geese. OUL24 (Burrow Strand) is c. 176ha with most of this area exposed at low water. It is the large intertidal area to the west of the Island. A total of 33 bird species were recorded in OUL24 including 12 of the 14 SCI species for the SPA. The peak count of Light-bellied Geese in this subsite (814 birds) exceeded the threshold for sites of international importance and five species Shelduck (231), Red-breasted Merganser (102), Grey Plover (40), Knot (431) and Dunlin (608) were recorded in nationally important numbers on at least one survey occasion. The peak counts of birds recorded roosting in this subsite is consistent with the earlier counts of OUL24 (Lewis & Butler 2017). OUL25 (Malahide Pt.) is c. 36ha in size and lies to the south of the Island in the outer estuary. The subsite comprises intertidal sand to muddy sand, with the tip of the island supporting an area of saltmarsh (Atlantic Salt Meadows). A total of 30 bird species was recorded in this subsite with 11 of the 14 SCI species of the SPA present. The peak monthly count of Oystercatchers exceeded the national threshold of importance in five of the monthly counts and the peak count of Knot in this area exceeded the national threshold in November 2016. The peak counts of Oystercatcher were all associated with roosting birds that were present at a well-known roost at the tip of the Island.

Greenway/Estuary Bird Survey (Winter 2017/2018)

3.3.50 Bird numbers and distributions at Malahide Estuary were monitored during the winter of 2017/2018 to provide up-to-date bird use data (see Figure 3.2, and Table 3.13 to Table 3.15 below).

3.3.51 In total, 13 low and high-tide counts were undertaken between November 2017 and April 2018 (six high-tide and seven low-tide counts). Separate totals were collected for the inner and outer parts of the estuary (to the west and east of the embankment respectively). Additionally, separate counts were collected for the area bordering the western edge of the embankment in three distance bands (100m, 101-300m and 301-500m).

3.3.52 The total number of waterbirds recorded ranged between 1,353 (high-tide count, 08/04/18) and 5,944 (high-tide count 11/02/18). High-tide counts were higher than low-tide counts in all months other than in April. In total, 42 waterbird species were recorded, including 18 species recorded during most counts (in at least 12 out of 13 counts). Light-bellied Brent Goose was recorded in numbers of international importance and a further 14 species were recorded in numbers of national importance (Table 3.13 below).

3.3.53 In total, 24 species were recorded within 500 metres of the embankment on the west side. Notable proportions of the inner estuary totals of several species were recorded at times, especially diving species such as Red-breasted Merganser (*Mergus serrator*), Little Grebe (*Tachybaptus ruficollis*) and Great Crested Grebe (*Podiceps cristatus*). Light-bellied Brent Geese and Oystercatchers (*Haematopus ostralegus*) were relatively numerous, especially within the weir area of the embankment. A wader roost was occasionally reported in the northeast corner of the inner estuary (see Table 3.14 and Table 3.15 below).

Birds Recorded in Terrestrial Fields at Kilcrea

3.3.54 Fields at Kilcrea corresponding to Sections E, F and G in Roe & Lovatt (2009) were resurveyed by walkover by a pair of ornithologists on five separate occasions from October to December 2011 (see Figure 3.3 below). These fields were included in baseline walkovers of the route options carried out between November 2013 and March 2014.

3.3.55 The fields traversed by the proposed route from south to north were named as E9, F1, G11, G1, G2, G8, G7, G6, and G5.

3.3.56 Roe & Lovatt, (2009) found a relatively low diversity of birds in E9 in winter 2008/09. A peak count of 350 Brent Geese was recorded across four survey visits between January and March 2009. On 16th November 2011 a peak of 92 Brent Geese were recorded in field E9, all of which were roosting in the middle of the large arable field. On that survey, the main concentration of Brent Geese (380) was observed roosting and feeding in a field approximately 750–1,000m west of the embankment. Red Kite, which were reintroduced at Newbridge Demesne in 2011, were observed overflying the fields west of E9 (E7 and E6) in November 2011. The terrestrial lands at Kilcrea were surveyed on nine occasions over the winter of 2016/2017 (Lewis & Butler 2017). These surveys did not record any Light-bellied Brent Geese using field E9 with repeated observations to the west in field E6 with single observations of birds foraging in fields E1 and E7 in March 2017. There were a number of sightings of Lapwing in field E9 in the winter of 2016/2017 with a peak count of 33 birds observed in December 2016 (*loc cit*).

3.3.57 Field F1 is rank grassland and areas of scrubby hedgerow adjoin the Pill River. This field adjoined by a variety of habitats was an area of relatively high species diversity in the 2009 survey and this result was mirrored in the 2011 walkover. Roe & Lovatt, (2009) recorded a mixture of ducks associated with the river (Teal, Wigeon and Mallard), songbirds such as Reed Bunting and Skylark. Kingfisher was recorded on the Pill in 2009 and once again along the Pill River in November and December 2011 and March 2014. In the recent survey of the terrestrial lands at Kilcrea only three of the waterbird SCIs for the SPA were recorded in this area: Shelduck, Black-tailed Godwit and Redshank. Peak counts occurring in field F1 for these species was relatively low: Shelduck (14), Black-tailed Godwit (19) and Redshank (5) and these species were infrequently present with Shelduck present on only one occasion, Black-tailed Godwit recorded on two occasions and Redshank present on four of the nine survey occasions. On occasion, numbers of Teal (peak count 50) and Wigeon (peak count 41) in field F1 were relatively high, associated with the River Pill and adjoining grassland.

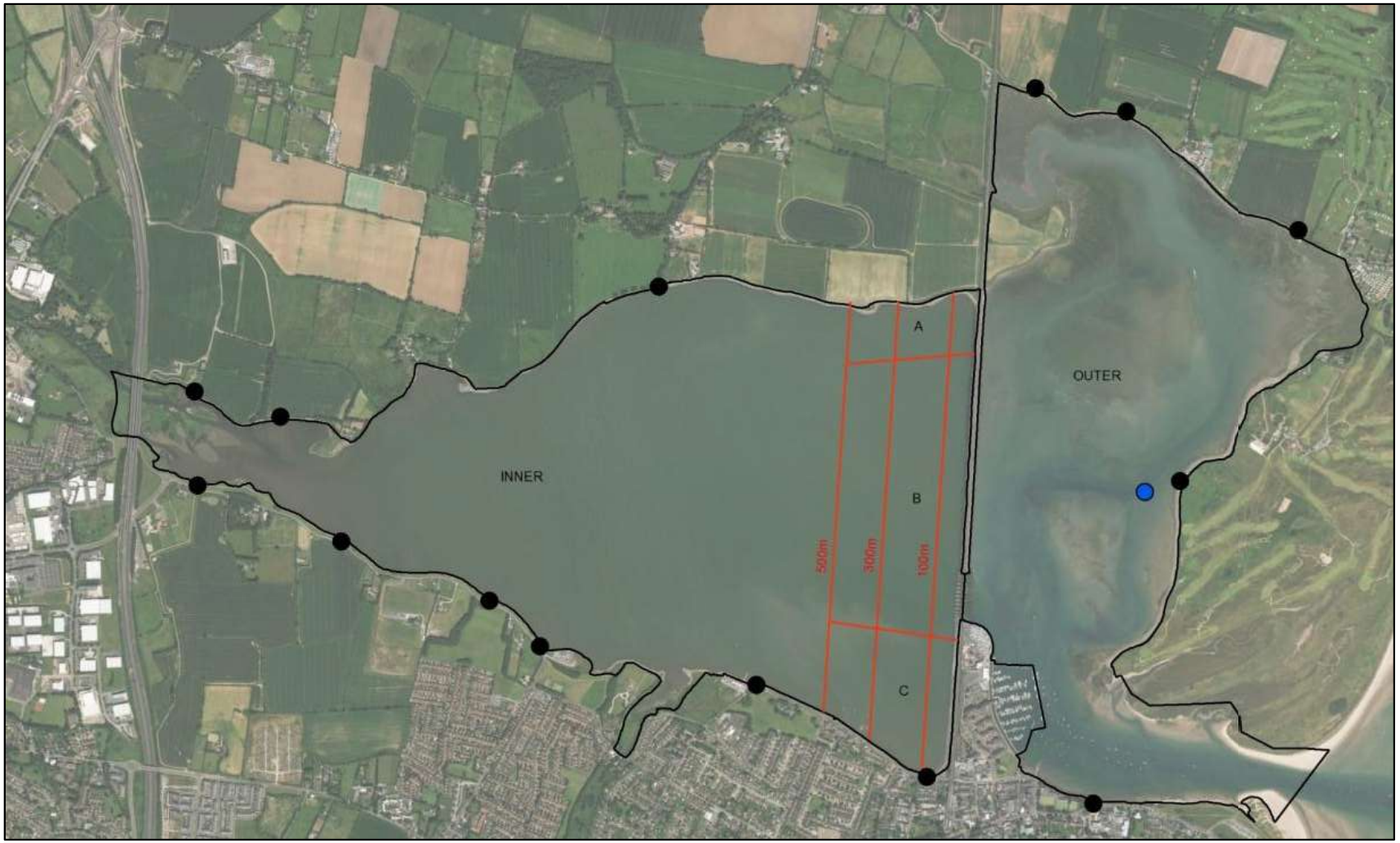

Figure 3.2. Coverage at Malahide Estuary, illustrating the two main count sections (inner and outer), the vantage points used (blue = low-tide surveys only), the three distance bands on the inner estuary (100m, 300m, 500m), and the divisions from north (A) to south (C). Note: The blue dot in this figure indicates a supplementary vantage point (VP) used at low tide but (obviously) not accessible at high tide. There were many LW and HW counts using the other VPs.

Table 3.13 **Peak count of each species recorded in the inner and outer sections of the estuary, and at high and low tide. The 1% thresholds for national (Crowe and Holt 2013) and international (Wetland International 2018) importance are also given.**

			INNER		OUTER	
	1%N	1%I	HT	LT	HT	LT
Mute Swan	90		72	78		
Light-bellied Brent Goose		400	550	879	505	399
Shelduck	120	3,000	17	22	614	458
Wigeon	630	15,000			119	103
Gadwall	20	600		2		
Teal	340	5,000	82	46	320	318
Mallard	290	20,000	85	96	22	61
Pintail	20	600	4		70	61
Shoveler	30	400			40	33
Goldeneye	60	11,500	88	119		
Red-breasted Merganser	20	1,700	33	51	16	10
Red-throated Diver	20	3,000				1
Little Grebe	20	4,000	58	30	4	15
Great Crested Grebe	40	3,500	32	40	2	2
Cormorant	120	1,200	8	86	21	17
Shag		2,000		1		5
Little Egret	20	1,300	3	2	3	5
Grey Heron	25	2,700	13	6	1	9
Moorhen		20,000	3	5		
Oystercatcher	690	8,200	383	98	1,480	806
Ringed Plover	100	730			12	77
Golden Plover	1,200	9,300	9		7	
Grey Plover	30	2,500	2	1	41	36
Lapwing	1,100	20,000	627	381	10	126
Knot	280	4,500	2	15	1,895	1,290
Dunlin	570	13,300	370	10	199	352
Snipe		20,000		6		
Black-tailed Godwit	190	610	469	163	259	412
Bar-tailed Godwit	150	1,200		37	149	66
Whimbrel		6,700			1	
Curlew	350	8,400	110	1	359	213
Greenshank	20	2,300	43	14	9	9
Redshank	300	3,900	112	95	125	194
Turnstone	95	1,400	41	20	39	5
Black-headed Gull		20,000	364	471	167	82
Ring-billed Gull		20,000	1		1	
Common Gull		16,400	34	81	140	8
Lesser Black-backed Gull		5,500	43	23	2	6
Herring Gull		10,200	154	207	167	67
Great Black-backed Gull		4,200	34	18	15	8
Sandwich Tern					32	1

The darker colour highlights when counts were in excess of the threshold for International Importance and the lighter colour highlights counts in excess of the threshold for sites of national importance.

Table 3.14 Total Counts of Each Species Recorded Within 500 metres of the Railway Embankment.

Species	20/11	12/12	17/12	29/12	10/01	18/01	26/01	11/02	23/02	09/03	22/03	11/04	18/04	Peak
Mute Swan		3	1					6	1		2	2		6
Light-bellied Brent Goose			4		16	7	19	116	36	25	53	15		116
Mallard				5	5	5	6	3	4	2	1			6
Goldeneye		2		2	4					6				6
Red-breasted Merganser		12	21	5	44	7	36		14	3	8	14		44
Little Grebe	11	14	1		10	3	11	2	4	1	3			14
Great Crested Grebe	4	2	6	5	19	18	27	1	2	22	3		2	27
Cormorant	7	86	4		3	2						1	1	86
Shag		1												1
Little Egret									1					1
Grey Heron										1	1	2		2
Oystercatcher		43	12		9	35	43	199	36	2	5	24		199
Lapwing					51	60								60
Dunlin						219	10	40						219
Black-tailed Godwit	9							28						28
Curlew						110			1					110
Greenshank					3	10	2		2		2			10
Redshank	30			1	22	16	53	10	4		2			53
Turnstone	3				2	2	20	12	2	3				20
Black-headed Gull	2	2	13	6	23	24	20	32	47	9	9	8	1	47
Common Gull		3			9	9	52	21	12	1				52
Lesser Black-backed Gull										2		7	7	7
Herring Gull		2		4	20	8	13	13	46	12	5	16	16	46
Great Black-backed Gull	1	3		2		3			7	4	1	1	6	7

Table 3.15 Peak count of each species within the three distance bands (100, 300, 500m) and in each section A to C, together with the sum of species peaks and a total species recorded. Refer to Figure 3.2 above for definition of these boundaries.

Species	A	B	C	100	300	500
Mute Swan	2		6	6	2	1
Light-bellied Brent Goose	115	41	4	45	10	115
Mallard	2		6	6	5	1
Goldeneye	6	4			2	6
Red-breasted Merganser	44	27	13	13	40	27
Little Grebe	3	14	9	14	2	4
Great Crested Grebe	22	16		14	8	16
Cormorant	86	4		86	1	1
Shag	1				1	
Little Egret			1	1		
Grey Heron	1	2		2		
Oystercatcher	35	185	4	189	5	28
Lapwing	60				60	
Dunlin	219			9	10	210
Black-tailed Godwit	28					28
Curlew	110	1		1		110
Greenshank	10		2	2	10	2
Redshank	52		2	24	22	30
Turnstone	20	3	12	10	10	3
Black-headed Gull	23	21	45	33	20	19
Common Gull	52	9	10	45	21	8
Lesser Black-backed Gull	7	5	2	7		5
Herring Gull	12	16	40	42	10	16
Great Black-backed Gull	3	2	5	5	4	3
Total	**913**	**350**	**161**	**554**	**243**	**633**
Total species	**23**	**15**	**15**	**20**	**19**	**20**

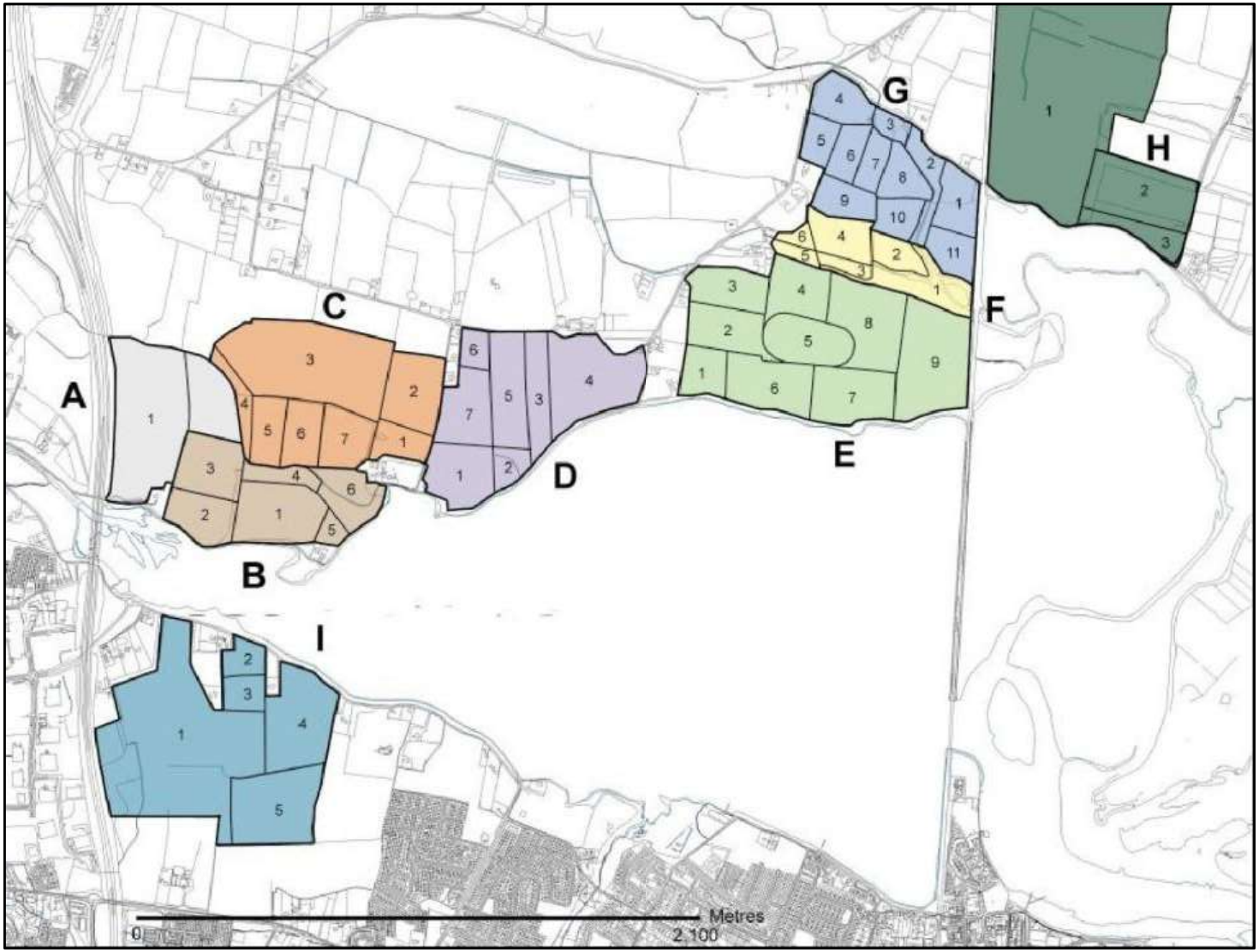

Figure 3.3. Colour coded map study sections for lands surrounding the Broadmeadow/Swords Estuary (Roe & Lovatt 2009).

3.3.58 Field G1 which is adjacent to the Pill had a peak of 1,600 Brent Geese in September 2009 (Roe & Lovatt, 2009) – but no Brent Geese were present in this field on two of the four (2009) survey visits. No Brent Geese were recorded in this field on five survey visits between October and December 2011 and the three walkovers between November 2013 and March 2014. Roe & Lovatt (2009) recorded Brent Geese in fields G7 and G8 but no Brent Geese were recorded in these fields in the surveys carried out between in 2011-2014. A notable difference between the results of the terrestrial survey in winter 2016/2017 (Lewis & Butler 2017) and Roe & Lovatt's earlier survey was the absence of Light-bellied Brent Geese in Section G (Kilcrea North). Indeed, only one of the SCI species of the SPA was recorded in these fields by Lewis & Butler (2017) with one sighting of 22 Redshank observed in G11. Only three waterbird species were recorded in G11, there was one observation of single Curlew recorded in field G1, three waterbird species recorded in low numbers in G2 and G8, one sighting of a Mallard in G7, there were low numbers of six waterbird species recorded in G6 and no waterbirds recorded in field G5. The diversity and abundance of waterbirds recorded in Section G was consistently low throughout the winter months.

3.3.59 Both Roe & Lovatt, (2009) and the 2013-14 survey recorded Brent Geese in several fields – particularly E2, E3, E8 and E9. Results of the 2016/2017 surveys indicated that Field E9 was not being used by Light-bellied Brent Goose (Lewis & Butler 2017).

3.3.60 Roe and Lovatt (2009) showed that the fields and amenity grassland all around the inner estuary are an important resource for a range of wildfowl and waders during the winter months. However, it also illustrated that, a few stand-out counts apart, that the fields along the route of the proposed greenway were not especially important or consistently used by a large proportion of the local population of any species. That result is consistent with the findings of the intensive field surveys carried out in the most recent winter season (Lewis & Butler 2017).

3.3.61 During the summer months the terrestrial lands hold many fewer species and individuals. Breeding Skylark and Linnet were noted and small numbers of passage waders were recorded. Typically, the birds present were common lowland farmland breeding birds. Tree Sparrows breed locally but did not occur along the route of the proposed greenway. Two Tree Sparrows were recorded during November 2011 along with a mixed finch flock of 250 Goldfinch and Linnet moving through fields west of the proposed greenway (Field E7).

Mammal Survey

3.3.62 A mammal survey at Malahide Demesne (Keeley 2006) recorded active Badger and Fox burrows and signs of Stoat (*Mustela erminea*), Rabbit, Rat/Mouse, Hedgehog (*Erinaceus europaeus*), and Grey Squirrel (*Sciurus carolinensis*). Bioblitz 2010 recorded Fox, Grey Squirrel, Brown Rat, Hare and Rabbit at Newbridge Demesne (www.biodiversityireland.ie).

3.3.63 During the walkover surveys of the embankment and at Kilcrea several mammal species were recorded, either directly or by tracks and signs. The vegetation on the west of the railway embankment is generally scrubby and dense and is relatively unmanaged.

3.3.64 Brown Rats (*Rattus norvegicus*) were frequently observed along the proposed route, both on the railway embankment and also in the fields and hedgerows at Kilcrea. Small mammal paths are common throughout and are especially obvious in the rank

grassland near the Pill River. Given the available habitats it is likely that several other small mammalian species, such as Field Mouse (*Apodemus sylvaticus*) and Pygmy Shrew (*Sorex minutus*), are widespread and locally common in the area. Fox (*Vulpes vulpes*) scat and scent was recorded at several locations in the fields at Kilcrea and two suspected dens were located in the narrow wooded glen several hundred metres west of the railway embankment at Kilcrea. In the same narrow wooded glen a number of active Badger setts were recorded. These setts were several hundred metres west of the railway embankment. An active Badger sett was recorded at the same location during terrestrial bird surveys in the winter of 2016/2017 (Lewis & Butler 2017). A Badger was recorded on a trail camera deployed near that location from 31st May to 8th June 2018.

3.3.65 Irish Hare were frequently observed in the stubble fields and recently resown tillage fields at Kilcrea.

3.3.66 Otter (*Lutra lutra*) spraints were recorded on three occasions, at the south of Malahide Inner Estuary west of Malahide Yacht Club. A sub-adult Otter was recorded swimming west towards Seatown along the southern shore of the estuary during a low-water estuary survey in September 2011. Several of the land drains at Kilcrea as well as the River Pill all have potential for Otter – the walkover of this area in October 2011 followed a flood event and this may have obscured any regular sprainting sites in these areas of suitable habitat. Spraint was recorded at the southern margin of the railway viaduct in March 2014 and an adult Otter was observed feeding just to the east of the viaduct in the outer estuary on the same survey occasion. Otters were observed on a number of occasions in the outer estuary (during bird surveys). Regular activity was recorded at the northeast of the railway embankment and may indicate the presence of a holt at that location. No holt was recorded on the west of the railway embankment.

3.3.67 Rabbit burrows and droppings were recorded along several field boundaries, particularly at the west of the study area. No burrows or droppings were noted along the route of the railway line. In fact, other than infrequent sightings of Brown Rat and fox scats along the railway embankment mammal activity was low. No Badger setts or fox dens were located on, or adjacent to, the proposed route of the proposed greenway. A dead Badger was recorded on the local road near the rail bridge at Kilcrea in December 2011.

3.3.68 Three trail cameras were deployed along the route of the proposed greenway from 31st May to 8th June 2018. One camera was deployed on Corballis Cottages Road from Bissets Strand close to the weir. The other two cameras were deployed on lands at Kilcrea. Very few images of wild mammals were captured. Several night-time shots of Badger were recorded from a camera close to the Pill River. The other cameras recorded a number of photos of domestic pets (cats and dogs).

3.3.69 Non-volant mammals recorded in the 10km grid square (O24) in which the proposed greenway will be located include Hedgehog, Irish Hare, Otter, Badger, Stoat, Rabbit, Grey Squirrel, Pygmy Shrew and Fox (www.biodiversityireland.ie).

Bat Survey

3.3.70 The weather on both active survey nights was mild and generally calm. Foraging bats were observed and recorded on both survey nights although species diversity was low. The route of the proposed greenway was walked and the lanes and local roads were driven (<15km/h) to develop a picture of the activity across the area. No bats were

recorded along the route of the proposed greenway or along the Pill River. A single record of Common Pipistrelle (*Pipistrellus pipistrellus*) was picked up on a secondary heterodyne detector by the rail bridge over the local road leading to the northwest of the outer estuary (5th October 2011). There were no records from the shore close to Bissets Strand which was visited on both survey occasions.

3.3.71 The most consistent and active area of bat activity was near Kilcrea Equestrian Centre. The roadway to the shore is tree-lined and there is a large old stone wall with good potential for roosting bats. *Post-hoc* analysis of the bat recordings taken on the nights of the 5th and 27th October 2011 confirmed the presence of two species, Common Pipistrelle and Soprano Pipistrelle (*Pipistrellus pygmaeus*). Near Kilcrea Equestrian Centre there was considerable social calling noted on both survey nights. Common Pipistrelle were especially active in this area and it is a suitable area for foraging and may also be close to a roost site. There have been records of Leisler's Bat (*Nyctalus leisleri*), Brown Long-eared Bat (*Plecotus auritus*) and Soprano Pipistrelle from this 10km square (www.biodiversityireland.ie). Mammal records collected from Newbridge Demesne in May 2010 (Bioblitz 2010; www.biodiversityireland.ie) included Leisler's Bat, and Soprano Pipistrelle. The habitats at both demesnes are attractive for a range of bat species. Given the habitats present it is likely that several bat species occur at both demesnes throughout year.

3.3.72 The results of a deployment of a passive bat detector (Wildlife Acoustics SM4) near the Pill River on lands at Kilcrea from 31st May to 8th June 2018 confirmed the presence of four bat species. *Post hoc* analysis identified Leisler's Bat, Soprano Pipistrelle, Common Pipistrelle and Daubenton's Bat (*Myotis daubentonii*). Leisler's Bat was the most frequently recorded bat at this location (171 registrations), followed by Soprano Pipistrelle (67 registrations) and Common Pipistrelle (44 registrations). There was only one confirmed registration of Daubenton's Bat from this location. Overall, the level of bat activity was relatively low and the pattern of activity was variable from night to night. There was no evidence of bimodal activity indicative of the presence of a nearby bat roost.

Existing Environment

Malahide Estuary

3.3.73 The proposed greenway travels from Malahide North toward Donabate running parallel to Dublin-Belfast railway line for much of its route. The railway line runs along an embankment which separates the inner Malahide Estuary from the outer Malahide Estuary. The inner estuary communicates with the outer estuary through a ~170m gap in the railway embankment coinciding with the railway viaduct. The tide moves in and out to the inner estuary at this point but the amount of exchange is controlled by a weir. The presence of the weir ensures that the inner estuary is largely covered with water at all times except in its very inner 'bottleneck' close to Seatown West, Swords. The Broad Meadow and Ward Rivers join just north of the village of Swords and discharge into the Broadmeadow Water.

3.3.74 As recently as 2014 the EPA has classified the lower reaches of both rivers as poor (i.e. with a Q-rating of Q2-3 and Q3 for the Broad Meadow and Ward respectively) (see paragraphs 3.3.85 to 3.3.88 below for further details of this classification system). Despite this, however, there is a salmon and sea trout run into the Ward River and a sea trout run into the Broad Meadow River and trout are fished in the estuary. In addition,

surveys in 2008 and 2010 by Inland Fisheries Ireland in the Broadmeadow Water have shown that high numbers of a small number of fish occur there including: sand gobies (*Pomatoschistus minutus*), thick-lipped grey mullet (*Chelon labrosus*), flounder (*Platichthys flesus*) and spratt (*Sprattus sprattus*). Less abundant species include, among others, eel, brown trout, roach, 3-spined stickleback and bass. There does not appear to be a current transitional water classification for this part of the estuary, although it was previously considered eutrophic. It was provisionally classified as good status by IFI in 2010 based on its fish community.

3.3.75 The outer Malahide Estuary, which is classified as a coastal water body under the WFD was classified as intermediate by the EPA for the 2010-2012 period (latest available), while just beyond this the open coast (denoted as the North West Irish Sea) is classified under the WFD as unpolluted.

3.3.76 The principal marine Annex I habitat is mud flats and sand flats uncovered at low tide. Within this broad category, five distinct habitats were identified. Four of these are located in the outer estuary, while the inner estuary, where the extent of the Annex I habitat is much more restricted, has just one habitat type. These habitats, their indicative areas and their locations are listed in Table 3.16.

Table 3.16 The marine habitats comprising Annex I habitat: mudflats and sand flats not covered at low tide in Malahide Estuary.

Benthic Habitat	Indicative Area (Ha)	Location
Sand to muddy sand with *Peringia ulvae*, *Tubificoides benedii* and *Cerastoderma edule* community complex	169	Outer Estuary
Fine sand with oligochaetes, amphipods, bivalves and polychaetes community complex	126	Outer Estuary
Estuarine sandy mud with Chironomidae and *Hediste diversicolor* community complex	7	Inner Estuary
Zostera-dominated community	5	Outer Estuary
Mytilus-dominated community complex	4	Outer Estuary

3.3.77 In addition to these soft sediment habitats which comprise the vast majority of the estuary's area the rock armour of railway embankment comprises a range of typical sheltered rocky-shore habitats dominated by lichens in the upper shore-supra littoral area with the main intertidal dominated by fucoid (brown) macroalgae, along with associated mollusc and crustacean intertidal fauna (Appendix 6-Plates 1 and 2).

3.3.78 In particular, the intertidal community present along the hard benthos of the maintenance track consists primarily of grey-green and yellow lichens present along the upper zone of the rock armouring. The upper-mid to low shore is dominated by green algae, primarily *Prasiola* sp., *Ulothrix* sp. and *Ursopora* sp. which forms thin coatings on the rock surface. Immediately at low water, a filamentous brown diatom, *Melosira* sp. dominates. A layer of the fucoid, *Fucus serratus*, is present below low water. Overall, faunal diversity along the rock armouring is low, with only barnacles present at the site. However, below the low water level at one site there was a large clump of mussels present (location co-ordinates: IO 22530 46627).

3.3.79 The hard benthos present along the existing northern arm of the embankment almost identical to that identified along the southern maintenance track. The tidal zonation and species present are the same.

3.3.80 The biotopes identified across the survey area consisted of Yellow and grey lichens on supralittoral rock (LR.FLR.Lic.YG); *Prasiola stipitata* on nitrate-enriched supralittoral or littoral fringe rock (LR.FLR.Lic.Pra) and *Fucus serratus* and large *Mytilus edulis* on variable salinity lower eulittoral rock (LR.LLR.FVS.FserVS). These biotopes were present along both the maintenance track and northern parts of the Malahide railway embankment. See Appendix 6 (A and B) for details of a submersive soft sediment survey at the location of the weir maintenance track prior to placement in September 2009.

3.3.81 At the refurbished weir beneath the railway viaduct the hard substrates of stone, concrete and rock armour provide anchorage for macroalgae and filter feeding blue mussels (*Mytilus edulis*), which benefit from the presence of strong tidal fluxes several times each day as water moves between the inner and outer parts of the SAC via these narrows.

Pill River – Kilcrea

3.3.82 At its northern end the proposed greenway traverses the lower reaches of the Pill River which is referred to as the Pill River further upstream. The lower kilometre of the Pill from at least the Donabate road bridge (Hearse Road) (at Irish Grid 322133 249415) to the Malahide Estuary outflow, appears to have a tidal influence. This is very clear for the lower 400-500m of Pill where aerial views show the tidally exposed muddy margins of the channel. However, aspects of the macroinvertebrate fauna collected as part of this and previous studies in the area also point to a saline influence in these lower sections.

3.3.83 There are no suitable spawning or nursery habitats for salmonids present in this stretch and while slob trout or sea trout might utilise the lower reaches, the limited extent of the channel would suggest that this is unlikely. Given the nature of the habitat and the proximity of extensive saltmarsh and associated creeks immediately beyond the railway embankment, there is a good possibility that smaller species such as common goby (*Pomatoschistus microps*) and sand goby (*P. minutus*) as well as juvenile flounder (*Platichthys flesus*) or possibly plaice (*Pleuronectes platessa*) would use the lower reaches. Other species such as juvenile thick-lipped grey mullet (*Chelon labrosus*) and to a lesser extent bass (*Dicentrarchus labrax*) might also be present occasionally in small numbers.

Field Survey

3.3.84 As part of the assessment a walk-over survey of the lower Pill River and the Malahide Estuary immediately adjoining the outflow from the Pill under the railway embankment was undertaken. The fieldwork also included taking replicate intertidal cores in the Malahide Estuary close to the Pill outflow in order to confirm the principal marine soft sediment habitat in the area. In addition, a kick sample for macroinvertebrates was carried out at the road bridge upstream (Irish Grid 322133 249415) in order to gauge the water quality of the watercourse. Finally, a survey of the habitats at the upstream crossing point of the Pill at (Irish Grid 322406 29100) was also undertaken.

Methods

Intertidal Cores in Malahide Estuary

3.3.85 Three replicate cores (10cm diameter cores) were taken to a depth of 30cm in the mid intertidal level in the mudflat immediately on the Malahide Estuary side of the Pill River outfall. The samples were taken to laboratory on the same day and the following

morning were passed through a 0.5mm sieve mesh, fixed in 4% buffered formalin. Samples were then processed by eye with all visible fauna being extracted and stored in 70% ethanol. These were identified to the lowest taxonomic level possible, using standard keys for the European marine invertebrate fauna.

3.3.86 A surface mud scoop taken at the same site as the cores was processed for grain-size. The samples were first dried, then a portion was treated with hydrogen peroxide to remove organic matter and then soaked in sodium hexametaphosphate before being dried and sieved through a series of sieves in order to determine the following grain sizes: <63µm (silt/clay fraction), 63-2000 µm (sand), >2000µm (gravel). These data are used along with the data from the fauna in the cores in order to classify the benthic soft sediment habitat/community present.

Invertebrate Sampling in the Pill River

3.3.87 A kick-sample for aquatic macroinvertebrates was taken immediately upstream of the Hearse Road bridge using a standard kick sampling method as follows: a two-minute moving kick-sample was undertaken in riffle-type habitat with a long-handled pond net (1mm mesh). The material collected was sieved through a 500µm sieve to remove fines and examined on the bankside in a white tray. Abundance categories were assigned using the EPA method and Q-ratings were calculated.

3.3.88 This biotic index is used by the EPA on all river surface water monitoring programmes and is based on interpreting collections of aquatic macroinvertebrates. The index assigns a score to the macroinvertebrate collection at a given site depending on the relative proportion of pollution sensitive and pollution-tolerant organisms present. The greater the number and diversity of pollution sensitive types present (particularly, certain mayflies, stoneflies and cased caddis flies) the higher the score or quality class assigned to a given site. The highest score category is Q5 which indicates pristine water quality conditions and is recognised by having a high proportion of pollution-sensitive species and very few if any pollution-tolerant forms, whereas Q1 at the other end of the scale indicates gross pollution. Table 3.17 lists the Q-value scores which can be assigned and the corresponding degree of pollution associated with each. This system, used in Ireland since the early 1970s, has been intercalibrated with comparable European systems and now forms one of the cornerstones of ecological status classification under the Water Framework Directive (WFD) in Ireland. Table 3.17 also includes the corresponding WFD Status for each Q-rating category.

Table 3.17 EPA Q-Ratings and Corresponding Pollution Status and Water Framework Directive Status.

Q-Rating	EPA Pollution Status	WDF Status
Q5	Unpolluted	High
Q4-5	Unpolluted	High
Q4	Unpolluted	Good
Q3-4	Slightly Polluted	Moderate
Q3	Moderately Polluted	Poor
<Q3	Moderately-Seriously Polluted	Bad

Results of Fieldwork

MALAHIDE ESTUARY

3.3.89 Results from the present coring exercise in Malahide Estuary indicates the presence of an upper estuarine biological community. Table 3.18 lists the infaunal species and numbers identified in each of the three replicate cores.

Table 3.18 Species – Abundance Matrix for the Three Replicates at a Single Location in Malahide.

Species	Replicate A	Replicate B	Replicate C
Scrobicularia plana	5	5	4
Hydrobia ulvae	1	0	1
Corophium volutator	1	11	6
Hediste diversicolor	5	7	4
Streblospio sp.	0	3	4
Oligochaetae spp.	201	274	168
Nemertea	Present	Present	Present

3.3.90 Sediment grain sized at the coring site comprised 86% mud, 14% sand and <1% gravel. The fauna present at the site are typical of the *Hediste diversicolor* and oligochaetes in littoral mud biotope classification of Connor *et al.* (2004). This biotope has been described as 'A species-poor community found in mud or slightly sandy mud in low salinity conditions, typically at the head of estuaries. The infauna is dominated by the ragworm *Hediste diversicolor* which is typically superabundant. Oligochaetes, including tubificids and *Heterochaeta costata*, can be abundant, as well as spionids. The peppery furrow shell *Scrobicularia plana* may be present in low abundances. The mud is often very soft and fluid, with a 'wet' surface appearance, or it may be compacted and form steep banks in the upper parts of macro-tidal estuaries and along saltmarsh creeks.'

3.3.91 This habitat is likely to be representative of the general soft sediment area immediately outside the tidal flap (Appendix 6–Plate 3) which controls the outlet of the Pill River (Appendix 6–Plate 4). This muddy intertidal area is fringed by saltmarsh in the supralittoral (Appendix 6)–Plate 5). In addition, localised areas of loose angular cobble in the upper shore are covered in brown seaweeds (including *Fucus ceranoides* and *Ascophyllum nodosum*). However, the thick veneer of muddy sediment over all hard substrates coupled with the upper estuarine location probably explains the general absence of encrusting faunas such as sponges and anemones on these substrates as well as absence of a range of molluscs and invertebrates one would expect to observe in sediment-free hard substrate intertidal habitats. This habitat, which is located outside the tidal flap which separated the SAC (on the outer side) from the inner Pill Estuary where the greenway will be constructed, is contiguous with the entire Annex I habitat complex which dominates the outer estuary, i.e. Mudflats and Sandflats not covered by seawater at Low Tide, which is just over 300ha in extent.

PILL RIVER

3.3.92 The macroinvertebrate results from the kick-sample taken at the road bridge on the Pill River are presented in Table 3.19.

Table 3.19 Results of Kick Sample on Pill River by Road Bridge.

	Quality Class	Road Bridge
CADDIS FLIES (Trichoptera)		
Limnephilidae	C	Frequent
F/W SHRIMPS (Crustacea)		
Gammarus sp.	C	Dominant
Asellus	D	Common
SNAILS (Mollusca)		
Planorbidae	C	Few
EPA Q Value		Q3 (Q2-3)

Abundance Categories: F = Few (1-5), C = Common (6-20), N=Numerous (21-50), D = Dominant (51-75), E = Excessive (>75%)

3.3.93 These results reveal a very impoverished invertebrate community with no sensitive mayfly or stone fly species and a very low diversity overall. This may point to a residual saline influence even at this point, a proposition supported by the very turbid nature of the water (Appendix 6–Plate 6). Samples taken on the same river farther downstream as part of a previous study (Conservation Services, 2010) also suggested a saline influence in this stream. While a Q-rating was assigned during the present survey, which indicates that the water is polluted in this case corresponding to Poor WFD Status, the fact that there may be a saline influence means that strictly speaking, the Q-rating system should not be used. Despite this, however, the data probably also points to impaired quality.

3.3.94 A further site on the Pill was examined at a point about 500m further downstream at where a footbridge on the proposed trackway will cross the channel, although no kick-samples were taken here. This site was about 4-5m wide and about 40-50cm deep with a silted angular cobble bed with softer margins to the channel. There was no evidence of in-channel or marginal macrophyte growth and the banks were earthen with gravel and overgrown. The in-channel habitat was a glide/run with some suggestion that the channel had been drained in the past (Appendix 6–Plate 7). The habitat was unsuitable for salmonids due to the absence of spawning or nursery areas, furthermore the water was also very turbid in this stretch.

Table 3.20 Pill River at Bridge on Hearse Road (Irish Grid 322133 249415).

Width (m)	~4-5m
Depth (cm)	25-40
Habitat Type	Glide Run and Run
Substrate	Cobble 5, Gravel/pebble 4
Flow	Moderate/swift and turbulent
Macrophyte	Plant free
Other observation	Water very turbid
Q Rating	Q2-3

Habitat Evaluation

MALAHIDE ESTUARY

3.3.95 The area of the Malahide Estuary into which the Pill River discharges contains mud-flats, tidal creeks and saltmarsh, all of which are within the Malahide Estuary SAC and all of which are therefore protected under the Habitats Directive. The designation of the site by the EPA as being intermediate in terms of its WFD status is consistent with the

presence of extensive areas of filamentous green algae in the intertidal areas during the summer-autumn period, indicating that the site is under a degree of nutrient pressure.

3.3.96 At the railway viaduct, where a 180m footbridge is proposed for the proposed greenway, the habitats principally are hard benthic in nature covered with macroalgae and associated with blue mussels taking advantage of the strong local water movements. These currents drop off rapidly in the inner estuary due to the presence of the weir that controls the level, whereas the outer estuary experiences much greater tidal currents. Of the habitats listed above only the mudflats and their associated marine habitats (Table 3.16 above) and saltmarsh areas fall within the conservation objectives of the site. Overall this site is of international importance.

PILL RIVER

3.3.97 This watercourse is a small tidally influenced stream with a very limited range of habitats and species which have likely been further depressed by impaired water quality. An improvement in water quality in the future might see an increase in invertebrate and aquatic plant diversity at the site. Despite its current shortcomings the site would be classified as of high local importance due to the semi-natural nature of some its habitats especially in its very lower reaches which are allowed to flood naturally. It is important to note that this section of the Pill River has no ecological designation and is entirely outside the Malahide Estuary SAC and separated from it by a large tidal flap.

4.0 NIS – Stage 1

4.1 Identification of Relevant European Sites

4.1.1 In order to screen for the necessity to carry out an AA, locations and boundaries of European sites were identified and reviewed using the National Parks and Wildlife Service (NPWS) online map viewer.[7] This analysis confirmed that there are 16 European sites which must be considered (refer to Table 4.1 and Figure 4.1). The list of sites considered is listed in Table 4.1 below.

4.1.2 Also presented in Table 4.1 are the qualifying interests relevant to each site; these are extracted from the conservation objective documents hosted on the NPWS webpage (www.npws.ie). Other sources of information included site synopses, Natura data forms, NPWS site boundary maps (http://webgis.npws.ie/npwsviewer/), and conservation objectives supporting documents (where available). These can all be downloaded from the NPWS webpage.

4.1.3 As noted, each European site is designated for a unique combination of qualifying interests/special conservation interests (as set out in Table 4.1). In each case site-specific conservation objectives are to be set for each European site. Where these have not been published for a given site there are instead generic conservation objectives. In either case the ultimate aim is to maintain habitats and species for which European sites are designated in favourable conservation status.

4.1.4 Following on from Table 4.1 the proposed development is considered for the potential to negatively impact on these European sites. Where sites are clearly outside of zone of influence of the proposed project these can be discounted from further consideration.

[7] www.npws.ie

Table 4.1 European Sites within the vicinity of proposed development site at Broadmeadow.

Site Name (Code)	Qualifying Interests/Special Conservation Interests	Minimum Distance from Proposed Development	Potentially Within Zone of Influence
Malahide Estuary SAC (000205)	Mudflats and sandflats not covered by seawater at low tide [1140] *Salicornia* and other annuals colonising mud and sand [1310] Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] Mediterranean salt meadows (*Juncetalia maritimi*) [1410] Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120] Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]	0km	Yes.
Malahide Estuary SPA (004025)	Great Crested Grebe (*Podiceps cristatus*) [A005] Light-bellied Brent Goose (*Branta bernicla hrota*) [A046] Shelduck (*Tadorna tadorna*) [A048] Pintail (*Anas acuta*) [A054] Goldeneye (*Bucephala clangula*) [A067] Red-breasted Merganser (*Mergus serrator*) [A069] Oystercatcher (*Haematopus ostralegus*) [A130] Golden Plover (*Pluvialis apricaria*) [A140] Grey Plover (*Pluvialis squatarola*) [A141] Knot (*Calidris canutus*) [A143] Dunlin (*Calidris alpina*) [A149] Black-tailed Godwit (*Limosa limosa*) [A156] Bar-tailed Godwit (*Limosa lapponica*) [A157] Redshank (*Tringa totanus*) [A162] Wetland and Waterbirds [A999]	0km	Yes.
Rockabill to Dalkey Island SAC (003000)	Reefs [1170] *Phocoena* (Harbour Porpoise) [1351]	9km	No. No direct connection. Indirect hydraulic connectivity remote.
Lambay Island SAC (000204)	Reefs [1170] Vegetated sea cliffs of the Atlantic and Baltic coasts [1230] *Halichoerus grypus* (Grey Seal) [1364] *Phoca vitulina* (Harbour Seal) [1365]	9km	No. No direct connection. Indirect hydraulic connectivity remote.

Site Name (Code)	Qualifying Interests/Special Conservation Interests	Minimum Distance from Proposed Development	Potentially Within Zone of Influence
Lambay Island SPA (004069)	Fulmar (*Fulmarus glacialis*) [A009] Cormorant (*Phalacrocorax carbo*) [A017] Shag (*Phalacrocorax aristotelis*) [A018] Greylag Goose (*Anser anser*) [A043] Lesser Black-backed Gull (*Larus fuscus*) [A183] Herring Gull (*Larus argentatus*) [A184] Kittiwake (*Rissa tridactyla*) [A188] Guillemot (*Uria aalge*) [A199] Razorbill (*Alca torda*) [A200] Puffin (*Fratercula arctica*) [A204]	9km	Yes. Site is relatively distant but there could potentially be indirect impacts on mobile species that may occur closer to the route of the Broadmeadow Way at certain times during the year.
Ireland's Eye SAC (002193)	Perennial vegetation of stony banks [1220] Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]	8km	No. No direct connection. Indirect hydraulic connectivity remote.
Ireland's Eye SPA (004117)	Cormorant (*Phalacrocorax carbo*) [A017] Herring Gull (*Larus argentatus*) [A184] Kittiwake (*Rissa tridactyla*) [A188] Guillemot (*Uria aalge*) [A199] Razorbill (*Alca torda*) [A200]	8km	Yes. Site is relatively distant but there could potentially be indirect impacts on mobile species that may occur closer to the route of the Broadmeadow Way at certain times during the year.
Rogerstown Estuary SAC (000208)	Estuaries [1130] Mudflats and sandflats not covered by seawater at low tide [1140] *Salicornia* and other annuals colonising mud and sand [1310] Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] Mediterranean salt meadows (*Juncetalia maritimi*) [1410] Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120] Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]	4.5km	No. No direct connection. Indirect hydraulic connectivity remote.
Rogerstown Estuary SPA (004015)	Greylag Goose (*Anser anser*) [A043] Light-bellied Brent Goose (*Branta bernicla hrota*) [A046] Shelduck (*Tadorna tadorna*) [A048] Shoveler (*Anas clypeata*) [A056] Oystercatcher (*Haematopus ostralegus*) [A130] Ringed Plover (*Charadrius hiaticula*) [A137]	4.5km	Yes. Site is relatively distant but there could potentially be indirect impacts on mobile species that may occur closer to the route of the Broadmeadow Way at certain times during the year.

Site Name (Code)	Qualifying Interests/Special Conservation Interests	Minimum Distance from Proposed Development	Potentially Within Zone of Influence
	Grey Plover (*Pluvialis squatarola*) [A141] Knot (*Calidris canutus*) [A143] Dunlin (*Calidris alpina*) [A149] Black-tailed Godwit (*Limosa limosa*) [A156] Redshank (*Tringa totanus*) [A162] Wetland and Waterbirds [A999]		
Howth Head Coast SAC (000202)	Vegetated sea cliffs of the Atlantic and Baltic coasts [1230] European dry heaths [4030]	10km	No. No direct connection. Indirect hydraulic connectivity remote.
Howth Head Coast SPA (004113)	Kittiwake (*Rissa tridactyla*) [A188]	10km	No. This is a relatively distant breeding colony for a species that is largely pelagic outside the breeding season. Species is very rarely recorded in the Malahide Estuary during any time of year. Feeds offshore.
Bull Island SAC (encompassed by North Dublin Bay SAC 000206)	Mudflats and sandflats not covered by seawater at low tide [1140] Annual vegetation of drift lines [1210] *Salicornia* and other annuals colonising mud and sand [1310] Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] Mediterranean salt meadows (*Juncetalia maritimi*) [1410] Embryonic shifting dunes [2110] Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120] Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130] Humid dune slacks [2190] *Petalophyllum ralfsii* (Petalwort) [1395]	8km	No. No direct connection. Indirect hydraulic connectivity remote.
Bull Island SPA (004006)	Light-bellied Brent Goose (*Branta bernicla hrota*) [A046] Shelduck (*Tadorna tadorna*) [A048] Teal (*Anas crecca*) [A052] Pintail (*Anas acuta*) [A054] Shoveler (*Anas clypeata*) [A056] Oystercatcher (*Haematopus ostralegus*) [A130]	8km	Yes. Site is relatively distant but there could potentially be indirect impacts on mobile species that may occur closer to the route of the Broadmeadow Way at certain times during the year.

Site Name (Code)	Qualifying Interests/Special Conservation Interests	Minimum Distance from Proposed Development	Potentially Within Zone of Influence
	Golden Plover (*Pluvialis apricaria*) [A140] Grey Plover (*Pluvialis squatarola*) [A141] Knot (*Calidris canutus*) [A143] Sanderling (*Calidris alba*) [A144] Dunlin (*Calidris alpina*) [A149] Black-tailed Godwit (*Limosa limosa*) [A156] Bar-tailed Godwit (*Limosa lapponica*) [A157] Curlew (*Numenius arquata*) [A160] Redshank (*Tringa totanus*) [A162] Turnstone (*Arenaria interpres*) [A169] Black-headed Gull (*Chroicocephalus ridibundus*) [A179] Wetland and Waterbirds [A999]		
Baldoyle Bay SAC (Baldoyle Bay pNHA/SAC) (000199)	Mudflats and sandflats not covered by seawater at low tide [1140] *Salicornia* and other annuals colonising mud and sand [1310] Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] Mediterranean salt meadows (*Juncetalia maritimi*) [1410]	4.5km	No. No direct connection. Indirect hydraulic connectivity remote.
Baldoyle Bay SPA (004016)	Light-bellied Brent Goose (*Branta bernicla hrota*) [A046] Shelduck (*Tadorna tadorna*) [A048] Ringed Plover (*Charadrius hiaticula*) [A137] Golden Plover (*Pluvialis apricaria*) [A140] Grey Plover (*Pluvialis squatarola*) [A141] Bar-tailed Godwit (*Limosa lapponica*) [A157] Wetland and Waterbirds [A999]	4.5km	Yes. Site is relatively distant but there could potentially be indirect impacts on mobile species that may occur closer to the route of the Broadmeadow Way at certain times during the year.
Skerries Islands SPA (004122)	Cormorant (*Phalacrocorax carbo*) [A017] Shag (*Phalacrocorax aristotelis*) [A018] Light-bellied Brent Goose (*Branta bernicla hrota*) [A046] Purple Sandpiper (*Calidris maritima*) [A148] Turnstone (*Arenaria interpres*) [A169] Herring Gull (*Larus argentatus*) [A184]	c. 13km	Yes. Site is relatively distant but there could potentially be indirect impacts on mobile species that may occur closer to the route of the Broadmeadow Way at certain times during the year.

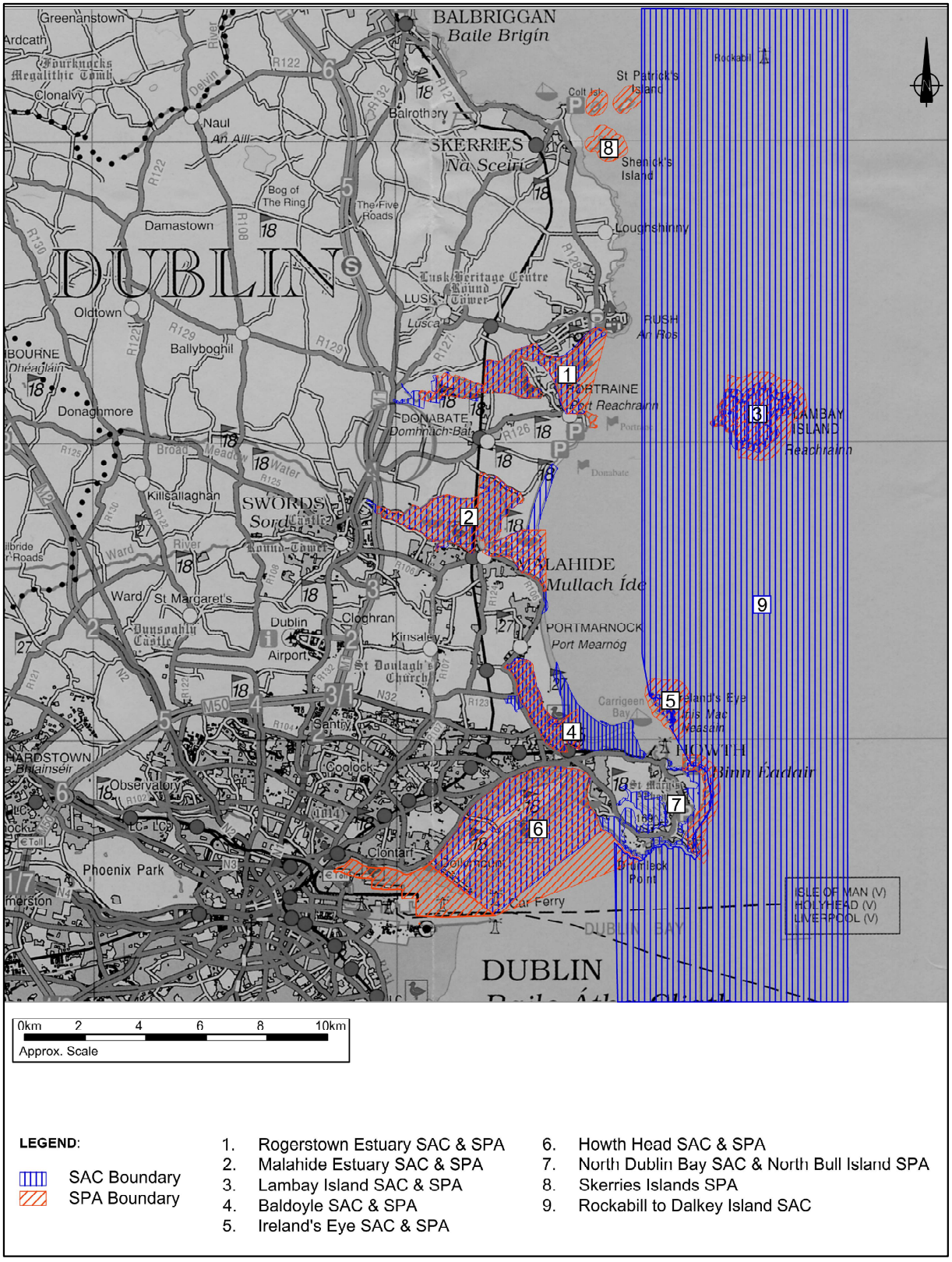

Figure 4.1. European Sites in the Wider Area.

4.2 Screening

4.2.1 Each European site was reviewed; location, distance to the proposed scheme, risk of direct/indirect impacts and the ecology of the relevant qualifying interests/special conservation interests were considered. In the case of bird species this includes consideration of season of occurrence; habitat preference; trophic group; diet and sensitivity to disturbance. In the case of, for example, intertidal waders, consideration is also given to the full tidal cycle; including high tide roosting and low tide foraging.

4.2.2 Note that both construction and operational impacts are considered when undertaking this exercise; however, for clarity, potential impacts are discussed together in the context of the project's full life cycle, with those directly relevant to a specific European site highlighted. However, broadly speaking in this instance construction impacts are more directly relevant to Malahide Estuary SAC, while operational impacts (e.g. disturbance) are more relevant to Malahide Estuary SPA.

4.2.3 The proposed development crosses two European sites, namely:

- Malahide Estuary SPA (004025)
- Malahide Estuary SAC (000205)

4.2.4 The proposed development runs across Malahide Estuary SAC on the railway embankment. As a result, the potential for negative effects on Malahide Estuary SAC and Malahide Estuary SPA cannot be entirely ruled out at this stage. As a result, these two sites are considered in more detail below in the context of their qualifying interests/special conservation interests.

4.2.5 There are a further six Special Areas of Conservation located within the vicinity of the proposed scheme. However, there is no physical overlap between the scheme and any of these sites. Nor is it predicted that there would be any indirect impact through, for example, deterioration in water quality, air quality due to the distance etc between the development and these sites. In the case of aquatic habitat conservation objectives in these SACs, which comprise Reefs (1170) or Mudflats and sandflats not covered at low tide (1140), although there is a hydrological connection, the nearest point between any of these SACs and the development is 7km, i.e. between the railway viaduct weir and Rogerstown Estuary, all the other SACs are at greater distances. Given that the only likely source of impact from the development would come from localised suspended solids generated during the construction period, and given the volume of intervening coastal water separating these sites, which will effect dilution, sedimentation and dispersion of any solids generated, it can be said with confidence that there will be no adverse interactions between the development and each of these SACs. These sites are as follows:

- Rockabill to Dalkey Island SAC (003000).
- Lambay Island SAC (000204).
- Ireland's Eye SAC (002193).
- Rogerstown Estuary SAC (000208).
- Howth Head Coast SAC (000202).
- Bull Island SAC (encompassed by North Dublin Bay SAC 000206).
- Baldoyle Bay SAC (Baldoyle Bay pNHA/SAC) (000199).

4.2.6 The above seven sites are therefore not considered further.

4.2.7 The sites remaining in consideration are all Special Protection Areas for birds. Of these remaining sites, four sites are marine/coastal in character, namely:

- Howth Head Coast SPA (004113): Kittiwake (breeding).
- Ireland's Eye SPA (004117): Cormorant, Herring Gull, Kittiwake, Guillemot, and Razorbill (all breeding).
- Lambay Island SPA (004069): Fulmar, Cormorant, Shag, Greylag Goose (wintering), Lesser Black-backed Gull, Herring Gull (breeding + wintering), Kittiwake, Guillemot, Razorbill, and Puffin (breeding, unless otherwise stated).
- Skerries Islands SPA (004122): Cormorant, Shag, Light-bellied Brent Goose, Purple Sandpiper, Turnstone, and Herring Gull.

4.2.8 As outlined in Table 4.1 a precautionary approach has been taken in terms of defining a potential zone of influence for the scheme on SPA sites that are located in the wider area. For many of the coastal SPAs there are a wide range of avian qualifying interests, some of which are highly mobile, and are likely to use resources at a range of coastal sites. This is particularly the case with wintering waterbirds and waders which have long been understood to utilise a range of feeding and roosting sites throughout the overwintering period (e.g. Erwin 1983). It is also the focus of an ongoing research project in Dublin Bay (Tierney *et al*. 2017) examining how waterbirds use the Dublin Port area and Dublin Bay overall, for roosting and foraging, by day and by night.

4.2.9 While species such as Fulmar, Shag, Guillemot, Razorbill and Puffin generally move offshore to feed; they certainly could also on occasion make use of inshore waters along the coast from Howth northwards to Malahide. However, the environs within which the proposed development is located is already served by existing walks, public beaches/parkland, busy roads and residential/commercial development. It is considered unlikely that the proposed scheme would disturb such species should they choose to enter Malahide Estuary to forage. However, the SPAs for which these species are qualifying interests also have conservation interests more likely to occur with some regularity in areas close to the Broadmeadow Way and a precautionary approach has been taken at screening stage to consider further potential impacts on these SPAs and their conservation objectives.

4.2.10 Both Herring Gull and Lesser Black-backed Gull are recorded in large numbers along the coast; both species avail of a mix of terrestrial, intertidal and coastal marine food resources; in addition, both make extensive use of human rubbish/wastes. As noted, the proposed development is largely based around an existing road and rail corridor in an area heavily used by people and by gulls. While Herring Gull is included on the red list of birds of conservation concern (Colhoun and Cummins, 2013), the proposed development will not affect their offshore nesting sites. No significant impact is predicted.

4.2.11 While sample size is admittedly small, a study assessing the movements and usage of a number of seabird species breeding on offshore islands (Rockabill, Lambay, Ireland's Eye and Dalkey Island) found no evidence of breeding Great Black-backed Gull; Herring Gull, Lesser Black-backed Gull, Shag or Kittiwake being dependant on the coastal estuaries (including Malahide Estuary) for foraging during the breeding season (Moss *et al*., 2016). Howth Head Coast SPA is located c. 10km from the route of Broadmeadow Way and is designated solely for the conservation of breeding Kittiwake. As outlined in Table 4.1 it

was concluded that there was negligible potential for impact on this breeding colony through construction or operation of the Broadmeadow Way. Kittiwakes breed on the steep sea cliffs at Howth and for much of the year are pelagic in distribution. Surveys of the estuary and coastal lands in the vicinity of the route of the Broadmeadow Way have shown that the species does not occur in the area with any regularity or in any numbers. Kittiwakes generally feed offshore and it is not surprising that the species is not typically recorded in Malahide Estuary. Given the ecology of the species and the nature and location of the proposed development c. 10km from the breeding colony it was concluded that impacts on Howth Head Coast SPA could be screened out.

4.2.12 Greylag Geese (of Icelandic, not feral origin) occur in North Dublin in Rogerstown Estuary, Skerries and on Lambay Island (Boland and Crowe, 2012). Birds from Rogerstown are believed to use Lambay as a secure roost site. There is some potential for the species to occur, e.g. in the fields around the estuary; however, Greylag Geese were very infrequently recorded in the area in the intensive surveys carried out at the site over the past decade.

4.2.13 Cormorant nest both on Ireland's Eye and Lambay Island. Lambay Island historically supported up to 98% of the east coast breeding Cormorant (in the period 1985-1988); by 2011 this was down to 21% of birds known to breed on the east coast. However, at the same time numbers have been increasing along the east coast as a whole (e.g. on Ireland's Eye and St. Patrick's Island) and new colonies have formed (e.g. at Bray Head). The number of 'apparently occupied nests' at Ireland's Eye rose from 19 to 306 in the period 1985/88 according to Seabird 2000; this had risen to 478 'apparently occupied nests' in 2010 (NPWS survey) and 417 in 2011 (all from Tierney *et al*., 2011). Thus, while there would appear to be issues specific to nesting birds on Lambay Island, the conservation status of Cormorant along the Dublin coast as a whole appears positive.

4.2.14 The mean foraging range of Cormorant from their breeding colonies is 8.5km, with a mean maximum of 32km and a maximum of 50km (Thaxter *et al*. 2012). Therefore, the inshore waters at Malahide Estuary are within the potential foraging range of the SPA population. In winter, Cormorants regularly occur within Malahide Estuary, but it is not known to what extent, if any, Cormorants use these areas in the summer. In a study of Cormorant diet at several Irish coastal breeding colonies, West *et al*. (1975) found that birds at the Lambay Island, Mattle and Little Saltee colonies were taking fish species associated with estuarine habitats. At Mattle and Little Saltee, wrasse predominated (77% and 85% of the diet by weight, respectively) indicating that the birds were mainly feeding in marine habitats. However, West *et al*. (1975) considered that, due to the absence of wrasse from their diet, the Lambay Island birds were mainly feeding in the estuaries at Rush and Malahide rather than in the marine waters around Lambay Island. However, birds from the Keeragh Island colony appeared to be feeding exclusively on marine fish, despite Keeragh Island being closer to estuarine habitat compared to the Little Saltee. The diet of Cormorants from two other breeding colonies (Great Saltee and Roaninish) was studied by Tierney *et al*. (2011). Again, wrasse predominated forming 65-70% of the diet by item, but some flatfish were taken indicating some foraging in estuarine habitats.

4.2.15 Overall, therefore, the available evidence from both the typical foraging range and diets of breeding Cormorants indicates that inshore waters at Malahide as well as waters along the coast provide potential foraging habitat for the SPA Cormorant populations. That said, as noted above these areas are already heavily developed and prone to substantial human disturbance. Cormorant appear to be very tolerant of human

presence; feeding actively even in ports, along urban rivers etc. There will be no direct impact on nesting sites from the proposed scheme; it would also seem highly unlikely that the proposed scheme would impact more generally upon this population, which as noted continues to grow in these heavily developed/used coastal waters.

4.2.16 The SPAs not yet considered are all estuarine in character and are dominated by intertidal mudflats.

- Rogerstown Estuary SPA (004015): Greylag Goose, Light-bellied Brent Goose, Shelduck, Shoveler, Oystercatcher, Ringed Plover, Grey Plover, Knot, Dunlin, Black-tailed Godwit, Redshank (wintering).
- North Bull Island SPA (004006): Light-bellied Brent Goose, Shelduck, Teal, Pintail, Shoveler, Oystercatcher, Golden Plover, Grey Plover, Knot, Sanderling, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Redshank, Turnstone and Black- headed Gull (wintering).
- Baldoyle Bay SPA (004016): Light-bellied Brent Goose, Shelduck, Ringed Plover, Golden Plover, Grey Plover, Bar-tailed Godwit, and Wetland and Waterbirds.

4.2.17 In all three cases there is no physical overlap or loss of habitat. There is therefore no impact from loss of the special conservation interest habitat (Wetland and Waterbirds [A999]) and this is not considered in detail in the NIS.

4.2.18 Rogerstown Estuary is located to the north just over 3km north of Malahide Estuary. Like Malahide it runs west to east and is partially enclosed by the dune complex known as the Burrow, north of Portrane. Like Malahide it is also crossed by the Dublin–Belfast railway line. As noted, Greylag Geese use the site roost at Lambay (Boland and Crowe, 2012). Otherwise the site is dominated by intertidal waders and wildfowl, though Light-bellied Brent Goose, Black-tailed Godwit and Oystercatcher are known to feed in fields surrounding the estuary to varying degrees.

4.2.19 North Bull Island SPA runs southwards from Sutton/Howth Head to Dollymount; it includes a large area of intertidal habitats and the North Bull Island. It is designated for a diverse array of intertidal waders and wildfowl. North Bull Island SPA is some 7.5km from Malahide Estuary.

4.2.20 Baldoyle Bay SPA is located to the north and east of Baldoyle and to the south of Portmarnock, Co. Dublin. The bay comprises a relatively small, narrow estuary separated from the open sea by a large sand dune system. Baldoyle Bay SPA is of high conservation importance, with an internationally important population of Light-bellied Brent Geese and nationally important populations of a further seven species, including two which are listed on Annex I of the EU Birds Directive (Golden Plover and Bar-tailed Godwit). The inner estuarine section is a Statutory Nature Reserve and is also designated as a wetland of international importance under the Ramsar Convention.

4.2.21 The possibility of movement of waders and wildfowl between sites such as Rogerstown Estuary SPA, Malahide Estuary SPA, North Bull Island SPA and Baldoyle Bay SPA cannot be discounted. Linkages between North Bull Island SPA, Baldoyle Bay SPA, Malahide Bay SPA and Rogerstown Estuary SPA are currently poorly understood; although they do share many of the same species (see Table 4.1, which presents a summary of the special conservation interests of all coastal SPAs close to the proposed scheme).

4.2.22 A preliminary tagging study on Brent Geese in 2017 showed that the Brent Geese move between North Bull Island, Baldoyle Bay and Malahide Estuary. This study is to be further expanded over the next four years to explore these links in more detail (H. Visser pers. comm.).

4.2.23 A three-year monitoring programme to identify key feeding and roosting areas is currently being undertaken by BirdWatch Ireland in partnership with Dublin Port and studies of the movements of colour-ringed birds will allow a better understanding of the ecological requirements of the birds using Dublin Bay (Tierney *et al*. 2017).[8] The colour ringing element of this project is focusing on Oystercatcher, Redshank and Bar-tailed Godwit; in time this will add to the understanding of how birds use the coastal estuaries such as Dublin Bay, Baldoyle Bay, Malahide Estuary and Rogerstown Estuary.

4.2.24 In addition, BirdWatch Ireland have been undertaking a project on the use of radio-tracking to follow movements of wintering waterbirds in Dublin Bay; this has focused on tracking small numbers of the target wading bird species. The diurnal and nocturnal distribution of the radio-tracked individuals has been reported in Tierney *et al*. (2017). Oystercatchers remained site faithful showing very local movements between foraging and roosting sites. Redshank were a little more mobile, but the movements were also relatively localised. Bar-tailed Godwits moved widely between a number of feeding and roosting locations.

4.3 Concluding Screening Statement

4.3.1 The proposed development crosses Malahide Estuary SAC (000205). The potential for impacts on this European site cannot be discounted; it is therefore considered further in the Stage 2 Natura Impact Statement presented below.

4.3.2 The proposed development also crosses Malahide Estuary SPA (004025). The potential for impacts on this European site cannot be discounted; it is therefore considered further in the Stage 2 NIS presented below.

4.3.3 A precautionary approach has been taken in assessing the potential for impact on SPAs in the wider area. For the sites screened in, some of the avian special conservation interests are known to be mobile and may use a range of coastal sites throughout the year. For instance, Light-bellied Brent Geese are a special conservation interest of Malahide Estuary SPA as well as Rogerstown Estuary SPA, Bull Island SPA, Baldoyle Bay SPA and Skerries Islands SPA. This species is highly mobile and occurs at the coastal SPAs, foraging in parks and amenity grassland throughout the greater Dublin area. Given the distances to the SPAs in the wider area there is negligible potential for any direct impact on the SPAS other than Malahide Estuary SPA. However, there is some potential for impact on these sites as the avian special conservation interests (SCIs) for these sites may occasionally occur locally and any significant change in the foraging and roosting resource of areas close to the route of the Broadmeadow Way could have wider impacts on these species and the conservation objectives of the local SPA network. The SPAs screened in and considered further in the NIS are thus: Malahide Estuary SPA, Lambay Is. SPA, Ireland's Eye SPA, Rogerstown Estuary SPA, Bull Island SPA, Baldoyle Bay SPA, Skerries Islands SPA.

[8] See for example http://dublinbaybirds.blogspot.com.

5.0 NIS – Stage 2

5.1 Introduction

5.1.1 The proposed development in part crosses the Malahide Estuary SAC and Malahide Estuary SPA on the western side of the existing railway causeway and at Bissets Strand. Works to ensure the safety of the railway were carried out to the embankments and weir by Irish Rail between 2002 and 2012. The proposed development is situated on top of the western railway embankment and related structures. The railway causeway lies largely outside both the SAC and SPA (see Figure 1.1 to Figure 1.6 above and Design Drawings 12-160-256 to 12-160-260 in Appendix 1). The greenway on the western embankment of the southern arm of the causeway lies within the SAC and SPA. The greenway crosses the SAC/SPA at the weir. The greenway on the western embankment on the northern arm of the causeway lies largely outside the SAC and SPA. The grass roadside margin at Bissets Strand lies partially within the SAC and adjacent to the SPA. Taking a precautionary approach, for the purpose of assessment, it is presumed that the proposed development lies within the Malahide Estuary SAC and SPA in its entirety in that part which follows the railway causeway across the estuary. This is because there is aerial and hydraulic continuity across the causeway from the inner estuary to the outer estuary and *vice versa*.

5.1.2 Elsewhere there is a small overlap between the proposed development and the Malahide Estuary SAC (but not the Malahide Estuary SPA) at Bissets Strand. The habitat at this location is a strip of amenity grassland; a habitat which does not correspond to any of the qualifying interest habitats of the Malahide Estuary SAC. Additionally a culvert will be provided to facilitate an existing drainage ditch that will be culverted under the proposed extended rock armour on the northern site of the estuary, within the Malahide Estuary SAC and Malahide Estuary SPA. The hedgebank habitat at this location does not correspond to any of the qualifying interest habitats of the Malahide Estuary SAC.

5.1.3 Therefore, the zone of potential influence is taken broadly as the Malahide SAC area, the Malahide SPA area and adjacent relevant coastal and estuarine SPAs on the east coast.

5.2 Malahide Estuary SAC and SPA

5.2.1 Malahide Estuary is designated as part of the Malahide Estuary SPA (Site Code 004025) and Malahide Estuary SAC (Site Code 000205). The areas subject to these designations are shown in Figure 1.5 to Figure 1.6 and currently extend to approximately 765ha for the SPA and 810ha for the SAC. Both site boundaries are contiguous with the Irish Sea. The conservation objectives for Malahide Estuary were updated in August 2013 (www.npws.ie). Malahide SPA and Malahide SAC encompass the inner estuary, an artificial coastal habitat with a restricted tidal range on the western side of the railway viaduct and embankment, and the outer estuary to the east of the railway, together with areas of salt meadow and sand dune habitat on Malahide Point, and an area of shallow coastal water.

5.2.2 The outer estuary is mostly cut off from the sea by a large sand spit, known as "the island". The outer estuary drains almost completely at low tide, exposing sand and mudflats. Much of the interior of the spit is taken up by golf courses (The Island and Corballis courses), though there are a number of rough areas and slacks. The inner stony shore of the spit has frequent Sea-holly (*Eryngium maritimum*). Well-developed

saltmarshes occur at the tip of the spit. The inner estuary does not drain at low tide apart from the extreme westerly part at Seatown.

5.2.3 The conservation objectives of Malahide Estuary SPA were published in August 2013 (see Appendix 2). The special conservation interests for Malahide Estuary SPA are:

- A005 Great Crested Grebe (*Podiceps cristatus*).
- A046 Brent Goose (*Branta bernicla hrota*).
- A048 Shelduck (*Tadorna tadorna*).
- A054 Pintail (*Anas acuta*).
- A067 Goldeneye (*Bucephala clangula*).
- A069 Red-breasted (Merganser *Mergus serrator*).
- A130 Oystercatcher (*Haematopus ostralegus*).
- A140 Golden Plover (*Pluvialis apricaria*).
- A141 Grey Plover (*Pluvialis squatarola*).
- A143 Knot (*Calidris canutus*).
- A149 Dunlin (*Calidris alpina alpina*).
- A156 Black-tailed Godwit (*Limosa limosa*).
- A157 Bar-tailed Godwit (*Limosa lapponica*).
- A162 Redshank (*Tringa totanus*).
- A999 Wetlands.

5.2.4 The conservation objectives for Malahide Estuary SAC were published in May 2013 (www.npws.ie) (see Appendix 3). The qualifying interests for Malahide Estuary SAC are:

- Mudflats and sandflats not covered by seawater at low tide [1140].
- *Salicornia* and other annuals colonising mud and sand [1310].
- *Spartina* swards (*Spartinion maritimae*) [1320].
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330].
- Mediterranean salt meadows (*Juncetalia maritimi*) [1410].
- Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120].
- Fixed coastal dunes with herbaceous vegetation (grey dunes)* [2130].

(* indicates a priority habitat under the Habitats Directive).

5.3 Other SPA Sites

5.3.1 As well Malahide Estuary SPA, a number of additional SPA sites, which could potentially be directly impacted by the development and operation of Broadmeadow Way, have been screened in. These include: Lambay Island SPA, Ireland's Eye SPA, Rogerstown Estuary SPA, Bull Island SPA, Baldoyle Bay SPA, and Skerries Islands SPA. The avian qualifying interests of Malahide Estuary SPA and these other sites in the wider hinterland are summarised in Table 5.1.

5.3.2 The special conservation interests of the SPA sites in the wider area include breeding and wintering species. These sites are located over 4.5km from the Broadmeadow Way, with Skerries Islands SPA located at c. 13km distance. As discussed in the screening report, these sites have been screened in due to a number of highly mobile bird species that are among the special conservation interests of these coastal SPAs.

5.3.3 The risk of direct impacts on these relatively distant SPA sites is negligible. The qualifying interests of the most proximate of these SPA sites (Lambay Island SPA) in the wider hinterland of the proposed Broadmeadow Way are:

- Greylag Goose (*Anser anser*) [A043]
- Light-bellied Brent Goose (*Branta bernicla hrota*) [A046]
- Shelduck (*Tadorna tadorna*) [A048]
- Shoveler (*Anas clypeata*) [A056]
- Oystercatcher (*Haematopus ostralegus*) [A130]
- Ringed Plover (*Charadrius hiaticula*) [A137]
- Grey Plover (*Pluvialis squatarola*) [A141]
- Knot (*Calidris canutus*) [A143]
- Dunlin (*Calidris alpina*) [A149]
- Black-tailed Godwit (*Limosa limosa*) [A156]
- Redshank (*Tringa totanus*) [A162]
- Wetland and Waterbirds [A999]

5.3.4 For mobile qualifying interests such as Light-bellied Brent Geese they may range between various coastal wintering sites and adjoining grassland foraging sites. Therefore, as a precautionary approach the local SPA sites with SCIs that occur in the vicinity of the Broadmeadow Way are included in this NIS. In practice, if it can be concluded that there will be no adverse impacts on the local SPA and its SCIs (Malahide Estuary SPA) it will also preserve the resource value for the mobile species which may occur in the area from time to time. Many of the key species of Malahide Estuary SPA are also qualifying interests of the other SPA sites under consideration e.g. Light-bellied Brent Geese.

5.3.5 The movement and site usage of many of the waterbird species that are qualifying interests of the SPA sites in the wider area is not fully understood (Tierney *et al*. 2017). It is assumed that some birds move widely between coastal sites and utilise a range of foraging and roosting sites. Therefore, the potential for impact on SCI species not listed for Malahide Estuary SPA but which are key qualifying interests of the other SPA sites in the wider area are considered in this SPA. Three of the SCIs are particular to Malahide Estuary: Red Breasted Merganser, Great Crested Grebe and Goldeneye and there are a further 11 SCIs of Malahide Estuary that are also qualifying interests of at least one other of the SPAs in the wider area. In addition, 12 species not qualifying interests of Malahide Estuary SPA are SCIs of the SPA sites in the hinterland area, namely:

- Cormorant (*Phalocrocorax carbo*).
- Shag (*Phalocrocorax aristotelis*).
- Greylag Goose (*Anser anser*).
- Teal (*Anas crecca*).
- Shoveler (*Anas clypeata*).
- Ringed Plover (*Charadrius hiaticula*).
- Sanderling (*Calidris alba*).
- Curlew (*Numenius arquata*).
- Turnstone (*Arenaria interpres*).
- Black-headed Gull (*Chroicocephalus ridibundus*).
- Purple Sandpiper (*Calidris maritima*).
- Herring Gull (*Larus argentatus*).

5.3.6 The avian conservation interests of each of the SPA sites and the seasonal phase for which each of the species is designated is summarised in Table 5.2. For the majority of the species they are present either exclusively in the winter months or only in important numbers during the winter period. For three of the SPA sites the primary importance is

concentration of breeding seabirds: Ireland's Eye SPA, Lambay Island SPA and Skerries Islands SPA. Ireland's Eye SPA and Skerries Island SPA are important breeding and wintering sites for Cormorant. Razorbill is present on Ireland's Eye SPA in important numbers in the breeding and winter season. Herring Gulls are present on Skerries Island year-round in similar numbers with c. 250 breeding pairs present. The three SPA sites closest to the proposed route of Broadmeadow Way are designated solely for the wintering populations of the avian conservation interests: Malahide Estuary SPA, Rogerstown Estuary SPA, and Baldoyle Bay SPA. North Bull Island SPA is also only designated for the conservation of overwintering bird species.

Table 5.1 Review of the special conservation interests of Dublin coastal SPAs within the zone of influence of the proposed scheme.

Qualifying Interests	Baldoyle Bay SPA	Malahide Estuary SPA	Rogerstown Estuary SPA	North Bull Island SPA	Lambay Island SPA	Ireland's Eye SPA	Skerries Islands SPA	Bull Island SPA
Cormorant					✓	✓	✓	
Shag							✓	
Great Crested Grebe		✓						
Greylag Goose			✓		✓			
Light-bellied Brent Goose	✓	✓	✓	✓			✓	✓
Shelduck	✓	✓	✓	✓				✓
Teal				✓				✓
Pintail		✓		✓				✓
Shoveler			✓	✓				✓
Goldeneye		✓						
Red-breasted Merganser		✓						
Oystercatcher		✓	✓	✓				✓
Ringed Plover	✓		✓					
Golden Plover	✓	✓		✓				✓
Grey Plover	✓	✓	✓	✓				✓
Knot		✓	✓	✓				✓
Sanderling				✓				✓
Dunlin		✓	✓					✓
Black-tailed Godwit		✓	✓	✓				✓
Bar-tailed Godwit	✓	✓		✓				✓
Curlew								✓
Redshank		✓	✓	✓				✓
Turnstone				✓			✓	✓
Black-headed Gull				✓				✓
Purple Sandpiper							✓	
Herring Gull							✓	

Table 5.2 Details of SCIs and Conservation Objectives of SPAs in potential zone of influence. Note: W – indicates that the particular species is designated for its wintering numbers, B – for the breeding population; and B&W designated for the presence of breeding and wintering birds.

Site Name	Distance from Broadmeadow Way (km)	Avian SCIs	Specific Conservation Objectives
Malahide Estuary SPA (004025)	0	Great Crested Grebe[W] (*Podiceps cristatus*) [A005] Light-bellied Brent Goose[W] (*Branta bernicla hrota*) [A046] Shelduck[W] (*Tadorna tadorna*) [A048] Pintail[W] (*Anas acuta*) [A054] Goldeneye[W] (*Bucephala clangula*) [A067] Red-breasted Merganser[W] (*Mergus serrator*) [A069] Oystercatcher[W] (*Haematopus ostralegus*) [A130] Golden Plover[W] (*Pluvialis apricaria*) [A140] Grey Plover[W] (*Pluvialis squatarola*) [A141] Knot[W] (*Calidris canutus*) [A143] Dunlin[W] (*Calidris alpina*) [A149] Black-tailed Godwit[W] (*Limosa limosa*) [A156] Bar-tailed Godwit[W] (*Limosa lapponica*) [A157] Redshank[W] (*Tringa totanus*) [A162]	Yes [August 2013; https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004025.pdf]
Rogerstown Estuary SPA (004015)	4.5	Greylag Goose[W] (*Anser anser*) [A043] Light-bellied Brent Goose[W] (*Branta bernicla hrota*) [A046] Shelduck[W] (*Tadorna tadorna*) [A048] Shoveler[W] (*Anas clypeata*) [A056] Oystercatcher[W] (*Haematopus ostralegus*) [A130] Ringed Plover[W] (*Charadrius hiaticula*) [A137] Grey Plover[W] (*Pluvialis squatarola*) [A141] Knot[W] (*Calidris canutus*) [A143] Dunlin[W] (*Calidris alpina*) [A149] Black-tailed Godwit[W] (*Limosa limosa*) [A156] Redshank[W] (*Tringa totanus*) [A162]	Yes [May 2013; https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004015.pdf]
Baldoyle Bay SPA (004016)	4.5	Light-bellied Brent Goose[W] (*Branta bernicla hrota*) [A046] Shelduck[W] (*Tadorna tadorna*) [A048] Ringed Plover[W] (*Charadrius hiaticula*) [A137] Golden Plover[W] (*Pluvialis apricaria*) [A140] Grey Plover[W] (*Pluvialis squatarola*) [A141] Bar-tailed Godwit[W] (*Limosa lapponica*) [A157]	Yes [February 2013; https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004016.pdf]

Site Name	Distance from Broadmeadow Way (km)	Avian SCIs	Specific Conservation Objectives
Ireland's Eye SPA (004117)	8	Cormorant[B] (*Phalacrocorax carbo*) [A017] Herring Gull[B] (*Larus argentatus*) [A184] Kittiwake[B] (*Rissa tridactyla*) [A188] Guillemot[W] (*Uria aalge*) [A199] Razorbill[B&W] (*Alca torda*) [A200]	No [February 2018; https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004117.pdf]
North Bull Island SPA (004006)	8	Light-bellied Brent Goose[W] (*Branta bernicla hrota*) [A046] Shelduck[W] (*Tadorna tadorna*) [A048] Teal[W] (*Anas crecca)* [A052] Pintail[W] (*Anas acuta*) [A054] Shoveler[W] (*Anas clypeata*) [A056] Oystercatcher[W] (*Haematopus ostralegus*) [A130] Golden Plover[W] (*Pluvialis apricaria*) [A140] Grey Plover[W] (*Pluvialis squatarola*) [A141] Knot[W] (*Calidris canutus*) [A143] Sanderling[W] (*Calidris alba*) [A144] Dunlin[W] (*Calidris alpina*) [A149] Black-tailed GodwitW (*Limosa limosa*) [A156] Bar-tailed Godwit[W] (*Limosa lapponica*) [A157] Curlew[W] (*Numenius arquata*) [A160] Redshank[W] (*Tringa totanus*) [A162] Turnstone[W] (*Arenaria interpres*) [A169] Black-headed Gull[W] (*Chroicocephalus ridibundus*) [A179]	Yes [March 2015; https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004006.pdf]
Lambay Island SPA (004069)	9	Fulmar[B] (*Fulmarus glacialis*) [A009] Cormorant[B&W] (*Phalacrocorax carbo*) [A017] Shag[B] (*Phalacrocorax aristotelis*) [A018] Greylag Goose[W] (*Anser anser*) [A043] Lesser Black-backed Gull[B] (*Larus fuscus*) [A183] Herring Gull[B] (*Larus argentatus*) [A184] Kittiwake[B] (*Rissa tridactyla*) [A188] Guillemot[B] (*Uria aalge*) [A199] Razorbill[B] (*Alca torda*) [A200] Puffin[B] (*Fratercula arctica*) [A204]	No [February 2018; https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004069.pdf]

Site Name	Distance from Broadmeadow Way (km)	Avian SCIs	Specific Conservation Objectives
Skerries Islands SPA (004122)	13	Cormorant[B&W] (*Phalacrocorax carbo*) [A017] Shag[B] (*Phalacrocorax aristotelis*) [A018] Light-bellied Brent Goose[W] (*Branta bernicla hrota*) [A046] Purple Sandpiper[W] (*Calidris maritima*) [A148] Turnstone[W] (*Arenaria interpres*) [A169] Herring Gull[B&W] (*Larus argentatus*) [A184]	No [February 2018; https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004122.pdf]

5.4 Description of the Elements of the Project Likely to Give Rise to Impacts on European Sites

5.4.1 There are both construction phase and operational phase elements which could potentially impact upon the European sites in the vicinity of the proposed greenway. Table 5.3 below shows the principal construction phase elements that have the potential to impact upon the nearby European sites. Potential operational phase impacts are described in Table 5.4 below. The adjoining Malahide Estuary SPA and the next two closest SPA sites (Rogerstown Estuary SPA and Baldoyle Bay SPA) are all designated for overwintering waterbirds. Therefore, any construction activity carried out during the overwintering period would have the greatest potential to directly disturb or displace key species. As described in Table 5.2 three relatively distant island SPA sites are designated for a number of breeding seabird species. There is some potential for a number of these breeding bird species to be present in areas close to the proposed construction zone during the summer months. For instance, there is a possibility that some of the Cormorants and Gulls breeding on Ireland's Eye and Lambay Island SPAs could occur locally during the summer period. The potential for direct construction related disturbance and displacement of other breeding species (should construction be carried out in the summer months) can be discounted due the fact that these species are very rarely recorded anywhere in the inner or outer estuary at Malahide, or on lands adjoining the SPA, e.g. Puffin, Razorbill and Kittiwake.

5.4.2 As outlined in Table 5.3 and Table 5.4 there is some potential for construction related impacts on birds and their habitats (e.g. run-off, disturbance etc.) and once in operation there would be some ongoing potential for users of the Broadmeadow Way (including maintenance teams) to cause disturbance to birds occurring in the area. These potential impacts would be largely localised to the areas immediately adjacent to the route. However, this could still potentially impact on SCIs of other SPA sites in the wider area that occasionally occur in or close to Malahide Estuary SPA. Similarly, any introduction of wastes and other pollutants during the operational period could potentially have wider impacts on other coastal sites, including areas of importance for roosting and feeding bird species.

Size and Scale

5.4.3 A section of the proposed development will run along the existing weir maintenance access track adjacent to the western face of the railway embankment to cross the estuary. Much of the greenway base is already in place by way of this weir maintenance access track, which currently runs from Bissets Strand to the southern abutment of the railway bridge, and the northern shoulder of the railway embankment to the northern estuary bank. See also Chapter 3.0 for detail.

5.4.4 The greenway will typically be c. 4m in width, other than sections where the greenway is utilising existing public roads, tracks and pathways. It will be finished with a macadam surfacing to ensure comfort and safety for cyclists, pedestrians and mobility-impaired users. A 2.4m high security fence will line the eastern edge of the greenway where it runs adjacent to the Dublin-Belfast railway line, to prevent access to the railway.

5.4.5 Permanent fencing will prevent egress to the agricultural lands and small number of residential properties at Kilcrea and to the northern shore of Malahide Estuary. The project will not involve a connection to the eastern embankment of the railway line at any point. This will be effective in minimising potential disturbance of birds roosting and feeding along the northern shoreline of the inner harbour at Kilcrea.

Table 5.3 Potential construction phase impacts of the proposed Broadmeadow Way.

Project Element	Principal Potential Impacts on European Sites	European site(s) Affected
Establishment of temporary working compounds and storage of construction materials	• Increased risk of run-off and increased turbidity. • Risk of introduction of contaminants. • Habitat removal or degradation. • Disturbance of birds (e.g. light/noise).	Malahide Estuary SAC, Malahide Estuary SPA, Rogerstown Estuary SPA, Baldoyle Bay SPA, Ireland's Eye SPA, North Bull Island SPA, Lambay Island SPA, Skerries Islands SPA.
In-stream construction works	• Risk of pollution. • Risk of contamination or degradation of aquatic habitats. • Impact on normal tidal flow. • Disturbance/displacement of birds.	Malahide Estuary SAC, Malahide Estuary SPA, Rogerstown Estuary SPA, Baldoyle Bay SPA, Ireland's Eye SPA, North Bull Island SPA, Lambay Island SPA, Skerries Islands SPA.
The erection of screening, security fencing, construction of wall and the pedestrian deck, hardtop across estuary	• Risk of introduction of contaminants. • Disturbance of birds. • Bird collision risk	Malahide Estuary SAC, Malahide Estuary SPA, Rogerstown Estuary SPA, Baldoyle Bay SPA, Ireland's Eye SPA, North Bull Island SPA, Lambay Island SPA, Skerries Islands SPA.
Tarring walkway	• Disturbance of birds. • Risk of introduction of contaminants.	Malahide Estuary SAC, Malahide Estuary SPA, Rogerstown Estuary SPA, Baldoyle Bay SPA, Ireland's Eye SPA, North Bull Island SPA, Lambay Island SPA, Skerries Islands SPA.
Security and safety features	• Disturbance/displacement of birds (e.g. light/noise).	Malahide Estuary SAC, Malahide Estuary SPA, Rogerstown Estuary SPA, Baldoyle Bay SPA, Ireland's Eye SPA, North Bull Island SPA, Lambay Island SPA, Skerries Islands SPA.
Topsoil stripping and establishment of greenway at Kilcrea	• Increased risk of run-off and increased turbidity. • Risk of introduction of contaminants. • Habitat removal or degradation. • Disturbance of birds and other fauna.	Malahide Estuary SAC, Malahide Estuary SPA, Rogerstown Estuary SPA, Baldoyle Bay SPA, Ireland's Eye SPA, North Bull Island SPA, Lambay Island SPA, Skerries Islands SPA.
Movement of machines, personnel	• Disturbance of birds and other fauna. • Introduction of food and other wastes. • Potential introduction of invasive species. • Risk of pollution.	Malahide Estuary SAC, Malahide Estuary SPA, Rogerstown Estuary SPA, Baldoyle Bay SPA, Ireland's Eye SPA, North Bull Island SPA, Lambay Island SPA, Skerries Islands SPA.

Table 5.4 Potential operational phase impacts of the proposed Broadmeadow Way.

Project Element	Potential Impact on European Sites	European Site(s) Affected
Movement of pedestrians, cyclists	• Disturbance of birds and other fauna, including visual, noise, light etc. • Introduction of food and other wastes.*	Malahide Estuary SPA, Rogerstown Estuary SPA, Baldoyle Bay SPA, Ireland's Eye SPA, North Bull Island SPA, Lambay Island SPA, Skerries Islands SPA.
Maintenance of weir and greenway	• Risk of pollution. • Risk of contamination or degradation of aquatic habitats. • Disturbance of birds.	Malahide Estuary SPA, Rogerstown Estuary SPA, Baldoyle Bay SPA, Ireland's Eye SPA, North Bull Island SPA, Lambay Island SPA, Skerries Islands SPA.

*Note: Waders and wildfowl are highly mobile and are likely to spend time in a number of coastal sites, including designated SPAs during the winter months.

5.4.6 The length of the greenway means that a range of habitats will be traversed and without mitigation there is a potential for disturbance of birds in Malahide Estuary SPA. Depending on the timing and duration of construction works there is a potential for disturbance and displacement of breeding or wintering birds. As described in later sections a key protective measure committed to is that construction of the proposed development will be phased. The construction period is likely to take c. 20 weeks in the estuary area (see Section 2.0). It is an intrinsic component of the construction scheduling that the works be carried out wholly outside of the main overwintering period for the qualifying avian species of Malahide Estuary SPA.

5.4.7 In operation, the movement of users of the Broadmeadow Way and associated noise and visual disturbance will be the chief sources of potential disturbance to SCI bird species. The area of influence will mainly along, over and closely adjacent (to the west) of the Broadmeadow Way walkway. There is no significant potential for disturbance or displacement impacts of birds using the outer estuary, separated as this is by the railway embankment and weir. The distance at which birds are likely to be disturbed or displaced (and the extent of such impacts) through noise and visual cues is dependent on the pattern of usage of the greenway, the level of acoustic and visual screening present and the resource usage of areas close to the causeway by SCI species. The usage of a predictable linear route is likely to encourage habituation of birds occurring in the area – this is observably the case elsewhere around the inner estuary where footfall is relatively high.

5.4.8 The maps accompanying the conservation objectives of Malahide Estuary SAC indicate that the route of the proposed development does not intersect with any of the qualifying interest habitats listed (see Tables 5.4 and 5.5 below).

5.4.9 There will be no works to the rock armour sides of the embankments (see Design Drawings 12-160-257 to 12-160-260) and therefore there will be no permanent displacement of habitat used for foraging or roosting by Special Conservation Interest bird species. The 1.4m high wall will prevent users of the greenway from accessing or causing disturbance to birds making use of the embankments.

Land Take

5.4.10 The greenway will utilise the existing railway infrastructure on the western embankment of the railway causeway crossing the Malahide Estuary. The maps accompanying the conservation objectives of Malahide Estuary SAC indicate that the route of the proposed development does not intersect with any of the conservation interests listed (see Table 5.5 below).

Table 5.5 Distance of greenway project from habitats of conservation interest in the inner estuary, Malahide Estuary SAC.

Qualifying Interests of Malahide Estuary SAC	Railway Causeway	
	Northern Arm	**Southern Arm**
Mudflats and sandflats not covered by seawater at low tide [1140]	c. 2.5km	c. 2.6km
Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330]	c. 2.5km	c. 1km

Table 5.6 Distance of greenway project from habitats of conservation interest in the outer estuary, Malahide Estuary SAC.

Qualifying Interests of Malahide Estuary SAC	Proximity of Corballis Cottages Road Realigned
Mudflats and sandflats not covered by seawater at low tide [1140]	Adjacent
Salicornia and other annuals colonising mud and sand [1310]	c. 1km
Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330]	Adjacent
Mediterranean salt meadows (*Juncetalia maritimi*) [1410]	c. 1.4km
Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120]	c. 2.4km
Fixed coastal dunes with herbaceous vegetation (grey dunes) [2130]	c. 2.25km

5.4.11 At Bissets Strand the 4m greenway and associated car parking will in part be located on the existing roadside grass margin within and adjacent to the SAC/SPA boundaries at Malahide Village. This habitat is not a qualifying interest and is assessed as having a low ecological value.

5.4.12 The construction of the greenway bridge deck at the weir will require a period of eight weeks of in-stream works. By virtue of historical works (2002-2012), there is a significant amount of experience in carrying out works at this location within Irish Rail and, accordingly, Irish Rail are providing the engineering design and construction management for the proposed bridge and in-stream works for the proposed development. In the absence of access to the experience gained and reportage on the extensive works to the weir (2009-2012), there is the potential for impact from the temporary change in tidal dynamics as a result of the proposed construction works at the weir.

5.4.13 At Kilcrea, north of the estuary and outside the SAC/SPA, the 4m path is located on terrestrial habitat that has been assessed as having relatively low ecological value. These lands are generally used for improved intensive agriculture with large tillage fields running north to the River Pill. Northward of the River Pill, and outside the SAC/SPA, the proposed development will run through pasture, closely following existing field margins. Construction will not involve the clearance of any mature trees and hedgerow removal will be minimal. So also, for the short road realignment at Corballis.

5.4.14 At the extreme northeastern corner of the inner Malahide Estuary the 4m greenway will cross a minor local agricultural drain by way of culvert. The hedgerow habitat at the crossing location is not a qualifying interest and is assessed as having a relatively low ecological value.

5.4.15 During construction there is minimal risk of displacement of significant numbers of SCI species of any of the SPA sites under consideration. The construction will be phased and take place outside of the main overwintering bird period. Areas close to the route of the Broadmeadow Way were not recorded as being of high resource value or observed usage by any of the breeding SCIs of the SPA sites in the wider hinterland. Certainly, it is possible that small numbers of qualifying Gull species and Cormorants could be recorded in the area in the summer months. Given the location of the breeding seabird colonies at offshore sites (>8km distant) and nature of the habitats present (including size and scale) in the development footprint it is improbable that a significant proportion

of any of the breeding SCIs would be present in areas close to greenway at any stage during the breeding season.

5.4.16 In operation, the movement of users of the Broadmeadow Way and associated noise and visual disturbance will be the chief sources of potential disturbance to SCI bird species. The area of influence will mainly along, over and closely adjacent (to the west) of the Broadmeadow Way walkway. There is no significant potential for disturbance or displacement impacts of birds using the outer estuary, separated as this is by the railway embankment and weir. The distance at which birds are likely to be disturbed or displaced (and the extent of such impacts) through noise and visual cues is dependent on the pattern of usage of the greenway, the level of acoustic and visual screening present and the resource usage of areas close to the causeway by SCI species. The usage of a predictable linear route is likely to encourage habituation of birds occurring in the area – this is observably the case elsewhere around the inner estuary where footfall is relatively high.

Excavation and Resource Requirements

5.4.17 The resource requirements for the construction of the proposed development are described in detail in Section 2.0. The contract documents for the proposed development will stipulate a requirement for the contractor to mobilise two crews in operation simultaneously, e.g. one at the Malahide side and one at the Donabate side of the estuary.

5.4.18 A site compound with welfare facilities will be located at the fenced area beside Bissets Strand and another at the open area beside the Corballis Cottages Road at the railway bridge. These areas have been previously used by Irish Rail during the emergency repair works for the railway bridge (see Section 2.0).

5.4.19 Following the rail bridge collapse in 2009 emergency repair works were initiated to replace the collapsed Pier 4 and to strengthen the remaining masonry piers and abutments. A weir access track was constructed to the west of the rail embankment to facilitate works to the rail viaduct and this track will be used to reach the greenway bridge construction site. While works were being carried out on the weir, piling for the greenway bridge was installed into the weir structure, together with foundations and piers. Consequently, and for safety reasons, there are no works proposed to permanently modify the weir as a result of the proposed development. To complete the bridge precast concrete beams will be placed on the existing piers to form a continuous deck across the 12 spans of the bridge.

5.4.20 Bridge beams will be loaded individually onto a transporter (self-propelled, multi-axle transporter). The transporter will travel along the weir carrying a bridge beam, halting at the first predetermined span to receive a bridge beam. The transporter will then move into position between the bridge piers and lower the bridge beam into place. Following positioning of the bridge beam the transporter will be lowered and manoeuvred back to the access road to pick up the next bridge beam. The bridge beams will be placed in a predetermined sequence of spans until completion.

5.4.21 For the purposes of putting the footbridge deck in place, the central scallops of the reprofiled (post collapse) weir, which are quite shallow, will be filled by approximately 0.5m to 0.65m to provide a level surface on the western weir apron. This will not occur in the viaduct centreline or on the eastern side of the viaduct. The works will progress

from the northern end. After the beams are placed together the weir at that location will be reprofiled to match the existing V-shaped channel profile.

5.4.22 The temporary weir reprofiling will require the importation of c. 1,500 tonnes of stone. This represents less than 1% of the stone (c. 112,000 tonnes) used to restore the weir in 2009 (Meagher, 2017). This material will be placed on the existing rock armour. The rock will be removed from site upon completion of the footbridge.

5.4.23 Permanent fencing will discourage egress to the lands at Kilcrea and security fencing will prevent any access onto the railway track. No connection will be made to the eastern embankment of the railway line at any point.

5.4.24 There will be some stripping of topsoil in bedding in the pathway on the lands at Kilcrea. This material will be used elsewhere on site. Stone will be transported from temporary compounds.

5.4.25 There will be no abstraction of water from the estuary and no outfall, or run-off of construction materials permitted from the site compounds. See CEMP in Chapter 2.0 (Section 2.12) for detail.

5.4.26 Excavation will not occur within the Malahide Estuary SAC/SPA. Neither will resource requirements derive from the Malahide Estuary SAC/SPA.

Emission (Disposal to Land, Water or Air)

5.4.27 There is the potential for run-off from several sources during the proposed construction works. The construction of the proposed development will require the importation of stone, surface dressing and tarmacadam. It will also involve some earthworks and vegetation clearance in the construction of the greenway through the lands at Kilcrea and Corballis adjacent to the Malahide Estuary SAC/SPA.

5.4.28 Any in-water works have the potential to cause direct damage to sediments, increase the risk of introducing pollutants (fuel, construction materials) and potentially increase turbidity of the waters locally. Placement of clean stone low in fines on the weir notches in order to provide a level platform for the multi-axle vehicle will likely result in the removal of algal and encrusting faunal cover in the footprint of the placement. This will constitute a minor local and temporary impact given the limited area involved and that this habitat is not included in the conservation objectives for the Malahide Estuary SAC. The algal and encrusting faunal weir communities will rapidly recolonise the affected weir footprint as soon as the stone is removed, such that the impact will be localised, slight adverse and temporary to short-term in duration.

5.4.29 Any in-stream works, or uncontained run-off has the potential to reduce the local resource value for foraging and roosting SCIs of the SPA sites under consideration. Summer and winter bird surveys in the area over the past decade have shown that there is no consistent high-water roost of any size along or adjacent to the route of the Broadmeadow Way. There are a number of consistent high-water roost sites including around Seatown, just east of the motorway crossing and at several locations in the outer estuary. Areas west of the rail embankment are used by foraging diving birds including Red Breasted Merganser, Great Crested Grebes and Shag. Resting, loafing and preening SCI species are typically observed in relatively low numbers in this area (within several hundred metres west of the route). The embankment, including the active rail-line is overflown by birds commuting between the Inner and outer estuary and lands adjoining the estuary.

5.4.30 Standard environmental control measures for working near sensitive sites, especially watercourses, will be applied (e.g. Transport Infrastructure Ireland (TII) (formerly NRA) *Guidelines on Crossings of Watercourses*; www.nra.ie; *CIRIA Guidelines*, www.ciria.org) to avoid the risk of significant adverse impacts on the local European sites through pollution or introduction of contaminants. The key measures required are (1) that all vehicles and plant are checked in advance for proper maintenance and possible hydrocarbon leaks and either repaired or replaced if found to be leaking; and (2) all stone and gravel used in the works will be clean and low in fines in order to reduce suspended solids escapement. Similarly, food wastes and welfare facilities will be controlled according to standard environmental controls and will not lead to any significant disruption to the local European sites. See the proposed Construction and Environmental Management Plan (CEMP) (Section 2.12).

5.4.31 With the above structured control measures (and as detailed in the CEMP) in place, no adverse impacts upon the Malahide Estuary SAC or avian SCI species of the SPA sites under consideration will occur as a result of emissions.

Transportation Requirements

5.4.32 Much of the base for the section of greenway crossing the inner estuary is in place by way of the weir maintenance access track. The visit frequency for ongoing weir maintenance would not lead to any significant increase in local traffic and would not adversely impact nearby European sites. To facilitate construction of the greenway there will be a short-term increase in the local movement of machinery including heavy plant and workers' vehicles. It is envisaged that the entire construction phase within the estuary area will take of the order of 20 weeks and it is intended that the construction works will take place wholly outside of the main wintering period for the avian qualifying interests of the SPA (April-September).

5.4.33 The SPA sites in the wider area with breeding avian SCIs are all located at over 8km from the route of the greenway. Many of these SCIs are not recorded anywhere within Malahide Estuary SAC and environs with any regularity or in any numbers. This is unsurprising for species such as Kittiwake, Razorbill, Fulmar and Puffin that are cliff-nesters that will commute offshore to feed during the breeding season. Indeed, while 8-13km is well within the foraging range for these breeding SCIs (e.g. Thaxton *et al*. 2012) the areas close to the route of the Broadmeadow Way are unattractive to most of the breeding seabird species listed as SCIs of the SPA sites under consideration. The potential exceptions include Shag, Cormorant and Herring Gull. Piscivorous diving birds are regularly found within 500m of the embankment, although summer season counts have recorded very small numbers relative to the overwintering period (G. Fennessy pers. obs.). These birds are feeding in areas with strong currents, spending prolonged periods underwater in search of prey. Noise from the active rail-line and water moving over the weir creates locally higher background noise levels in areas near the proposed bridge on Malahide Estuary. Noise and construction activity are likely to cause some localised disturbance to feeding/loafing or roosting birds occurring with a few hundred metres of the active areas of construction. These impacts will be localised and temporary in nature. Studies on disturbance distances of wading birds, and waterbirds suggest that birds are more likely disturbed by occasional percussive noise than general construction activity (see reviews by Hockin *et a*l. 1992, Carney & Sydeman 1999, Nisbet 2000, Woodfield & Langston 2004). In the study of disturbance effects on birds by noise, light, and other anthropogenic sources several sources describe the distances at which birds show a marked response in terms of alarm calling and flight. It is a common theme that an approaching disturbance source: human

or animal may be perceived as a predator and may elicit a greater response than a static or predictable source of disturbance (Kusters & Von Raden, 1986). Larger species of waterbirds have longer alert distances and flight distances than smaller species (Blumstein *et al*. 2005). Diving birds and larger Gulls were regularly observed feeding within 100m of the observer when on the maintenance causeway just south of the proposed bridge crossing. Given the low numbers of the breeding SCI species recorded in the area in the summer period there is no likelihood of any adverse impacts arising from the construction upon the conservation objectives of these species at the offshore breeding colonies in the wider area.

5.4.34 The transportation requirements of the proposed development will not result in an adverse impact upon the Malahide Estuary SAC or breeding avian SCI species of the SPA sites under consideration. As detailed in the CEMP and below, the construction phase will be confined to the summer period and this will effectively eliminate the potential for adverse transportation related impacts on the wintering SCI bird species during construction. Maintenance related traffic will not lead to any significant increase on current levels of movement of plant and personnel along the causeway and is not a cause for any concern in relation to the SCIs of the SPAs in the area.

5.4.35 In the longer term the use by the local community of the proposed development also has potential in reducing the number of local car movements through encouraging the use of Broadmeadow Way by pedestrians and cyclists on either side of Malahide Estuary.

Duration of Construction, Operation, Decommissioning

5.4.36 The construction of the proposed development will be phased. The construction period is likely to take c. 20 weeks in the estuary area (see Section 2.0). It is an intrinsic component of the construction scheduling that the works be carried out wholly outside of the main overwintering period for the qualifying avian species of Malahide Estuary SPA. As already discussed, the timing and duration of the works, together with the commitments contained in the CEMP, serve to eliminate the risk of significant adverse impacts on any of the SCI species of the local SPA network.

5.4.37 There will be minor maintenance works on the greenway which may be carried out at any time during the year. Maintenance related traffic will not lead to any significant increase on current levels of movement of plant and personnel along the causeway and is not a cause for any concern in relation to the SCIs of the SPAs in the area.

5.4.38 The greenway is intended to be a permanent amenity.

5.4.39 The duration of construction, operation, and decommissioning will not result in an adverse impact upon the Malahide Estuary SAC or SPAs under consideration in this NIS.

Construction Effects and Habitat Area

5.4.40 There will be no direct permanent removal of qualifying interest habitat within the SAC; any of the permanent works within the SAC boundary (e.g. placement of the greenway on top of parts of the existing railway embankment which fall within the SAC boundary) are non-qualifying interest habitat. Of six qualifying habitats, only two are found in localised areas in the inner estuary: mudflats and sandflats [1140] located c. 2.5km to the west of the project at Seatown, and Atlantic salt meadow [1330] c. 1km to the west of the project at Yellow Walls. All qualifying interest habitats are located in the outer estuary. See Chapter 3.0 for description of habitats along the route of the proposed

development. Rare and protected flora are not recorded for the line of the route. None of the vegetation present conforms to any of the EU Annex I habitat types for which the Malahide Estuary SAC has been designated.

5.4.41 The tidal ranges for the outer and inner estuaries are shown in Table 5.7 (see also Fluvio Report, 2015 in Appendix 5).

Table 5.7 Tidal Range.

Outer Estuary – Spring Tide	-2.3m OD to +2.3m OD
Outer Estuary – Neap Tide	-1.2m OD to +0.7m OD
Inner Estuary – Spring Tide	+1.2m OD to +2.0m OD
Inner Estuary – Neap Tide	+0.7m OD to +0.9m OD

5.4.42 The mudflats at Seatown occur between 0.75m OD to 1m OD. The saltmarsh at Seatown occurs at 1m OD to c. 1.3m OD. It would appear from Table 5.7 (derived from the Fluvio Report, 2015) that the Seatown saltmarsh area (inner estuary) is inundated in the ordinary way during average and spring high tides and exposed during neap tides.

5.4.43 The proposed temporary works would affect four neaps and four spring tides within the inner estuary. The works have no material effect on habitat exposure during spring lows (see page 8 of the Fluvio Report 2015). The works have an effect during neap lows when the mudflats at Seatown (ordinarily exposed at low tide) will be covered (see pages 7 and 8 of the Fluvio Report 2015). Consequently, there will be no material effect upon the saltmarsh at Seatown due to temporary weir works. Mudflats at Seatown will be covered during four neap cycles (c. 20% of the time) over an eight week period.

5.4.44 As the works will be undertaken outside of the winter bird season there will be no impact on these species as a result of temporary additional inundation of important high water roosts and occasional feeding sites and intertidal feeding areas at Seatown, during this eight week period.

5.4.45 Currently, the design of the weir crest is such that the tidal levels inside the causeway mimic exactly those which obtained before the weir was reconstructed following the railway viaduct collapse. This final design was developed after an extensive hydraulic modelling exercise which involved extensive consultation with the NPWS who approved the outcome. Once the eight week period required for the insertion of the walkway across the viaduct ope is completed then the weir will revert to its current configuration and the water level fluctuations inside the causeway will revert to their current amplitude and periodicity. At present the mudflats in the inner western extremity of the estuary are exposed during low water of both spring and neap tides, however the degree of exposure is very different. During low neap tides they are exposed to their greatest extent while during low spring tide they are, somewhat counterintuitively, almost entirely covered and that is because during the spring ebb there is insufficient time for the large volume of water that entered during the flood tide to exit via the weir opening. This in effect means that even during the existing tidal conditions the bulk of the mudflats remain inundated for a far greater time than they are exposed. The period of increased inundation resulting from the temporary raising of the water levels will in effect only be a fraction of the eight-week period during which these alterations prevail. This is borne out by the results of an additional modelling exercise which compared the degree of exposure of the inner mudflats at various tidal levels under the existing weir design with those that will obtain during the temporary alterations to it (Fluvio, 2015). This shows that during low spring tides there was virtually no difference between the degree of mudflat exposure, with both

scenarios resulting in virtually full mudflat inundation, with the existing scenario resulting in just a few hundred square metres greater exposure, overall, than the altered scenario (Fluvio Report, 2015–Appendix 13, third figure). At neap tide the situation differs, with about 4-5ha of mudflat more exposed at low neap tide during the existing weir configuration as opposed to the temporarily altered layout (Fluvio Report, 2015–Appendix 14). In effect for a few weeks other than usual, this part of the Broadmeadow Water is acting more as a lagoon than a tidal flat.

5.4.46 The dominant fauna at the site are *Hediste diversicolor* and Chironomid larvae, both groups known to be typical marine/brackish lagoon dwellers both in Ireland (Healy *et al*., 1982) and abroad. These very short term changes in the degree of inundation of the mudflats will have no impact on the benthic community in these mudflats and therefore no adverse impact will occur to the conservation objectives of the Malahide Estuary SAC as a result of the temporary change to the weir configuration.

5.4.47 The proposed development will require the partial completion of the line of rock armour that currently terminates c. 35m south of the agricultural land at Kilcrea. The line of rock armour was put in place on safety grounds to protect the railway embankment on its northwestern shoulder by Irish Rail in agreement with NPWS. Whilst the core of the rock armour is *in situ* in this area, it requires further topping out to raise the embankment shoulder to the requisite height for greenway construction purposes. The habitats present are not included as conservation interests of the SAC and are not of elevated conservation value.

5.4.48 By constructing the proposed development generally alongside the rail line on the existing embankment there will be no loss of habitats of conservation value in the Malahide Estuary SAC. There is no consistently used high water bird roost recorded along the western side of the railway embankment. On occasion, flocks of loafing Gulls and Light-bellied Brent Geese are present, particularly in the waters adjacent to the northern edge of the embankment at Kilcrea. However, there is no consistently used high-water roost in areas on or adjacent to the causeway.

Disturbance to Key Species

5.4.49 Disturbance of waterbirds could occur during the construction phase through movements of vehicles and personnel, noise, light (including flashing beacons), construction personal protective equipment (PPE), introduction of edible wastes through poor control of works site etc. However, as already stated a key protective measure of the proposed scheme is to carry out the construction works on a phased basis outside of the overwintering period for birds.

5.4.50 Several of the key conservation interests of the SPA do not regularly occur within 500m of the embankment. This would include Pintail, Golden Plover, Grey Plover, Knot, Dunlin, Godwit species and Redshank. Some of these species occur in areas adjacent to the weir and close-by in the outer estuary. Goldeneye are infrequently recorded close to the railway embankment, preferring the central portion of the inner estuary. Diving waterbirds including qualifying interests of Malahide Estuary SPA, Red Breasted Merganser and Great Crested Grebe, do regularly occur within a few hundred metres of the embankment. These birds actively feed in this area during the overwintering period.

5.4.51 Avoidance or reduced usage by certain species of areas close to the Broadmeadow Way route could result from periods of disturbance, both during construction and while in

operation. Certain species are likely to habituate quickly to some types of disturbance, but other species may choose not to frequent the zone of disturbance or fly energetically costly diversions around the source of disturbance. The feeding piscivorous species are large and believed to be more tolerant of disturbance (aural and visual cues) than, for instance, flocking wading birds. It is probable that during construction and in periods with highest usage there is the potential for some birds to be displaced from areas on and immediately adjacent to the footprint. This effect will be localised and given that the resource value of the area for species other than the piscivorous SCIs appears to be relatively low there is no likelihood that any temporary localised disturbance effects will have any significant adverse impacts on conservation objectives of any of the avian SCIs under consideration in this NIS.

5.4.52 Detailed studies of the bird usage and distribution of Malahide Estuary and terrestrial lands at Kilcrea have shown that the proposed development route has relatively little potential of disturbing large numbers of any of the waterbirds listed as conservation interests of the SPAs under consideration in this NIS. Throughout the year, generally small numbers of piscivorous birds are generally present close to the railway embankment, e.g. Shags and Red-breasted Mergansers. Other birds, including Light-bellied Brent Goose, do occur close to the railway embankment occasionally – usually in the quieter waters away from the weir. Gulls are frequently present loafing and sometimes feeding. The waterbird surveys have confirmed that the majority of birds present in the inner estuary are concentrated towards Seatown towards the western end of the SPA. In general, 2-6% of the total number of birds present in the inner estuary are concentrated within 500m of the rail causeway. In the most recent winter period of 2017/2018 there were occasional high counts of Light-bellied Brent Geese and wading birds (e.g. Oystercatcher and Dunlin) within 100-300m of the causeway. However, the typical pattern of the concentration of waterbirds at Seatown in the inner estuary was again evident. Species which persist in the area close to the active railway embankment show a certain tolerance of noise, e.g. associated with the passing trains and the rush of water over the weir. The qualifying interests of the three closest SPA sites to the Broadmeadow Way are overwintering species, many of which are entirely absent from the area for the summer months. The construction period for the crossing of the inner estuary will be outside of the overwintering period. However, in the absence of further bespoke mitigation, the construction phase as well the eventual users of the greenway could potentially disturb the existing pattern of bird usage of the inner estuary. Some species that are SCIs of SPA sites in the wider area and that could occur on occasion in areas close to the greenway could also be affected. Bespoke mitigation and commitments presented in the CEMP will ensure that such risks are negligible in magnitude.

Habitat or Species Fragmentation

5.4.53 The route of the greenway will run directly parallel to the existing rail line across the estuary until north of the River Pill in Kilcrea. The embankment already defines the boundary between inner and outer estuary and as the deck of the greenway will be at a similar elevation as it crosses the estuary, fragmentation is not a concern for the Malahide Estuary SPA. Neither is fragmentation of habitats of qualifying interest of concern for the Malahide Estuary SAC. There will be no impediment to aquatic or terrestrial animal movement. It may also be noted that birds are regularly observed flying over the active railway, commuting between the inner and outer estuary and it is concluded that the greenway will not constitute a significant barrier to movement or cause disruption to existing flight lines.

Reduction in Species Density

5.4.54 The proposed works could potentially displace some birds from the construction area and from around the area of the active greenway. The areas close to the proposed development route do not typically have high bird densities or a very wide diversity of species at any time of year. However, a good proportion of certain diving species, e.g. Great Crested Grebes, can occur close to the embankment from time to time. Occasionally flocks of Brent Geese and wading birds have also been recorded within 500m of the embankment during the winter months. It must also be noted that Brent Geese and several wading bird species are regularly observed overflying the active rail line, occasionally over the moving trains. The evidence from observations made at the site over the past decade would strongly suggest that Brent Geese will not be dissuaded from moving from outer to inner estuary when flying over the greenway route.

Changes in Key Indicators of Conservation Value

5.4.55 The inner estuary is an area that has been modified over a long period through the construction of the rail crossing and has created the conditions which are attractive to a range of foraging and roosting waterbirds, particularly at Seatown.

5.4.56 Throughout construction of the greenway there is a commitment to best environmental practice (see CEMP) for construction in/adjacent to sensitive sites and these measures will ensure that any potential damage or degradation of sensitive habitats are avoided. The avoidance of construction activities during the overwintering period for birds greatly avoids the risk of disturbance or negative impact upon the wintering special conservation interest species of the SPAs under consideration in this NIS. For reasons already stated there is no risk of significant adverse impacts on any of the breeding SCIs of the island SPAs in the wider area during the construction phase.

5.4.57 The works carried out in repairing the railway viaduct and weir demonstrated clearly that the weir levels are critical in managing the water levels in the inner estuary. Over a number of interventions from 2009 to 2012, it was shown that the weir design regulates the exposure of mudflats and the depth of water throughout the tidal cycle in the inner estuary (see McKeogh Technical Papers 1-5, Malahide Viaduct Reinstatement, UCC, 2010).

5.4.58 It is concluded objectively that that there will be no long-term impacts on the key relationships that define the structure or function of any of the European sites considered in this NIS.

5.5 Mitigation Measures

SAC

5.5.1 In the design of the weir re-profile in 2010 the requirements of NPWS were adopted to reinstate the inner estuary to its pre-railway viaduct collapse water levels. An important requirement was that the birdlife feeding and breeding grounds, on the mudflats at the western end of the estuary, be restored and have the same periods of time submerged and exposed during the tidal cycle as had existed previously. The mudflats are on a very shallow gradient so consequently a small variation in water level has an effect over a wide area. A conservative design approach was taken in the mathematical model to ensure that the NPWS requirements were met.

5.5.2 To strengthen the weir stability, stone material was added to both the eastern and western faces of the weir, which considerably widened the original weir width. Having strengthened and re-profiled the top face of the weir it was found that the inner estuary retained a lesser volume of water than before and considerably more area of mudflats was exposed throughout the tidal cycle.

5.5.3 As the water levels within the inner estuary for the as-constructed 2010/2011 weir were found to be lower than historic water levels, a revised mathematical model was developed. Adjustment works were carried out in 2012 to improve the hydraulic effect of the weir on the wider estuary.

5.5.4 The performance of the new design weir was hydraulically tested and elaborated on in the University College Cork report in July 2012. A comparison of the recorded and historic water levels at that time showed that the reconfigured weir replicated the hydrodynamic conditions on the entire Malahide Estuary and throughout the tidal cycle that occurred before the collapse of the weir.

5.5.5 To maintain the weir profile in line with that above, the design methodology for bridge deck placement at the weir for the proposed development will incorporate the following:

- A full survey of the existing channels to ensure the exact profile is replicated on completion of the works.
- Filling the channels to an agreed level (+1.15m OD) to allow the maximum working time but allowing the Malahide Estuary to remain as a tidal estuary.
- Works to commence only when all precast units are fabricated (at a commercial off site facility) and ready for installation.
- Timeframe for the works to the bridge that will affect the tidal zone of the Malahide Estuary to be restricted to an eight week period.
- On completion of the works the construction stone fill will be removed from the weir surface and each channel checked to ensure that the original profile has not changed.

5.5.6 Computer modelling of the temporary weir reprofiling to facilitate the construction of the footbridge (Fluvio R&D Ltd., 2015) identifies that there will be a temporary rise in the water levels in the inner estuary across the tidal cycle (Appendix 5). This means that for a one-off period of c. 8 weeks there will be less mud exposure at the upper parts of the inner estuary. However, once the existing weir profile is replaced the tidal flow will be re-established. The impact is of a minor and temporary nature and occurring outside of the overwintering period it will not adversely impact upon qualifying avian interests of the SPA. Moreover, the short-term changes to the normal emersion/immersion cycle will have no adverse impact on the principal benthic invertebrates present (chironomids and *Hediste diversicolor*) which all have longer life spans than the eight week period and all of which can cope with far longer periods of immersion than the eight weeks entailed here. This means that there will be no change to the benthic community that characterise the mudflats in question.

5.5.7 The only terrestrial habitat (saltmarsh habitat) of qualifying interest of the inner estuary is Atlantic salt meadows (*Glauco Puccinellietalia maritimae*) [1330] and Mudflats and sandflats not covered by seawater at low tides [1140]. As for the SPA, the impacts upon these habitats are minor and temporary in nature and will not adversely impact upon conservation objectives as the effect will occur outside of the winter bird season. All

other terrestrial habitats of qualifying interest for the site occur only in the outer estuary which will not be impacted by the proposed works.

SPA

5.5.8 A CEMP has been developed to provide environmental commitments that will apply throughout the construction phase. For instance, measures to ensure that water quality is not adversely impacted, and that run-off and pollution events are avoided. These measures, along with the overarching commitment to carry out the construction outside of the overwintering period for birds, will be effective in eliminating the risk of adverse construction phase impacts on the avian SCIs of the SPAs considered in this NIS.

5.5.9 Due to the potential to disturb birds in areas close to the Broadmeadow Way, particularly where it crosses the inner estuary, there is a requirement to screen the western side of the proposed development. Various designs have been considered which balance the needs of those using the amenity while seeking to minimise the potential disturbance of birds. The potential to disturb birds in areas close to the greenway, especially in Malahide Estuary SPA, was considered in detail. Observations of the distribution of birds in Malahide Estuary has confirmed that the area of the inner estuary close to the railway embankment is not an area that regularly holds a wide diversity, or high overall abundance, of waterbirds. The area of the SPA close to the railway embankment is constantly inundated (i.e. always under water) and does not afford good feeding opportunities for birds other than diving piscivores.

5.5.10 A solid wall screen (1.4m) is proposed for the entire length of the causeway, including the bridge crossing at the weir. The screen would substantially decrease the risk of disturbance of birds in the inner estuary especially those that frequent the areas within 300m of the embankment. This area has very low bird abundance and species diversity and is already used for recreational boating, wind-surfing etc. Any potential negative impacts are amenable to mitigation in this way.

5.5.11 The greenway on the southern railway embankment (which lies adjacent to Malahide Marina and Malahide Waste Water Treatment Plant) is overflown by fewer birds than the more northerly shoulder of the railway embankment. The solid wall screen, as a whole, will serve to screen birds close to the embankment, e.g. diving birds from movement along the greenway. It will also serve to attenuate noise from passing walkers and cyclists.

5.5.12 This area has been found to generally have a low usage by most of the SCI species under consideration in this NIS. On occasion, some diving ducks are present within a few hundred metres of the railway embankment. They tend to concentrate in the highly disturbed waters west of the weir. This is an area with typically high levels of background noise and it is not considered that the species that forage in this area are especially susceptible to disturbance from construction activity or operation of the greenway. Diving ducks are believed to show a much greater response, and at much greater distances, from boats than from walkers (e.g. Borgmann, 2011).

5.5.13 The area to be illuminated by LED lamps (which will be located 1.8m above the greenway surface) is the surface of the greenway itself. The design illuminance on the greenway surface is proposed to be 7.5 lux at full illumination with a minimum of 1.5 lux. This illuminance complies with IS EN 13201:2015 Class P3. Light spill onto the water in the estuary had been addressed in two ways. Firstly, each light fitting will have an optic which will direct light onto the greenway surface only. Secondly, the light fitting will be placed

such that the rear of the fitting (from which light emission is zero) is facing the estuary. In addition, the LED lighting will dim to 20% of maximum output during periods when no pedestrians or cyclists are present. The lighting circuits will be 'segmented' with a series of lamps fully illuminated as a pedestrian or cyclist approaches, dimming (to 20%) a period after the user leaves that portion of the greenway. In that way only sections of the greenway in active use will be illuminated to full illumination. Reflected light from a surface is a function of the reflective properties of that surface. The greenway will generally have a dense bitumen macadam (DBM) surface finish. These finishes are generally dark in colour or black and these finishes have low reflectance values (less than 10%). There will therefore not be any perceptible 'sky glow' from the greenway-lighting. The lighting design minimises the illumination spill from the causeway to areas above or adjacent to the causeway. It is envisaged that the lighting of the greenway be switched off automatically at around 12:30AM in the winter months (October-March) and not be illuminated again until 05:30AM – this is based on predicted usage patterns associated with the current train timetable. However, if a person is detected on the greenway during the 'night' hours, lighting will switch on and function as described above, until such time as no further movement is detected. See Appendix 4.

5.5.14 All construction works on the embankment across the estuary will be conducted outside of the overwintering period, i.e. construction will take place between the end of April (once Brent Geese are confirmed to have departed) and September. The construction activity will take place in daylight hours only and all machinery will be returned to site compounds at the end of each working day. Best practice environmental practices will be adopted as set out in the CEMP – including the storage and refuelling of all machinery at set locations from bunded containers. Monitoring of bird distribution and movements in the first year of operation of the proposed development will be conducted. The vegetated railway embankment in Kilcrea will not be disturbed.

5.5.15 Signage indicating the importance of the area for wintering birds and requesting responsible behaviour (e.g. no disposing of food wastes) while using the amenity will be erected at both access points. Fingal County Council will inspect the greenway to confirm the integrity of the screen wall on a regular basis and maintain a clean and waste free pathway. Fingal County Council will have cognisance of a report and any recommendations from a qualified ecologist who will be appointed to monitor the construction and first year of operation of the greenway using the methodology already established at this site.

The Likely Success of the Mitigation Measures

5.5.16 The design of construction and operational phase mitigation measures were drawn up using guidelines set out in the following best practice guidance documents:

- *Guidelines for the crossing of watercourses during the construction of National Road Schemes*. Environmental Series on Construction Impacts. Transport Infrastructure Ireland (TII) (formerly NRA), 2008.
- *Environmental Impact Assessment of National Road Schemes – A Practical Guide*. Transport Infrastructure Ireland (TII) (formerly NRA) (2008).
- *Guidelines for Assessment of Ecological Impacts of National Road Schemes*. Transport Infrastructure Ireland (TII) (formerly NRA) (2009).
- Institute of Environmental Assessment. *Guidelines for Baseline Ecological Assessment*. Chapman & Hall (E & F.N. Spon) (1995).

- Chartered Institute of Ecology and Environmental Management (CIEEM). *Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine* (2018).
- CIRIA Control of water pollution from construction sites. Guidance for consultants and contractors (C532).
- BS 5228-1:2009 Code of practice for noise and vibration control on construction and open sites.
- Pollution Prevention Guidelines (PPG):
  - PPG1: General guide to the prevention of water pollution.
  - PPG2: Above ground oil storage tanks.
  - PPG4: The disposal of sewage where no mains drainage is available.
  - PPG5: Works in, near or liable to affect watercourses.
  - PPG6: Working at construction and demolition sites.
  - PPG8: Safe storage and disposal of used oil.
  - PPG21: Pollution incident response planning.
  - PPG26: Dealing with spillages on highways.

5.5.17 A high degree of knowledge has been acquired (over the period 2009-2018) in relation to the requisite weir profile to maintain SAC and SPA conservation objectives in the inner estuary. Design knowledge gained in the period 2009-2012 has been applied in the design of the proposed temporary works to the weir.

5.5.18 The mitigation measures are standard best practice measures for addressing potential impacts on birds. The detailed studies of waterbirds using aquatic and terrestrial habitats close to the route of the proposed development were key to defining the nature and extent of the recommended mitigation measures.

5.5.19 The measures proposed have been implemented (and improved) for many years, for a wide range of developments – as evidenced in the guideline documents and experience. For this reason, it can be considered that the mitigation measures will have a high degree of success.

Contingency Plan for Mitigation Failure

5.5.20 The most significant mitigation failure that could potentially occur is through one of the following:

- a pollution event;
- a failure of mitigation measures relating to installation of temporary weir works during construction; or
- failure to provide adequate screening during operation.

5.5.21 Prior to construction, the contractor will submit to Fingal County Council appropriate contingency plans and reporting procedures to address and manage any pollution events that occur, for approval by Fingal County Council's project team. The project team will include an Ecological Clerk of Works with relevant experience in construction schemes in sensitive areas.

5.5.22 All construction staff will be made aware of pollution prevention techniques and will be trained in their use. All works in or adjacent to watercourses will comply with the

Environmental Protection Agency (EPA)/Inland Fisheries Ireland/Office of Public Works requirements.

5.5.23 The following procedures will take place in response to a silting/spillage or water contamination incident:

- The source and activities causing the problem will be stopped immediately.
- Appropriate measures will be taken to filter and slow down the rate of discharge.
- The relevant agencies such as EPA, Inland Fisheries Ireland, etc will be contacted immediately.
- Any incident will be subject to a thorough analysis and review.

5.5.24 A qualified ecologist with relevant experience will be appointed by Fingal County Council to monitor the bird distribution and abundance throughout the construction and commissioning phase for the proposed development and for its first year of operation. The ecologist will liaise closely with Fingal County Council and advise on any deviations from the required mitigation measures and propose any operational changes that will further decrease the likelihood of adverse impacts on the designated European sites.

5.6 Potential Effect Upon Conservation Objectives

Table 5.8 below identifies the attributes, measures, targets and notes of the conservation objectives of the Malahide Estuary SPA as well as the potential effects of the proposed development. Table 5.9 below identifies the attributes, measures, targets and notes of the conservation objectives of the Malahide Estuary SAC as well as the potential effects of the proposed development. In sum it is considered that the proposed development would have no adverse effect upon the integrity of the conservation objectives of the SPAs and SAC within the potential zone of influence.

Table 5.8 Details of SCIs and Conservation Objectives of SPAs in potential zone of influence. Note: W – indicates that the particular species is designated for its wintering numbers, B – for the breeding population; and B&W designated for the presence of breeding and wintering birds.

Avian SCIs	Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
Malahide Estuary SPA (004025)					
Great Crested Grebe[W] (*Podiceps cristatus*) [A005] Light-bellied Brent Goose[W] (*Branta bernicla hrota*) [A046] Shelduck[W] (*Tadorna tadorna*) [A048] Pintail[W] (*Anas acuta*) [A054] Goldeneye[W] (*Bucephala clangula*) [A067] Red-breasted Merganser[W] (*Mergus serrator*) [A069] Oystercatcher[W] (*Haematopus ostralegus*) [A130] Golden Plover[W] (*Pluvialis apricaria*) [A140] Grey Plover[W] (*Pluvialis squatarola*) [A141] Knot[W] (*Calidris canutus*) [A143] Dunlin[W] (*Calidris alpina*) [A149] Black-tailed Godwit[W] (*Limosa limosa*) [A156] Bar-tailed Godwit[W] (*Limosa lapponica*) [A157] Redshank[W] (*Tringa totanus*) [A162]	Population trend.	Percentage change.	Long term population trend stable or increasing.	Waterbird population trends are presented in part four of the conservation objectives supporting document.	No adverse effect on integrity of conservation objectives for the site. No indication from field data and observations of several years that there would be any potential of the project to impact on the population trends of any of these SCIs. This takes into account the distribution, site usage and general ecology of the species in question. These considerations are described in greater detail in the text of the report.
	Distribution.	Range, timing and intensity of use of areas.	No significant decrease in the range, timing or intensity of use of areas by avian species, other than that occurring from natural patterns of variation.	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part five of the conservation objectives supporting document.	No adverse effect on integrity of conservation objectives for the site. No indication from field data and observations of several years that there would be any potential of the project to significantly impact on the distribution of any of these SCI birds. This takes into account the distribution, site usage and general ecology of the species in question. These considerations are described in greater detail in the text of the report.
Rogerstown Estuary SPA (004015)					
Greylag Goose[W] (*Anser anser*) [A043] Light-bellied Brent Goose[W] (*Branta bernicla hrota*) [A046] Shelduck[W] (*Tadorna tadorna*) [A048] Shoveler[W] (*Anas clypeata*) [A056] Oystercatcher[W] (*Haematopus ostralegus*) [A130] Ringed Plover[W] (*Charadrius hiaticula*) [A137] Grey Plover[W] (*Pluvialis squatarola*) [A141] Knot[W] (*Calidris canutus*) [A143]	Population trend.	Percentage change.	Long term population trend stable or increasing.	Waterbird population trends are presented in part four of the conservation objectives supporting document.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact on the population trends of any of these SCIs. This takes into account the nature of the proposed development and the distribution, site usage and general ecology of the species in question. These considerations are described in greater detail in the text of the report.

Avian SCIs	Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
Dunlin[W] (*Calidris alpina*) [A149] Black-tailed Godwit[W] (*Limosa limosa*) [A156] Redshank[W] (*Tringa totanus*) [A162]	Distribution	Number and range of areas used by waterbirds.	No significant decrease in the range, timing or intensity of use of areas by avian species, other than that occurring from natural patterns of variation.	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part five of the conservation objectives supporting document.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact upon the distribution of the SCIs of this SPA given the distance from the proposed project area and the ecology and distribution of the species in question.
Baldoyle Bay SPA (004016)					
Light-bellied Brent Goose[W] (*Branta bernicla hrota*) [A046] Shelduck[W] (*Tadorna tadorna*) [A048] Ringed Plover[W] (*Charadrius hiaticula*) [A137] Golden Plover[W] (*Pluvialis apricaria*) [A140] Grey Plover[W] (*Pluvialis squatarola*) [A141] Bar-tailed Godwit[W] (*Limosa lapponica*) [A157]	Population trend.	Percentage change.	Long term population trend stable or increasing.	Waterbird population trends are presented in part four of the conservation objectives supporting document.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact on the population trends of any of these SCIs. This takes into account the nature of the proposed development and the distribution, site usage and general ecology of the species in question. These considerations are described in greater detail in the text of the report.
	Distribution.	Range, timing and intensity of use of areas.	No significant decrease in the range, timing or intensity of use of areas by avian species, other than that occurring from natural patterns of variation.	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part five of the conservation objectives supporting document.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact upon the distribution of the SCIs of this SPA given the distance from the proposed project area and the ecology and distribution of the species in question.
Ireland's Eye SPA (004117)					
Cormorant[B] (*Phalacrocorax carbo*) [A017] Herring Gull[B] (*Larus argentatus*) [A184] Kittiwake[B] (*Rissa tridactyla*) [A188] Guillemot[W] (*Uria aalge*) [A199] Razorbill[B&W] (*Alca torda*) [A200]	Population trend[W]	Percentage change.	Long term population trend stable or increasing.	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact on the population trends of any of these SCIs. This takes into account the nature of the proposed development and the distribution, site usage and general ecology of the species in question. These considerations are described in greater detail in the text of the report.

Avian SCIs	Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
	Distribution[W]	Range, timing and intensity of use of areas and extent of these areas.	No significant decrease in the range, timing or intensity of use of areas, or extent of these areas, by avian species, other than that occurring from natural patterns of variation.	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact upon the distribution of the SCIs of this SPA given the distance from the proposed project area and the ecology and distribution of the species in question.
	Breeding population abundance (AOSs)[B]	Number	No significant decline	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact upon the breeding numbers of the breeding SCIs of this SPA given the distance from the proposed project area and the ecology and distribution of the species in question.
	Productivity Rate[B]	Mean Number	No significant decline	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact on the productivity rate of any of the breeding SCIs. This takes into account the nature of the proposed development and the distribution, site usage and general ecology of the species in question. These considerations are described in greater detail in the text of the report.
	Distribution breeding colonies[B]	Number; location; area (ha)	No significant decline	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact upon the distribution of the breeding colonies of the SCIs of this SPA given the distance from the proposed project area and the ecology and distribution of the species in question.
	Prey Biomass Available[B]	Kilogrammes	No significant decline	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact on the prey biomass available for any of the breeding SCIs. This takes into account the nature of the proposed development and the distribution, site usage and general ecology of the species in question. These considerations are described in greater detail in the text of the report.

Avian SCIs	Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
	Barriers to connectivity[B]	Number; location; shape; area (ha)	No significant increase	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to create barriers to connectivity of the breeding SCIs of this SPA given the nature of the proposed development and the distance from the proposed project area and the ecology and distribution of the species in question.
	Disturbance to the breeding site[B]	Level of impact	No significant increase	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to cause disturbance at the breeding site for the breeding SCIs of this SPA given the distance from the proposed project area.
	Disturbance at marine areas immediately adjacent to the colony[B]	Level of impact	No significant increase	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to cause disturbance at marine areas immediately adjacent to the colony for any of the breeding SCIs. This takes into account the nature of the proposed development and the distribution, site usage and general ecology of the species in question. These considerations are described in greater detail in the text of the report.
North Bull Island SPA (004006					
Light-bellied Brent Goose[W] (*Branta bernicla hrota*) [A046] Shelduck[W] (*Tadorna tadorna*) [A048] Teal[W] (*Anas crecca)* [A052] Pintail[W] (*Anas acuta*) [A054] Shoveler[W] (*Anas clypeata*) [A056] Oystercatcher[W] (*Haematopus ostralegus*) [A130] Golden Plover[W] (*Pluvialis apricaria*) [A140] Grey Plover[W] (*Pluvialis squatarola*) [A141]	Population trend	Percentage change.	Long term population trend stable or increasing.	Waterbird population trends are presented in part four of the conservation objectives supporting document.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact on the population trends of any of these SCIs. This takes into account the nature of the proposed development and the distribution, site usage and general ecology of the species in question. These considerations are described in greater detail in the text of the report.
Knot[W] (*Calidris canutus*) [A143] Sanderling[W] (*Calidris alba*) [A144] Dunlin[W] (*Calidris alpina*) [A149] Black-tailed GodwitW (*Limosa limosa*) [A156] Bar-tailed Godwit[W] (*Limosa lapponica*) [A157] Curlew[W] (*Numenius arquata*) [A160] Redshank[W] (*Tringa totanus*) [A162] Turnstone[W] (*Arenaria interpres*) [A169] Black-headed Gull[W] (*Chroicocephalus ridibundus*) [A179]	Distribution	Range, timing and intensity of use of areas.	No significant decrease in the range, timing or intensity of use of areas by avian species, other than that occurring from natural patterns of variation.	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part five of the conservation objectives supporting document.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact upon the distribution of the SCIs of this SPA given the distance from the proposed project area and the ecology and distribution of the species in question.

Avian SCIs	Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
Lambay Island SPA (004069)					
Fulmar[B] (*Fulmarus glacialis*) [A009] Cormorant[B&W] (*Phalacrocorax carbo*) [A017] Shag[B] (*Phalacrocorax aristotelis*) [A018] Greylag Goose[W] (*Anser anser*) [A043] Lesser Black-backed Gull[B] (*Larus fuscus*) [A183] Herring Gull[B] (*Larus argentatus*) [A184] Kittiwake[B] (*Rissa tridactyla*) [A188] Guillemot[B] (*Uria aalge*) [A199] Razorbill[B] (*Alca torda*) [A200] Puffin[B] (*Fratercula arctica*) [A204]	Population trend[W]	Percentage change.	Long term population trend stable or increasing.	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential to impact upon the population trends of these SCI birds. This conclusion takes into account the distance of the SPA from the proposed development site as well as the distribution and ecology of the SCI birds of this SPA.
	Distribution[W]	Range, timing and intensity of use of areas and extent of these areas.	No significant decrease in the range, timing or intensity of use of areas, or extent of these areas, by avian species, other than that occurring from natural patterns of variation.	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential to impact upon the distribution of these SCIs due to the distance of this SPA from the development site in addition to the ecology of the bird species in question.
	Breeding population abundance (AOSs)[B]	Number	No significant decline	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact upon the breeding numbers of the breeding SCIs of this SPA given the distance from the proposed project area and the ecology and distribution of the species in question.
	Productivity Rate[B]	Mean Number	No significant decline	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact on the productivity rate of any of the breeding SCIs. This takes into account the nature of the proposed development and the distribution, site usage and general ecology of the species in question. These considerations are described in greater detail in the text of the report.
	Distribution breeding colonies[B]	Number; location; area (ha)	No significant decline	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact upon the distribution of the breeding colonies of the SCIs of this SPA given the distance from the proposed project area and the ecology and distribution of the species in question.

Avian SCIs	Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
	Prey Biomass Available[B]	Kilogrammes	No significant decline	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact on the prey biomass available for any of the breeding SCIs. This takes into account the nature of the proposed development and the distribution, site usage and general ecology of the species in question. These considerations are described in greater detail in the text of the report.
	Barriers to connectivity[B]	Number; location; shape; area (ha)	No significant increase	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to create barriers to connectivity of the breeding SCIs of this SPA given the nature of the proposed development and the distance from the proposed project area and the ecology and distribution of the species in question.
	Disturbance to the breeding site[B]	Level of impact	No significant increase	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to cause disturbance at the breeding site for the breeding SCIs of this SPA given the distance from the proposed project area.
	Disturbance at marine areas immediately adjacent to the colony[B]	Level of impact	No significant increase	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to cause disturbance at marine areas immediately adjacent to the colony for any of the breeding SCIs. This takes into account the nature of the proposed development and the distribution, site usage and general ecology of the species in question. These considerations are described in greater detail in the text of the report.
Skerries Islands SPA (004122)					
Cormorant[B&W] (*Phalacrocorax carbo*) [A017] Shag[B] (*Phalacrocorax aristotelis*) [A018] Light-bellied Brent Goose[W] (*Branta bernicla hrota*) [A046] Purple Sandpiper[W] (*Calidris maritima*) [A148] Turnstone[W] (*Arenaria interpres*) [A169] Herring Gull[B&W] (*Larus argentatus*) [A184]	Population trend[W]	Percentage change.	Long term population trend stable or increasing.	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential to impact upon the population trends of these SCI birds. This conclusion takes into account the distance of the SPA from the proposed development site as well as the distribution and ecology of the SCI birds of this SPA.

Avian SCIs	Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
	Distribution[W]	Range, timing and intensity of use of areas and extent of these areas.	No significant decrease in the range, timing or intensity of use of areas, or extent of these areas, by avian species, other than that occurring from natural patterns of variation.	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. This takes into account the distance of the SPA from the development site and the known distribution and ecology of Herring Gull in the area.
	Breeding population abundance (AOSs)[B]	Number	No significant decline	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact upon the breeding numbers of the breeding SCIs of this SPA given the distance from the proposed project area and the ecology and distribution of the species in question.
	Productivity Rate[B]	Mean Number	No significant decline	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact on the productivity rate of any of the breeding SCIs. This takes into account the nature of the proposed development and the distribution, site usage and general ecology of the species in question. These considerations are described in greater detail in the text of the report.
	Distribution breeding colonies[B]	Number; location; area (ha)	No significant decline	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact upon the distribution of the breeding colonies of the SCIs of this SPA given the distance from the proposed project area and the ecology and distribution of the species in question.
	Prey Biomass Available[B]	Kilogrammes	No significant decline	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to impact on the prey biomass available for any of the breeding SCIs. This takes into account the nature of the proposed development and the distribution, site usage and general ecology of the species in question. These considerations are described in greater detail in the text of the report.

Avian SCIs	Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
	Barriers to connectivity[B]	Number; location; shape; area (ha)	No significant increase	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to create barriers to connectivity of the breeding SCIs of this SPA given the nature of the proposed development and the distance from the proposed project area and the ecology and distribution of the species in question.
	Disturbance to the breeding site[B]	Level of impact	No significant increase	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to cause disturbance at the breeding site for the breeding SCIs of this SPA given the distance from the proposed project area.
	Disturbance at marine areas immediately adjacent to the colony[B]	Level of impact	No significant increase	Inferred from generic conservation objectives.	No adverse effect on integrity of conservation objectives for the site. No potential for the project to cause disturbance at marine areas immediately adjacent to the colony for any of the breeding SCIs. This takes into account the nature of the proposed development and the distribution, site usage and general ecology of the species in question. These considerations are described in greater detail in the text of the report.

Table 5.9 Details of SCIs and Conservation Objectives of Malahide Estuary SAC (000205) in potential zone of influence.

Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
1140 Mudflats and Sandflats Not Covered by Seawater at Low Tide				
Habitat area	Hectares	The permanent habitat area is stable or increasing, subject to natural processes. See map 3.	Habitat area was estimated using OSI data at 311ha.	No adverse effect on integrity of conservation objectives for the site. There is no overlap between the footprint of the development and the protected habitats in the SAC. During the eight week construction period of the greenway across the railway viaduct weir, 4-5ha of the inner mudflats will be inundated for slightly longer than normal but essentially only during the neap tidal cycles. This will not result in a change to the benthic community, which is dominated by chironomids and *Hediste diversicolor*, both tolerant of extended immersion.
Community extent	Hectares	Maintain the extent of the *Zostera*-dominated community and the *Mytilus edulis*-dominated community complex, subject to natural processes. See map 4.	Based on intertidal surveys undertaken in 2010 and 2011 (ASU, 2011). See marine supporting document for further information.	No adverse effect on integrity of conservation objectives for the site. These sub-habitat types are in the outer estuary and will therefore not be impacted by the temporary water level changes to the inner estuary.
Community structure: *Zostera* density	Shoots/m^2	Conserve the high quality of the *Zostera*-dominated community, subject to natural processes.	Estimated by the EPA during 2011 intertidal survey. See marine supporting document for further details.	No adverse effect on integrity of conservation objectives for the site. This habitat sub-community occurs east of the railway causeway and outside the Pill River tidal flat. This, combined with the use of construction best practice in construction of the Pill River crossing, will protect the habitat from elevated suspended solids levels.
Community structure: *Mytilus edulis* density	Individuals/m^2	Conserve the high quality of the *Mytilus edulis*-dominated community, subject to natural processes.	Estimated during 2010 intertidal survey (ASU, 2011). See marine supporting document for further details.	No adverse effect on integrity of conservation objectives for the site. This habitat sub-community occurs east of the railway causeway and outside the Pill River tidal flat. This, combined with the use of construction best practice in construction of the Pill River crossing, will protect the habitat from elevated suspended solids levels.

Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
Community distribution	Hectares	Conserve the following community types in a natural condition: Fine sand with oligochaetes, amphipods, bivalves and polychaetes community complex; Estuarine sandy mud with Chironomidae and *Hediste diversicolor* community complex; and Sand to muddy sand with *Peringia ulvae*, *Tubificoides benedii* and *Cerastoderma edule* community complex. See map 4.	Based on intertidal surveys undertaken in 2010 and 2011 (ASU, 2011). See marine supporting document for further information.	No adverse effect on integrity of conservation objectives for the site. The footprint of the development will not overlap with any of these community types. Moreover, fine sand with oligochaetes, amphipods, bivalves and polychaetes community complex and sand to muddy sand with *Peringia ulvae*, *Tubificoides benedii* and *Cerastoderma edule* community complex are both found on the outer estuary and will be unaffected by temporary changes to the water levels in the inner estuary during construction of the proposed development. About 4-5ha of the estuarine sandy mud with Chironomidae and *Hediste diversicolor* community complex in the inner estuary will experience a slight increase in its degree of inundation during the eight week period of the placement of the pedestrian bridge across the weir; however, this will only occur during neap tides. As the dominant species comprising the community (i.e. Chironomidae and *Hediste diversicolor*) are capable of withstanding extended periods of inundation, no adverse impact on the community is predicted as a result of these temporary water level changes.
1310 *Salicornia* and Other Annuals Colonising Mud and Sand				
Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: Malahide Estuary-1.93ha. See map 5.	Based on data from Saltmarsh Monitoring Project (SMP) (McCorry, 2007). Habitat surveyed and mapped as a single sub-site, giving a total estimated area of 1.93ha. NB further unsurveyed areas may be present within the site. See coastal habitats supporting document for further details.	There will be no direct loss of habitat area of this habitat resulting from the proposed development. The works will be carried out on the existing artificial weir and there will be no directed works in any areas of this habitat within the SAC.

Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
Habitat distribution	Occurrence	No decline, or change in habitat distribution, subject to natural processes. See map 5 for known distribution.	Based on data from SMP (McCorry, 2007). *Salicornia* is an annual species, so its distribution can vary significantly from year to year. The largest area of *Salicornia* flats occurs in the outer estuary. See coastal habitats supporting document for further details.	There will be no change in habitat distribution of this habitat resulting from the proposed development, works will only be carried out over existing infrastructure and will not change the distribution or extent of this natural habitat type. Moreover, the species poor *Salicornia* dominated community complex is located in the outer estuary and will be unaffected by temporary changes to the water levels in the inner estuary during construction. No adverse impact on the community is predicted as a result of these temporary water level changes.
Physical structure: sediment supply	Presence/absence of physical barriers	Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstructions.	Based on data from SMP (McCorry, 2007). Sediment supply is particularly important for pioneer saltmarsh community, as the distribution of this habitat depends on accretion rates. The saltmarsh habitats at this site have been disturbed in the past by the construction of the railway viaduct across the estuary. This has led to the development of more brackish or lagoonal-type conditions in the inner estuary and a reduced tidal range. See coastal habitats supporting document for further details.	Natural circulation and sediment supply will not be impacted over and above the current site conditions as a result of the development along the existing railway causeway.
Physical structure: creeks and pans	Occurrence	Maintain creek and pan structure, subject to natural processes, including erosion and succession.	Based on data from SMP (McCorry, 2007). Creeks deliver sediment throughout saltmarsh system. See coastal habitats supporting document for further details.	Creek and pan structure will not be impacted over and above the current site conditions as a result of the development along the existing railway causeway.
Physical structure: flooding regime	Hectares flooded; frequency	Maintain natural tidal regime.	Based on data from SMP (McCorry, 2007). This pioneer saltmarsh community requires regular tidal inundation. The viaduct that was built over the estuary in the 1800s has modified the tidal regime of the estuary over time and prevents the inner estuary emptying completely at low tide, thereby creating a lagoon. See coastal habitats supporting document for further details.	Tidal range will not be impacted over and above the current site conditions as a result of the development along the existing railway causeway. Moreover, the species poor *Salicornia* dominated community complex is located in the outer estuary and will be unaffected by temporary changes to the water levels in the inner estuary. No adverse impact on the community is predicted as a result of these temporary water level changes.

Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.	Based on data from McCorry (2007). At Malahide Island there are natural transitions between ASM and *Salicornia* flats and there are also transitions between ASM and sand dune habitats. Transitions between ASM and *Spartina* swards occur at the northern end of the outer estuary. See coastal habitats supporting document for further details.	All natural habitat range will be retained as per the current site conditions. No adverse impact will occur as a result of the development along the existing railway causeway.
Vegetation structure: vegetation height	Centimetres	Maintain structural variation within sward.	Based on data from McCorry (2007). Grazing by livestock is absent from Malahide Estuary resulting in a high vegetation cover and a wide range of sward heights. See coastal habitats supporting document for details.	Vegetation structure and height will not be impacted over and above the current site conditions as a result of the development along the existing railway causeway.
Vegetation structure: vegetation cover	Percentage cover at a representative sample of monitoring stops	Maintain more than 90% of area outside creeks vegetated.	Based on data from SMP (McCorry and Ryle, 2009). See coastal habitats supporting document for details.	Vegetation structure and cover will not be impacted over and above the current site conditions as a result of the development along the existing railway causeway.
Vegetation composition: typical species and subcommunities	Percentage cover	Maintain the presence of species-poor communities listed in SMP (McCorry and Ryle, 2009).	Based on data from SMP (McCorry and Ryle, 2009). See coastal habitats supporting document for further details.	Vegetation composition will not be impacted over and above the current site conditions as a result of the development along the existing railway causeway.
Vegetation structure: negative indicator species – *Spartina anglica*	Hectares	No significant expansion of common cordgrass (*Spartina anglica*). No new sites for this species and an annual spread of less than 1% where it is already known to occur.	Based on data from SMP (McCorry, 2007). There is frequent *Spartina* recorded throughout the SAC. See coastal habitats supporting document for further details.	The spread of *Spartina anglica* will not be increased by the proposed development as the works will not impact the mudflat areas (being carried out on existing causeway not within areas of mudflat) and propagules of the plant will not be spread into any mud or sand areas.
1330 Atlantic Salt Meadows (*Glauco-Puccinellietalia maritimae*)				
Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: Malahide Estuary - 25.33ha. See map 5.	Based on data from Saltmarsh monitoring Project (SMP) (McCorry, 2007). Habitat surveyed and mapped as a single sub-site, giving a total estimated area of 25.33ha. NB further unsurveyed areas may be present within the site. See coastal habitats supporting document for further details.	There will be no direct loss of habitat area of this habitat resulting from the proposed development. The works will be carried out on the existing artificial causeway and there will be no direct works in any areas of this habitat within the SAC.

Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
Habitat distribution	Occurrence	No decline or change in habitat distribution, subject to natural processes. See map 5 for known distribution.	Based on data from SMP (McCorry, 2007). The ASM is the most prominent saltmarsh habitat at this SAC. See coastal habitats supporting document for further details.	The footprint of the development will not overlap with the community type. This vegetation forms the middle and upper reaches of saltmarshes, where tidal inundation still occurs but with decreasing frequency and duration. About 5ha of the Atlantic Salt Meadows occurs in the inner estuary and may experience a slight increase in its degree of inundation during the eight week period of the construction works at the viaduct weir but this will effectively only occur during neap tides. However, as the dominant species comprising the community (e.g. *Puccinellia maritima, Aster tripolium, Festuca rubra, Halimione portulacoide*s) are capable of withstanding occasional extended periods of inundation (e.g. flood events), no adverse impact on the community is predicted as a result of these temporary water level changes.
Physical structure: sediment supply	Presence/absence of physical barriers	Maintain natural circulation of sediments and organic matter, without any physical obstructions.	Based on data from McCorry (2007). The saltmarsh habitats have been disturbed in the past by the construction of a railway viaduct across the estuary. This has led to the development of more brackish or lagoonal-type conditions in the inner estuary and a reduced tidal estuary. In spite of the M1 Broadmeadow motorway bridge having been constructed across the saltmarsh at Lissenhall (2001-2003), the saltmarsh has remained more or less intact. See coastal habitats supporting document for further details.	Natural circulation and sediment supply will not be impacted over and above the current site conditions as a result of the proposed development along the existing railway causeway.
Physical structure: creeks and pans	Occurrence	Allow creek and pan structure to develop, subject to natural processes, including erosion and succession.	Based on data from McCorry (2007). At Malahide Island the saltmarsh is in good condition. The ASM at Lissenhall is also in relatively good condition despite any disturbance resulting from construction of the M1 motorway bridge. See coastal habitats supporting document for further details.	Creek and pan structure will not be impacted over and above the current site conditions as a result of the proposed development along the existing railway causeway.

Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
Physical structure: flooding regime	Hectares flooded; frequency	Maintain natural tidal regime.	Based on data from McCorry (2007). The viaduct that was built over the estuary in the 1800s has modified the tidal regime of the estuary over time, which prevents the inner estuary emptying completely at low tide. thereby creating a lagoon. See coastal habitats supporting document for further details.	Tidal regime will not be impacted during the operational phase of the development over and above the current site conditions as a result of the operation of the proposed development on the existing railway causeway. During the construction phase about 5ha of the Atlantic Salt Meadows in the inner estuary may experience a slight increase in inundation during the eight week period of the construction of the proposed development across the viaduct weir but this will only occur during neap tides. As the dominant species comprising the community (e.g. *Puccinellia maritima, Aster tripolium, Festuca rubra, Halimione portulacoide*s) are capable of withstanding occasional extended periods of inundation (e.g. flood events), no adverse impact on the community is predicted as a result of these temporary water level changes.
Vegetation structure: zonation	Occurrence	Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.	Based on data from McCorry (2007). At Malahide Estuary ASM is the dominant saltmarsh habitat where it occurs in mosaic with other saltmarsh habitats, including *'Salicornia* and other annuals colonising mud and sand' and MSM. At Malahide Island there are also some natural transitions between the ASM and sand dune habitats. See coastal habitats supporting document for further details.	All natural habitat range will be retained as per the current site conditions. No adverse impact will occur as a result of the proposed development along the existing railway causeway.
Vegetation structure: vegetation height	Centimetres	Maintain structural variation within sward.	Based on data from SMP (McCorry, 2007). Grazing by livestock is absent at this site. See coastal habitats supporting document for further details.	Vegetation structure and height will not be impacted over and above the current site conditions as a result of the proposed development along the existing railway causeway.
Vegetation structure: vegetation cover	Percentage cover at a representative sample of monitoring stops	Maintain more than 90% area outside creeks vegetated.	Based on data from SMP (McCorry and Ryle, 2009). See coastal habitats supporting document for further details.	Vegetation structure and cover will not be impacted over and above the current site conditions as a result of the proposed development along the existing railway causeway.
Vegetation composition: typical species and subcommunities	Percentage cover at a representative sample of monitoring stops	Maintain range of sub-communities with typical species listed in SMP (McCorry and Ryle, 2009).	See coastal habitats supporting document for further details.	Vegetation composition will not be impacted over and above the current site conditions as a result of the proposed development along the existing railway causeway.

Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
Vegetation structure: negative indicator species – *Spartina anglica*	Hectares	No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1% where it is known to occur.	Based on data from SMP (McCorry and Ryle, 2009). *Spartina* is widely distributed throughout the SAC. See coastal habitats supporting document for further details.	The spread of *Spartina anglica* will not be increased by the proposed development as the works will not impact the mudflat areas (being carried out on existing causeway not within areas of mudflat) and propagules of the plant will not be spread into any mud or sand areas
1410 Mediterranean Salt Meadows (*Juncetalia maritimi*)				
Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: Malahide Estuary - 0.64ha. See map 5.	Based on data from the Saltmarsh Monitoring Project (SMP) (McCorry, 2007). Habitat surveyed and mapped as a single sub-site (0.64ha). NB further unsurveyed areas maybe present within the site. See coastal habitats supporting document for further details.	There will be no direct loss of habitat area of this habitat resulting from the proposed works. A small section of "Mediterranean salt meadows (*Juncetalia maritimi*)" occurs at Barrow Strand surrounded by areas of Atlantic salt meadow. However, this area is located seaward of the proposed works and will not be impacted by the proposed development.
Habitat distribution	Occurrence	No decline, subject to natural processes. See map 5 for known distribution.	Based on data from McCorry (2007). MSM only occurs in the outer estuary. See coastal habitats supporting document for further details.	The footprint of the proposed development will not overlap with the natural distribution of the community at the site. Therefore no adverse impact is predicted.
Physical structure: sediment supply	Presence/absence of physical barriers	Maintain/restore natural circulation of sediments and organic matter, without any physical obstructions.	Based on data from McCorry (2007). The saltmarsh habitats have been disturbed in the past by the construction of a railway viaduct across the estuary. This has led to the development of more brackish or lagoonal-type conditions in the inner estuary and a reduced tidal estuary. In spite of the M1 Broadmeadow motorway bridge having been constructed across the saltmarsh at Lissenhall (2001-2003), the saltmarsh has remained more or less intact. See coastal habitats supporting document for further details.	Natural circulation and sediment supply will not be impacted over and above the current site conditions.
Physical structure: creeks and pans	Occurrence	Maintain creek and pan structure, subject to natural processes, including erosion and succession.	Based on data from the SMP (McCorry, 2007). See coastal habitats supporting document for further details.	Creek and pan structure will not be impacted over and above the current site conditions.

Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
Physical structure: flooding regime	Hectares flooded; frequency	Maintain natural tidal regime.	Mediterranean salt meadows are found high up in the saltmarsh but requires occasional tidal inundation. Based on data from McCorry (2007). The viaduct that was built over the estuary in the 1800s has modified the tidal regime of the estuary over time, which prevents the inner estuary emptying completely at low tide, thereby creating a lagoon. See coastal habitats supporting document for further details.	Tidal regime will not be impacted as the habitat occurs seaward of the area of works.
Vegetation structure: zonation	Occurrence	Maintain range of saltmarsh habitats including transitional zones, subject to natural processes including erosion and succession.	Based on data from McCorry (2007). At Malahide Estuary there are mosaics of ASM, MSM and *Salicornia* flats. See coastal habitats supporting document for further details.	All natural habitat range will be retained as per the current site conditions. No adverse impact will occur as a result of the proposed development along the existing railway causeway.
Vegetation structure: vegetation height	Centimetres	Maintain structural variation in the sward.	Based on data from McCorry (2007). Livestock grazing is absent from Malahide Estuary. See coastal habitats supporting document for further details.	Vegetation structure and height will not be impacted over and above the current site conditions as a result of the proposed development along the existing railway causeway.
Vegetation structure: vegetation cover	Percentage cover at a representative sample of monitoring stops	Maintain more than 90% of area outside creeks vegetated.	See coastal habitats supporting document for further details.	Vegetation structure and cover will not be impacted over and above the current site conditions as a result of the proposed development along the existing railway causeway.
Vegetation composition: typical species and subcommunities	Percentage cover at a representative sample of monitoring stops	Maintain range of sub-communities with characteristic species listed in SMP (McCorry and Ryle, 2009).	See coastal habitats supporting document for further details.	Vegetation composition will not be impacted over and above the current site conditions as a result of the proposed development along the existing railway causeway.
Vegetation structure: negative indicator species – *Spartina anglica*	Hectares	No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1% where it is already known to occur.	Based on data from McCorry (2007). *Spartina* is widely distributed throughout the SAC. See coastal habitats supporting document for further details. See coastal habitats supporting document for further details.	The spread of *Spartina anglica* will not be increased by the proposed development as the works will not impact the mudflat areas (being carried out on existing causeway not within areas of mudflat) and propagules of the plant will not be spread into any mud or sand areas.
2120 Shifting Dunes Along the Shoreline with *Ammophila arenaria* (White Dunes)				
Habitat area	Hectares	Area stable or increasing, subject to natural processes including erosion and succession. Total area mapped: 1.80ha. See map 6.	Based on data from the Coastal Monitoring Project (CMP) (Ryle *et al*., 2009). Habitat was mapped from a single sub-site: Malahide Island. Habitat is very difficult to measure in view of its dynamic nature. See coastal habitats supporting document for further details.	No adverse effect on integrity of conservation objectives for the site. This habitat is in the outer estuary and will not be impacted by the proposed development.

Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
Habitat distribution	Occurrence	No decline, or change in habitat distribution, subject to natural processes. See map 6 for known distribution.	Based on Ryle *et al*. (2009). At Malahide Island the mobile dunes occur as a thin band along the northeastern edge of the spit. See coastal habitats supporting document for further details.	No adverse effect on integrity of conservation objectives for the site. This habitat is in the outer estuary and will not be impacted by the proposed development.
Physical structure: functionality and sediment supply	Presence/absence of physical barriers	Maintain the natural circulation of sediment and organic matter, without any physical obstructions.	Based on Ryle *et al*. (2009). Dunes are naturally dynamic systems that require continuous supply and circulation of sand. Marram grass (*Ammophila arenaria*) reproduces vegetatively and requires constant accretion of fresh sand to maintain active growth encouraging further accretion. The mobile dunes at Malahide Island are undergoing some erosion along the north and eastern edge as well as some accretion to the south. See coastal habitats supporting document for further details.	No adverse effect on integrity of conservation objectives for the site. This habitat is in the outer estuary and will not be impacted by the proposed development.
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.	Based on data from Gaynor (2008) and Ryle *et al*. (2009). At Malahide Island, there are transitional communities between a range of sand dune habitats as well as a range of saltmarsh habitats. See coastal habitats supporting document for further details.	No adverse effect on integrity of conservation objectives for the site. This habitat is in the outer estuary and will not be impacted by the proposed development.
Vegetation composition: plant health of dune grasses	Percentage cover	95% of marram grass (*Ammophila arenaria*) and/or lyme-grass (*Leymus arenarius*) should be healthy (i.e. green plant parts above ground and flowering heads present).	Based on Ryle *et al*. (2009). See coastal habitats supporting document for further details.	No adverse effect on integrity of conservation objectives for the site. This habitat is in the outer estuary and will not be impacted by the proposed development.
Vegetation composition: typical species and subcommunities	Percentage cover at a representative sample of monitoring stops	Maintain the presence of species-poor communities dominated by marram grass (*Ammophila arenaria*) and/or lyme-grass (*Leymus arenarius*).	Based on Ryle *et al*. (2009). Sea holly (*Eryngium maritimum*) occurs occasionally throughout the mobile dunes at Malahide Island. See coastal habitats supporting document for further details.	No adverse effect on integrity of conservation objectives for the site. This habitat is in the outer estuary and will not be impacted by the proposed development.

Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
Vegetation composition: negative indicator species.	Percentage cover	Negative indicator species (including non-natives) to represent less than 5% cover.	Based on Ryle *et al*. (2009). Negative indicators include non-native species; species indicative of changes in nutrient status and species not considered characteristic of the habitat. Sea-buckthorn (*Hippophae rhamnoides*) should be absent or effectively controlled. This species has been planted on the seaward side of the spit as a coastal protection measure by the adjacent golf course. See coastal habitats supporting document for further details.	No adverse effect on integrity of conservation objectives for the site. This habitat is in the outer estuary and will not be impacted by the proposed development.
2130 Fixed Coastal Dunes with Herbaceous Vegetation (Grey Dunes)				
Habitat area	Hectares	Area stable or increasing, subject to natural processes including erosion and succession. Total area mapped: 21.42ha. See map 6	Based on data from Coastal Monitoring Project (CMP) (Ryle *et al*., 2009). Habitat was mapped from a single sub-site: Malahide Island. See coastal habitats supporting document for further details.	No adverse effect on integrity of conservation objectives for the site. This habitat is in the outer estuary and will not be impacted by the proposed development.
Habitat distribution	Occurrence	No decline, or change in habitat distribution, subject to natural processes. See map 6 for known distribution.	Based on data from Ryle *et al*. (2009). The fixed dune habitat flanks the eastern and southern edge of Malahide Island. See coastal habitats supporting document for further details.	No adverse effect on integrity of conservation objectives for the site. This habitat is in the outer estuary and will not be impacted by the proposed development.
Physical structure: functionality and sediment supply	Presence/absence of physical barriers	Maintain the natural circulation of sediment and organic matter, without any physical obstructions.	Physical barriers can lead to fossilisation or over-stabilisation of dunes, as well as beach starvation resulting in increased rates of erosion. Coastal protection works consisting of railway sleepers and chestnut paling have been installed on the seaward side of the spit. In addition, concrete filled plastic barrels and planting of sea buckthorn (*Hippophae rhamnoides*) are measures that have been used for coastal protection by the adjacent golf course. See coastal habitats supporting document for further details.	No adverse effect on integrity of conservation objectives for the site. This habitat is in the outer estuary and will not be impacted by the proposed development.
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession.	Based on data from Ryle *et al*. (2009). At Malahide Island, there are transitional communities between a range of sand dune habitats as well as a range of saltmarsh habitats. This site represents one of the more intact examples of a dune-saltmarsh complex on the northeastern coastline. See coastal habitats supporting document for further details.	No adverse effect on integrity of conservation objectives for the site. This habitat is in the outer estuary and will not be impacted by the proposed development.

Attribute	Measure	Target	Notes	Potential Effect of Proposed Development
Vegetation structure: bare ground	Percentage cover	Bare ground should not exceed 10% of fixed dune habitat, subject to natural processes.	Based on data from Gaynor (2008) and Ryle *et al*. (2009). See coastal habitats supporting document for further details.	No adverse effect on integrity of conservation objectives for the site. This habitat is in the outer estuary and will not be impacted by the proposed development.
Vegetation structure: sward height	Centimetres	Maintain structural variation within sward.	Based on data from Gaynor (2008) and Ryle *et al*. (2009). Grazing by livestock is absent from the dunes. See coastal habitats supporting document for further details.	No adverse effect on integrity of conservation objectives for the site. This habitat is in the outer estuary and will not be impacted by the proposed development.
Vegetation composition: typical species and subcommunities	Percentage cover at a representative sample of monitoring stops	Maintain range of sub-communities with typical species listed in Ryle *et al*. (2009).	Based on data from Ryle *et al*. (2009). The protected and Red Data Book species Hairy violet (*Viola hirta*) occurs at this site. See coastal habitats supporting document for further details.	No adverse effect on integrity of conservation objectives for the site. This habitat is in the outer estuary and will not be impacted by the proposed development.
Vegetation composition: negative indicator species (including *Hippophae rhamnoides*)	Percentage cover	Negative indicator species (including non-natives) to represent less than 5% cover.	Based on data from Ryle *et al*. (2009). Negative indicators include non-native species, species indicative of changes in nutrient status and species not considered characteristic of the habitat. Sea-buckthorn (*Hippophae rhamnoides*) should be absent or effectively controlled. This species has been planted on the seaward side of the spit as a coastal protection measure by the adjacent golf course. See coastal habitats supporting document for further details.	No adverse effect on integrity of conservation objectives for the site. This habitat is in the outer estuary and will not be impacted by the proposed development.
Vegetation composition: scrub/trees	Percentage cover	No more than 5% cover or under control.	Based on data from Ryle *et al*. (2009). At Malahide Island, the fixed dune has been invaded by Dog-rose (*Rosa canina*), Privet (*Ligustrum* sp.) as well as single trees of Turkey oak (*Quercus cerris*). See coastal habitats supporting document for further details.	No adverse effect on integrity of conservation objectives for the site. This habitat is in the outer estuary and will not be impacted by the proposed development.

6.0 In-Combination Effects

6.1 Introduction

6.1.1 Article 6(3) of the Habitats Directive requires an assessment of a plan/project to consider other plans/projects that might, in combination with the proposed plan/project, have the potential to adversely impact upon European sites.

6.1.2 The proposed construction and operation of the greenway was assessed with consideration of the current and projected future use of the areas close to the greenway and in a broader sense the activity in the wider area that could interact with the potential impacts arising from this project. The activity close to the route of the greenway is chiefly characterised by recreational use (e.g. Malahide and Newbridge Demesnes, walkers and joggers around parts of the inner estuary, boating on the inner estuary, occasional seasonal hunting) and commuting (walkers, cyclists, road vehicles, agricultural vehicles and trains). Agricultural activities dominate in areas north of the inner estuary (Kilcrea).

6.1.3 Activities that are most likely to cause disturbance to fauna are those related to noise, light, and visual and auditory cues. The existing (receiving environment) has a relatively high level of these types of disturbance, particularly in areas with high levels of human related activity near the inner estuary. As such, it would be expected that many of the species occurring in the area are relatively tolerant of, or habituated to, these kinds of disturbance. The location and scale of the sources of disturbance are also critical factors in determining the overall impact and cumulative impact.

6.2 Historical Projects

6.2.1 The Broadmeadow bridge carries the M1 motorway bridge across the Malahide Estuary at its western extremity. Bridge design commenced in 1993 and an environmental impact statement was prepared in 1995. The bridge was constructed in the period 2000-2003 as part of the Lissenhall section of the northern motorway contract no. 1 (Caffrey *et al.*, 2003).

6.2.2 *Malahide Estuary SAC (site code 000205) Conservation Objectives Supporting Document – Coastal Habitats (Version 1 – May 2013)* notes (p. 3): "The Broadmeadow M1 motorway bridge has been constructed to cross the western side of the inner estuary, above the saltmarsh" and further at p. 9, "The M1 Broadmeadow motorway bridge was constructed to cross the estuary at Lissenhall in 2001-2003. Care was taken during the construction phase not to damage the structure or surface of the saltmarsh and by and large the structure of the saltmarsh has remained intact (McCorry, 2007)".

6.2.3 The Malahide waste water treatment plant (WWTP) is located at Strand Road, Malahide, on the seaward side of the Malahide railway embankment. This WWTP has a plant capacity population equivalent (pe) of 21,000, and discharges to the outer Malahide Estuary. A Natura impact statement (NIS) was prepared in support of a discharge licence application to the Environmental Protection Agency (EPA) in 2009. The NIS concluded that there would be no adverse effect upon the conservation objectives of the estuary due to operation of the Malahide WWTP. The annual environmental reports (AERs), up to and including 2017, to the EPA under licence registration number D0021-01 may be viewed at http://www.epa.ie/licensing/watwaste/wwda/.

6.2.4 The Swords waste water treatment plant (WWTP) is located at Spittal Hill Road, Swords at the head of the inner Malahide Estuary. This WWTP has a plant capacity population equivalent (pe) of 90,000 and discharges to the inner estuary in proximity to the M1 motorway bridge. A Natura impact statement (NIS) was prepared in support of a discharge licence application to the EPA in 2009. The NIS concluded that there would be no adverse effect upon the conservation objectives of the estuary due to operation of the Swords WWTP. The annual environmental reports (AERs), up to and including 2017, to the EPA under licence registration number D0024-01 may be viewed at http://www.epa.ie/licensing/watwaste/wwda/.

6.2.5 Works to ensure the safety of railway workings were carried out to the northern and southern railway embankments by Irish Rail between 2002 and 2003. These works, by way of Ministerial Consent, included the armouring of the northern embankment (west side) and the armouring of the southern embankment (west side).

6.2.6 On the 21st August 2009 part of the rail bridge crossing the Malahide Estuary collapsed. Scouring of one of the pier bases, caused by the strong tidal flows under the viaduct, led to the sudden collapse of that pier together with the two adjacent bridge spans. By way of Ministerial Consent, Irish Rail reinstated the rail bridge and weir, engaged in embankment strengthening on the northern embankment (east side), and constructed a weir maintenance track from Bissets Strand at Malahide to the weir in the period 2009-2012.

6.2.7 Following placement of all physical elements required for railway safety, a detailed hydrological analysis and physical refinement of the weir profile was conducted in 2010-2012. This was to ensure that water levels in the inner estuary were returned to the pre-collapse regime.

6.2.8 Given the open rock armour nature of the weir, and high velocities of flood and ebb tides under each span of the viaduct, there is a necessity for continuous monitoring and inspection of the weir structure. Under the Railway Safety Act 2005, Irish Rail requires the use of the weir maintenance track from Bissets Strand for inspection, routine maintenance and repair of the weir and bridge structure.

6.2.9 The environmental report on the remedial works on the Malahide Viaduct (CHE, 2010) concluded that the works did not adversely affect the conservation objectives of the European sites at Malahide.

6.2.10 The works carried out by Irish Rail to the weir and the railway embankments allow for the completion of the greenway across the estuary without an adverse effect upon conservation objectives of the European sites at Malahide. The hydraulic investigations conducted by Irish Rail in agreement with NPWS allow certainty in knowledge as to the non-adverse effects of temporary works to the weir crest.

6.3 Current Projects

6.3.1 There are a number of known proposed development projects in the Fingal area which, in combination with the proposed greenway development, may have a cumulative environmental effect. These projects include.

- Malahide: Sutton to Swords Greenway (design stage).
- Kilcrea: Donabate Distributor Road (construction stage, project opening late 2019).

- Kilcrea: Expansion of Portrane Hospital (construction stage, project opening 2020).
- Kilcrea: Housing application (McGarrell Reilly Homes, planning ref. F17A/0113) (opening late 2019).

6.3.2 With the exception of the Donabate Distributor Road, the other construction projects will be completed in advance of potential works or are remote in terms of location or design stage. An EIS and NIS were prepared in support of the Donabate Distributor Road in 2010. The NIS found that the development of this road scheme, to the north of the Malahide Estuary, would not have an adverse effect upon the conservation objectives of the European sites at Malahide. No adverse cumulative construction effect has been identified as the project is due to complete in late 2019. The Broadmeadow Way will continue in planning phase at this time. Likewise, no adverse cumulative operational impact has been identified.

6.4 Plans

Greater Dublin Area – Cycle Network Plan

6.4.1 In this project, as in similar projects elsewhere in the Great Dublin Area, there has been considerable attention given to a spatial strategy (GDA Cycle Network Plan; Transport Strategy for GDA 2016-2035). This seeks to improve connectivity through the region without compromising the local biodiversity. By formalising the routes of cycleways/greenways people are encouraged to enjoy the natural environment along selected corridors where the potential for cumulative disturbance impacts can be carefully considered and mitigated as appropriate. By concentrating use along formalised networks, it can also serve to decrease the more unpredictable usage of informal routes and access points with a cumulative benefit in terms of overall disturbance on important locally occurring species and habitats.

Fingal County Development Plan – Strategic Environmental Assessment

6.4.2 The Fingal County Development Plan SEA (March 2017) at p. 79 recommends that policy Objective MALAHIDE 6 includes the phrase "whilst avoiding any routing along northern boundary of Malahide inner estuary by virtue of its ecological sensitivity. Such a routing refers to the potential east-west use of the inner estuary shoreline along its northern boundary. Cognisance of this objective has been taken in the design and development of the Broadmeadow Way project. Its operation will not involve the east-west use of the northern shoreline.

Fingal Biodiversity Action Plan

6.4.3 The Fingal Biodiversity Action Plan 2010-2015 sets out in its vision for the Fingal estuaries and wetland and their surrounding buffer zones that these will continue to provide an excellent wintering habitat for the thousands of birds that spend the winter here. It envisages that the buffer zones around the designated sites shall be developed as multi-functional landscapes and that the agricultural land-use shall be maintained and where appropriate combined with nature conservation targets and low-intensity recreational use. The plan identifies the townlands of Kilcrea and Corballis as part of an ecological buffer zone on the northern margin of Malahide Estuary. In its design, construction and operation the Broadmeadow Way has taken cognisance of the Fingal Biodiversity Action Plan and complies with its conception of low-intensity recreational use in the areas of Kilcrea and Corballis.

6.5 Summary

6.5.1 The potential for adverse cumulative impacts on species and habitats of qualifying interest was considered throughout the assessment. Many of the qualifying bird species, for instance, are known to move between coastal SPAs within the Greater Dublin Area and the potential for wider scale impacts (e.g. arising from displacement) were considered. The overall conclusion was that with the implementation of the proposed mitigation there is no potential for adverse residual impacts on sites or the conservation objectives arising from this project, on its own or in combination with other plans or projects in the wider area.

7.0 Concluding Statement

7.1.1 Detailed knowledge of the operation of the weir beneath the railway bridge has been presented in this NIS. Arising from the viaduct collapse in 2009, detailed and certain working knowledge has been generated which demonstrates the close relationship between weir crest height and water levels in the inner estuary. All of this knowledge has been brought to bear in designing temporary works for the greenway bridge deck positioning which will not result in a permanent change to the inner estuary water levels.

7.1.2 With the application of the mitigation proposals, particularly those proposed for temporary works to the weir, the assessment concludes that there will be no adverse impacts on the Malahide Estuary SAC.

7.1.3 Detailed bird surveys have shown that the permanently inundated waters close to the crossing of the inner estuary generally hold a relatively low diversity and abundance of bird species. Typically, there is very little usage of the areas within 500m of the crossing by any of the qualifying interests of the SPA. Occasional flocks of loafing Brent Geese and Gull species are recorded in the waters close to the causeway. Waterbirds moving between feeding and roosting sites in the area regularly overfly the existing railway embankment and there is no reason to anticipate that the construction or operation of the proposed development will impact upon these commuting flights.

7.1.4 The use of screening to minimise the visual disturbance to waterbirds is a well-established wildlife management technique (e.g. Hockin, 1992; Borgmann, 2011). The proposed solid wall screening will be effective in breaking up the outline of users of the walkway and minimising visual disturbance to birds present on the adjacent parts of the inner estuary. Similarly, the lighting design minimises the risk of disturbance to birds. The LED segmented dimming lamp-arrays are designed to light the greenway surface only during the periods when the greenway will be in active use. Light spill to the inner estuary will be insignificant and the design will ensure that there are prolonged periods of darkness throughout the night-time period.

7.1.5 There is a wealth of information on the usage of the site by birds, and the estuary is already a busy amenity area, crossed by a main rail line, and the inner estuary is a popular water sport area.

7.1.6 With the application of the mitigation measures there will be no adverse impact on the Malahide Estuary SPA.

7.1.7 There will be no long-term impacts on the key relationships that define the structure or function of the European sites considered in this NIS. The integrity of Malahide Estuary SPA and Malahide Estuary SAC will not be adversely affected by the proposed development in terms of wholeness or soundness of their conservation objectives.

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Appendices

Appendix 1

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SADS-16-BROAD-PRE-002	Proposed Broadmeadow Way Footbridge Construction Sequence Stage 2 of 4.
SADS-16-BROAD-PRE-003	Proposed Broadmeadow Way Footbridge Construction Sequence Stage 3 of 4.
SADS-16-BROAD-PRE-004	Proposed Broadmeadow Way Footbridge Construction Sequence Stage 4 of 4.

Appendix 2

Conservation Objectives – Malahide Estuary SPA

ISSN 2009-4086

National Parks and Wildlife Service

Conservation Objectives Series

Malahide Estuary SPA 004025

An Roinn
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Introduction

The overall aim of the Habitats Directive is to maintain or restore the favourable conservation status of habitats and species of community interest. These habitats and species are listed in the Habitats and Birds Directives and Special Areas of Conservation and Special Protection Areas are designated to afford protection to the most vulnerable of them. These two designations are collectively known as the Natura 2000 network.

European and national legislation places a collective obligation on Ireland and its citizens to maintain habitats and species in the Natura 2000 network at favourable conservation condition. The Government and its agencies are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites.

A site-specific conservation objective aims to define favourable conservation condition for a particular habitat or species at that site.

The maintenance of habitats and species within Natura 2000 sites at favourable conservation condition will contribute to the overall maintenance of favourable conservation status of those habitats and species at a national level.

Favourable conservation status of a habitat is achieved when:

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

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, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Notes/Guidelines:

1. The targets given in these conservation objectives are based on best available information at the time of writing. As more information becomes available, targets for attributes may change. These will be updated periodically, as necessary.
2. An appropriate assessment based on these 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. It is essential that the date and version are included when objectives are cited.
3. Assessments cannot consider an attribute in isolation from the others listed for that habitat or species, or for other habitats and species listed for that site. A plan or project with an apparently small impact on one attribute may have a significant impact on another.
4. Please note that the maps included in this document do not necessarily show the entire extent of the habitats and species for which the site is listed. This should be borne in mind when appropriate assessments are being carried out.
5. When using these objectives, it is essential that the relevant backing/supporting documents are consulted, particularly where instructed in the targets or notes for a particular attribute.

Qualifying Interests

**** indicates a priority habitat under the Habitats Directive***

004025 Malahide Estuary SPA

A005	Great Crested Grebe *Podiceps cristatus*
A046	Brent Goose *Branta bernicla hrota*
A048	Shelduck *Tadorna tadorna*
A054	Pintail *Anas acuta*
A067	Goldeneye *Bucephala clangula*
A069	Red-breasted Merganser *Mergus serrator*
A130	Oystercatcher *Haematopus ostralegus*
A140	Golden Plover *Pluvialis apricaria*
A141	Grey Plover *Pluvialis squatarola*
A143	Knot *Calidris canutus*
A149	Dunlin *Calidris alpina alpina*
A156	Black-tailed Godwit *Limosa limosa*
A157	Bar-tailed Godwit *Limosa lapponica*
A162	Redshank *Tringa totanus*
A999	Wetlands

Please note that this SPA overlaps with Malahide Estuary SAC (000205). See map 2. The conservation objectives for this site should be used in conjunction with those for the overlapping site as appropriate.

Supporting documents, relevant reports & publications

Supporting documents, NPWS reports and publications are available for download from: www.npws.ie/Publications

NPWS Documents

Year :	2013
Title :	Malahide Estuary SPA (site code 4025) Conservation objectives supporting document V1
Author :	NPWS
Series :	Conservation objectives supporting document

A005 Great Crested Grebe *Podiceps cristatus*

To maintain the favourable conservation condition of Great Crested Grebe in Malahide Estuary SPA, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Population trend	Percentage change	Long term population trend stable or increasing	Waterbird population trends are presented in part four of the conservation objectives supporting document
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by great crested grebe, other than that occurring from natural patterns of variation	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part five of the conservation objectives supporting document

A046 Brent Goose *Branta bernicla hrota*

To maintain the favourable conservation condition of Light-bellied Brent Goose in Malahide Estuary SPA, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Population trend	Percentage change	Long term population trend stable or increasing	Waterbird population trends are presented in part four of the conservation objectives supporting document
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by light-bellied brent goose, other than that occurring from natural patterns of variation	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part five of the conservation objectives supporting document

A048 Shelduck *Tadorna tadorna*

To maintain the favourable conservation condition of Shelduck in Malahide Estuary SPA, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Population trend	Percentage change	Long term population trend stable or increasing	Waterbird population trends are presented in part four of the conservation objectives supporting document
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by shelduck, other than that occurring from natural patterns of variation	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part five of the conservation objectives supporting document

A054 Pintail *Anas acuta*

To maintain the favourable conservation condition of Pintail in Malahide Estuary SPA, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Population trend	Percentage change	Long term population trend stable or increasing	Waterbird population trends are presented in part four of the conservation objectives supporting document
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by pintail, other than that occurring from natural patterns of variation	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part five of the conservation objectives supporting document

A067 Goldeneye *Bucephala clangula*

To maintain the favourable conservation condition of Goldeneye in Malahide Estuary SPA, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Population trend	Percentage change	Long term population trend stable or increasing	Waterbird population trends are presented in part four of the conservation objectives supporting document
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by goldeneye, other than that occurring from natural patterns of variation	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part five of the conservation objectives supporting document

A069 Red-breasted Merganser *Mergus serrator*

To maintain the favourable conservation condition of Red-breasted Merganser in Malahide Estuary SPA, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Population trend	Percentage change	Long term population trend stable or increasing	Waterbird population trends are presented in part four of the conservation objectives supporting document
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by red-breasted merganser, other than that occurring from natural patterns of variation	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part five of the conservation objectives supporting document

A130 Oystercatcher *Haematopus ostralegus*

To maintain the favourable conservation condition of Oystercatcher in Malahide Estuary SPA, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Population trend	Percentage change	Long term population trend stable or increasing	Population trends are presented in part four of the conservation objectives supporting document
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by oystercatcher, other than that occurring from natural patterns of variation	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part four of the conservation objectives supporting document

A140 Golden Plover *Pluvialis apricaria*

To maintain the favourable conservation condition of Golden Plover in Malahide Estuary SPA, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Population trend	Percentage change	Long term population trend stable or increasing	Population trends are presented in part four of the conservation objectives supporting document
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by golden plover, other than that occurring from natural patterns of variation	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part five of the conservation objectives supporting document

A141 Grey Plover *Pluvialis squatarola*

To maintain the favourable conservation condition of Grey Plover in Malahide Estuary SPA, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Population trend	Percentage change	Long term population trend stable or increasing	Population trends are presented in part four of the conservation objectives supporting document
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by grey plover, other than that occurring from natural patterns of variation	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part five of the conservation objectives supporting document

A143 Knot *Calidris canutus*

To maintain the favourable conservation condition of Knot in Malahide Estuary SPA, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Population trend	Percentage change	Long term population trend stable or increasing	Waterbird population trends are presented in part four of the conservation objectives supporting document
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by knot, other than that occurring from natural patterns of variation	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part five of the conservation objectives supporting document

A149 **Dunlin *Calidris alpina alpina***

To maintain the favourable conservation condition of Dunlin in Malahide Estuary SPA, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Population trend	Percentage change	Long term population trend stable or increasing	Population trends are presented in part four of the conservation objectives supporting document
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by dunlin, other than that occurring from natural patterns of variation	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part five of the conservation objectives supporting document

A156 Black-tailed Godwit *Limosa limosa*

To maintain the favourable conservation condition of Black-tailed Godwit in Malahide Estuary SPA, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Population trend	Percentage change	Long term population trend stable or increasing	Population trends are presented in part four of the conservation objectives supporting document
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by black-tailed godwit, other than that occurring from natural patterns of variation	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part five of the conservation objectives supporting document

A157 Bar-tailed Godwit *Limosa lapponica*

To maintain the favourable conservation condition of Bar-tailed Godwit in Malahide Estuary SPA, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Population trend	Percentage change	Long term population trend stable or increasing	Population trends are presented in part four of the conservation objectives supporting document
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by bar-tailed godwit, other than that occurring from natural patterns of variation	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part five of the conservation objectives supporting document

A162 Redshank *Tringa totanus*

To maintain the favourable conservation condition of Redshank in Malahide Estuary SPA, which is defined by the following list of attributes and targets:

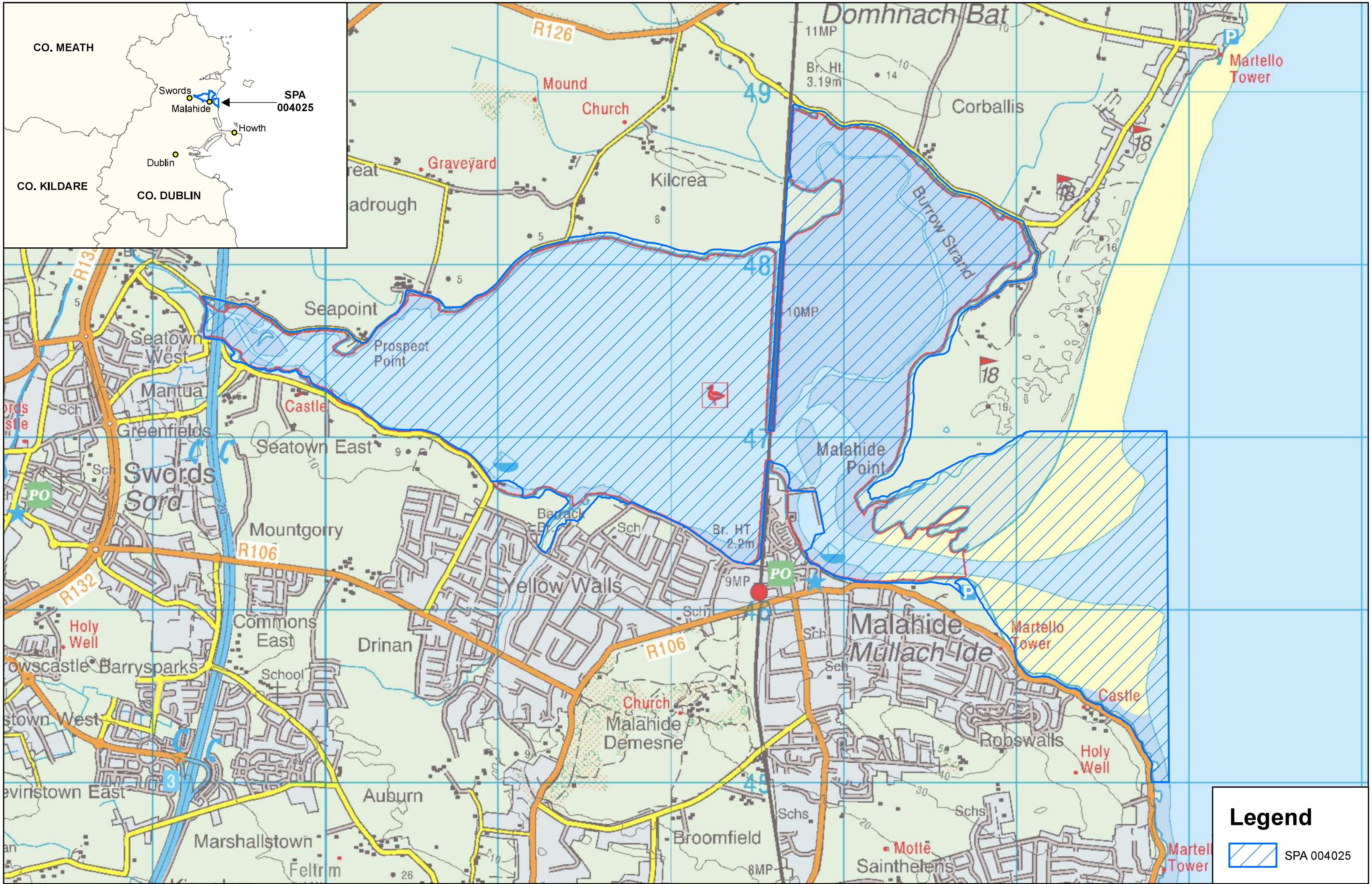
Attribute	Measure	Target	Notes
Population trend	Percentage change	Long term population trend stable or increasing	Population trends are presented in part four of the conservation objectives supporting document
Distribution	Range, timing and intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by redshank, other than that occurring from natural patterns of variation	Waterbird distribution from the 2011/2012 waterbird survey programme is discussed in part five of the conservation objectives supporting document

Conservation Objectives for : Malahide Estuary SPA [004025]

A999 Wetlands

To maintain the favourable conservation condition of the wetland habitat in Malahide Estuary SPA as a resource for the regularly-occurring migratory waterbirds that utilise it. This is defined by the following attribute and target:

Attribute	Measure	Target	Notes
Habitat area	Hectares	The permanent area occupied by the wetland habitat should be stable and not significantly less than the area of 765 hectares, other than that occurring from natural patterns of variation	The wetland habitat area was estimated as 765ha using OSi data and relevant orthophotographs. For further information see part three of the conservation objectives supporting document



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Department of Arts, Heritage and the Gaeltacht

MAP 1:
MALAHIDE ESTUARY SPA
CONSERVATION OBJECTIVES
SPA DESIGNATION

Map to be read in conjunction with the NPWS Conservation Objectives Document.

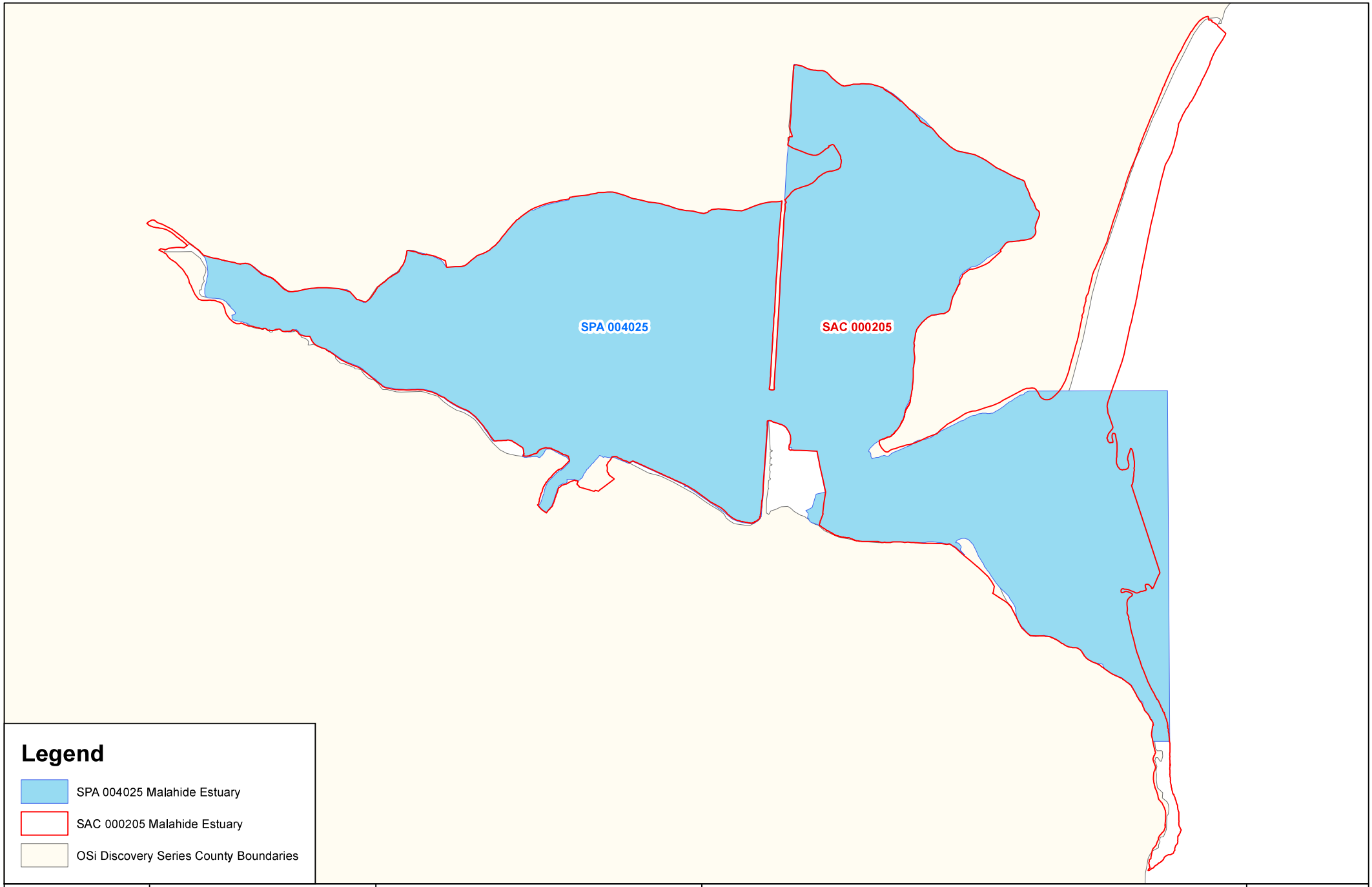
0 0.5 1 km

N

Boundaries of designated areas are subject to revision. Reproduced from Ordnance Survey material by permission of the Government (Permit number EN 0059212).

Féadfar athbhreithnithe a déanamh ar theorainneacha na gceantar comharthaithe. Macasamhail d'ábhar na Suirbhéarachta Ordonáis le chead ón Rialtas (Ceadunas Uimh. EN 0059212)

Site Code
SPA 004025
Version: 1.03
Map Version 1
Date: March 2013



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Department of Arts, Heritage and the Gaeltacht

MAP 2:
MALAHIDE ESTUARY SPA
CONSERVATION OBJECTIVES
ADJOINING / OVERLAPPING
DESIGNATIONS

Map to be read in conjunction with the NPWS Conservation Objectives Document.

0 0.5 1 km

N

Site Code
SPA 004025 version 1.03
SAC 000205 version 1.02
Map Version 1
Date: March 2013

Appendix 3

Conservation Objectives – Malahide Estuary SAC

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National Parks and Wildlife Service

Conservation Objectives Series

Malahide Estuary SAC 000205

An Roinn
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Introduction

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Favourable conservation status of a habitat is achieved when:

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

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, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Notes/Guidelines:

1. The targets given in these conservation objectives are based on best available information at the time of writing. As more information becomes available, targets for attributes may change. These will be updated periodically, as necessary.
2. An appropriate assessment based on these 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. It is essential that the date and version are included when objectives are cited.
3. Assessments cannot consider an attribute in isolation from the others listed for that habitat or species, or for other habitats and species listed for that site. A plan or project with an apparently small impact on one attribute may have a significant impact on another.
4. Please note that the maps included in this document do not necessarily show the entire extent of the habitats and species for which the site is listed. This should be borne in mind when appropriate assessments are being carried out.
5. When using these objectives, it is essential that the relevant backing/supporting documents are consulted, particularly where instructed in the targets or notes for a particular attribute.

Qualifying Interests

**** indicates a priority habitat under the Habitats Directive***

000205	Malahide Estuary SAC
1140	Mudflats and sandflats not covered by seawater at low tide
1310	*Salicornia* and other annuals colonising mud and sand
1320	*Spartina* swards (Spartinion maritimae)
1330	Atlantic salt meadows (Glauco-Puccinellietalia maritimae)
1410	Mediterranean salt meadows (Juncetalia maritimi)
2120	Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)
2130	Fixed coastal dunes with herbaceous vegetation (grey dunes)*

Please note that this SAC overlaps with Malahide Estuary SPA (004025). See map 2. The conservation objectives for this site should be used in conjunction with those for the overlapping site as appropriate.

Supporting documents, relevant reports & publications

Supporting documents, NPWS reports and publications are available for download from: www.npws.ie/Publications

NPWS Documents

Year :	2007
Title :	Saltmarsh Monitoring Project 2006
Author :	McCorry, M.
Series :	Unpublished report to NPWS
Year :	2009
Title :	Coastal Monitoring Project 2004-2006
Author :	Ryle, T.; Murray, A.; Connolly, C.; Swann, M.
Series :	Unpublished report to NPWS
Year :	2009
Title :	Saltmarsh monitoring project 2007-2008
Author :	McCorry, M; Ryle, T.
Series :	Unpublished report to NPWS
Year :	2013
Title :	Malahide Estuary SAC (site code 205) Conservation objectives supporting document- coastal habitats V1
Author :	NPWS
Series :	Conservation objectives supporting document
Year :	2013
Title :	Malahide Estuary SAC (site code 205) Conservation objectives supporting document- marine habitats V1
Author :	NPWS
Series :	Conservation objectives supporting document

Other References

Year :	2002
Title :	New atlas of the British and Irish flora
Author :	Preston, C.D.; Pearman, D.A.; Dines, T.D.
Series :	Oxford University Press, Oxford
Year :	2003
Title :	*Spartina* in Ireland. In: Wetlands in Ireland
Author :	McCorry, M.J.; Curtis, T.G.F.; Otte, M.L.
Series :	UCD Press, Dublin
Year :	2008
Title :	The phytosociology and conservation value of Irish sand dunes
Author :	Gaynor, K.
Series :	Unpublished PhD thesis, National University of Ireland, Dublin
Year :	2011
Title :	A survey of mudflats and sandflats in Ireland. An intertidal soft sediment survey of Malahide Estuary
Author :	ASU
Series :	Unpublished report to the Marine Institute and NPWS

Spatial data sources

Year :	Interpolated 2012
Title :	2010 intertidal survey
GIS Operations :	Polygon feature classes from marine community types base data sub-divided based on interpolation of marine survey data. Expert opinion used as necessary to resolve any issues arising
Used For :	1140, marine community types (maps 3 and 4)
Year :	2005
Title :	OSi Discovery series vector data
GIS Operations :	High water mark (HWM) and low water mark (LWM) polyline feature classes converted into polygon feature classes and combined; EU Annex I Saltmarsh and Coastal data erased out if present
Used For :	Marine community types base data (map 4)
Year :	Revision 2010
Title :	Saltmarsh Monitoring Project 2007-2008. Version 1
GIS Operations :	QIs selected; clipped to SAC boundary; overlapping regions with Coastal CO data investigated and resolved with expert opinion used
Used For :	1310, 1330, 1410 (map 5)
Year :	2009
Title :	Coastal Monitoring Project 2004-2006. Version 1
GIS Operations :	QIs selected; clipped to SAC boundary; overlapping regions with Saltmarsh CO data investigated and resolved with expert opinion used
Used For :	2120, 2130 (map 6)

1140 Mudflats and sandflats not covered by seawater at low tide

To maintain the favourable conservation condition of Mudflats and sandflats not covered by seawater at low tide in Malahide Estuary SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	The permanent habitat area is stable or increasing, subject to natural processes. See map 3	Habitat area was estimated using OSi data as 311ha
Community extent	Hectares	Maintain the extent of the *Zostera*-dominated community and the *Mytilus edulis*-dominated community complex, subject to natural processes. See map 4	Based on intertidal surveys undertaken in 2010 and 2011 (ASU, 2011). See marine supporting document for further information
Community structure: *Zostera* density	Shoots/m²	Conserve the high quality of the *Zostera*-dominated community, subject to natural processes	Estimated by the EPA during 2011 intertidal survey. See marine supporting document for further details
Community structure: *Mytilus edulis* density	Individuals/m²	Conserve the high quality of the *Mytilus edulis*-dominated community, subject to natural processes	Estimated during 2010 intertidal survey (ASU, 2011). See marine supporting document for further details
Community distribution	Hectares	Conserve the following community types in a natural condition: Fine sand with oligochaetes, amphipods, bivalves and polychaetes community complex; Estuarine sandy mud with Chironomidae and *Hediste diversicolor* community complex; and Sand to muddy sand with *Peringia ulvae*, *Tubificoides benedii* and *Cerastoderma edule* community complex. See map 4	Based on intertidal surveys undertaken in 2010 and 2011 (ASU, 2011). See marine supporting document for further information

1310 Salicornia and other annuals colonising mud and sand

To maintain the favourable conservation condition of *Salicornia* and other annuals colonising mud and sand in Malahide Estuary SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: Malahide Estuary- 1.93ha. See map 5	Based on data from Saltmarsh Monitoring Project (SMP) (McCorry, 2007). Habitat surveyed and mapped as a single sub-site, giving a total estimated area of 1.93ha. NB further unsurveyed areas maybe present within the site. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline, or change in habitat distribution, subject to natural processes. See map 5 for known distribution	Based on data from SMP (McCorry, 2007). *Salicornia* is an annual species, so its distribution can vary significantly from year to year. The largest area of *Salicornia* flats occurs in the outer estuary. See coastal habitats supporting document for further details
Physical structure: sediment supply	Presence/ absence of physical barriers	Maintain, or where necessary restore, natural circulation of sediments and organic matter, without any physical obstructions	Based on data from SMP (McCorry, 2007). Sediment supply is particularly important for pioneer saltmarsh community, as the distribution of this habitat depends on accretion rates. The saltmarsh habitats at this site have been disturbed in the past by the construction of the railway viaduct across the estuary. This has led to the development of more brackish or lagoonal-type conditions in the inner estuary and a reduced tidal range. See coastal habitats supporting document for further details
Physical structure: creeks and pans	Occurrence	Maintain creek and pan structure, subject to natural processes, including erosion and succession	Based on data from SMP (McCorry, 2007). Creeks deliver sediment throughout saltmarsh system. See coastal habitats supporting document for further details
Physical structure: flooding regime	Hectares flooded; frequency	Maintain natural tidal regime	Based on data from SMP (McCorry, 2007). This pioneer saltmarsh community requires regular tidal inundation. The viaduct that was built over the estuary in the 1800s has modified the tidal regime of the estuary over time and prevents the inner estuary emptying completely at low tide, thereby creating a lagoon. See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Based on data from McCorry (2007). At Malahide Island there are natural transitions between ASM and *Salicornia* flats and there are also transitions between ASM and sand dune habitats. Transitions between ASM and *Spartina* swards occur at the northern end of the outer estuary. See coastal habitats supporting document for further details
Vegetation structure: vegetation height	Centimetres	Maintain structural variation within sward	Based on data from McCorry (2007). Grazing by livestock is absent from Malahide Estuary resulting in a high vegetation cover and a wide range of sward heights. See coastal habitats supporting document for details
Vegetation structure: vegetation cover	Percentage cover at a representative sample of monitoring stops	Maintain more than 90% of area outside creeks vegetated	Based on data from SMP (McCorry and Ryle, 2009). See coastal habitats supporting document for details
Vegetation composition: typical species and sub-communities	Percentage cover	Maintain the presence of species-poor communities listed in SMP (McCorry and Ryle, 2009)	Based on data from SMP (McCorry and Ryle, 2009). See coastal habitats supporting document for further details

Vegetation structure: negative indicator species - *Spartina anglica*	Hectares	No significant expansion of common cordgrass (*Spartina anglica*). No new sites for this species and an annual spread of less than 1% where it is already known to occur	Based on data from SMP (McCorry, 2007). There is frequent *Spartina* recorded throughout the SAC. See coastal habitats supporting document for further details

1320 Spartina swards (Spartinion maritimae)

Spartina **swards (Spartinion maritimae) was originally listed as a qualifying Annex I habitat for Malahide Estuary SAC due to historical records of two rare forms of cordgrass– small cordgrass (*Spartina maritima*) and Townsend's cordgrass (*S . x townsendii.*). However, Preston et al. (2002) considers both forms to be alien. In addition, all stands of cordgrass in Ireland are now regarded as common cordgrass (*S. anglica*) (McCorry et al., 2003; McCorry and Ryle, 2009). As a consequence, a conservation objective has not been prepared for this habitat. It will therefore not be necessary to assess the likely effects of plans or projects against this Annex I habitat at this site.**

1330 Atlantic salt meadows (Glauco-Puccinellietalia maritimae)

To restore the favourable conservation condition of Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) in Malahide Estuary SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: Malahide Estuary - 25.33ha. See map 5	Based on data from Saltmarsh monitoring Project (SMP) (McCorry, 2007). Habitat surveyed and mapped as a single sub-site, giving a total estimated area of 25.33ha. NB further unsurveyed areas maybe present within the site. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline or change in habitat distribution, subject to natural processes. See map 5 for known distribution	Based on data from SMP (McCorry, 2007). The ASM is the most prominent saltmarsh habitat at this SAC. See coastal habitats supporting document for further details
Physical structure: sediment supply	Presence/ absence of physical barriers	Maintain natural circulation of sediments and organic matter, without any physical obstructions	Based on data from McCorry (2007). The saltmarsh habitats have been disturbed in the past by the construction of a railway viaduct across the estuary. This has led to the development of more brackish or lagoonal-type conditions in the inner estuary and a reduced tidal estuary. In spite of the M1 Broadmeadow motorway bridge having been constructed across the saltmarsh at Lissenhall (2001 -2003), the saltmarsh has remained more or less intact. See coastal habitats supporting document for further details
Physical structure: creeks and pans	Occurrence	Allow creek and pan structure to develop, subject to natural processes, including erosion and succession	Based on data from McCorry (2007). At Malahide Island the saltmarsh is in good condition. The ASM at Lissenhall is also in relatively good condition despite any disturbance resulting from construction of the M1 motorway bridge. See coastal habitats supporting document for further details
Physical structure: flooding regime	Hectares flooded; frequency	Maintain natural tidal regime	Based on data from McCorry (2007). The viaduct that was built over the estuary in the 1800s has modified the tidal regime of the estuary over time, which prevents the inner estuary emptying completely at low tide. therby creating a lagoon. See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Based on data from McCorry (2007). At Malahide Estuary ASM is the dominant saltmarsh habitat where it occurs in mosaic with other saltmarsh habitats, including '*Salicornia* and other annuals colonising mud and sand' and MSM. At Malahide Island there are also some natural transitions between the ASM and sand dune habitats. See coastal habitats supporting document for further details
Vegetation structure: vegetation height	Centimetres	Maintain structural variation within sward	Based on data from SMP (McCorry, 2007). Grazing by livestock is absent at this site. See coastal habitats supporting document for further details
Vegetation structure: vegetation cover	Percentage cover at a representative sample of monitoring stops	Maintain more than 90% area outside creeks vegetated	Based on data from SMP (McCorry and Ryle, 2009). See coastal habitats supporting document for further details
Vegetation composition: typical species and sub-communities	Percentage cover at a representative sample of monitoring stops	Maintain range of sub-communities with typical species listed in SMP (McCorry and Ryle, 2009)	See coastal habitats supporting document for further details

Vegetation structure: negative indicator species - *Spartina anglica*	Hectares	No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1% where it is known to occur	Based on data from SMP (McCorry and Ryle, 2009). *Spartina* is widely distributed throughout the SAC. See coastal habitats supporting document for further details

1410 Mediterranean salt meadows (Juncetalia maritimi)

To maintain the favourable conservation condition of Mediterranean salt meadows (*Juncetalia maritimi*) in Malahide Estuary SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes, including erosion and succession. For sub-site mapped: Malahide Estuary - 0.64ha. See map 5	Based on data from the Saltmarsh Monitoring Project (SMP) (McCorry, 2007). Habitat surveyed and mapped as a single sub-site (0.64ha). NB further unsurveyed areas maybe present within the site. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline, subject to natural processes. See map 5 for known distribution	Based on data from McCorry (2007). MSM only occurs in the outer estuary. See coastal habitats supporting document for further details
Physical structure: sediment supply	Presence/ absence of physical barriers	Maintain/restore natural circulation of sediments and organic matter, without any physical obstructions	Based on data from McCorry (2007). The saltmarsh habitats have been disturbed in the past by the construction of a railway viaduct across the estuary. This has led to the development of more brackish or lagoonal-type conditions in the inner estuary and a reduced tidal estuary. In spite of the M1 Broadmeadow motorway bridge having been constructed across the saltmarsh at Lissenhall (2001 -2003), the saltmarsh has remained more or less intact. See coastal habitats supporting document for further details
Physical structure: creeks and pans	Occurrence	Maintain creek and pan structure, subject to natural processes, including erosion and succession	Based on data from the SMP (McCorry, 2007). See coastal habitats supporting document for further details
Physical structure: flooding regime	Hectares flooded; frequency	Maintain natural tidal regime	Mediterranean salt meadows is found high up in the saltmarsh but requires occasional tidal inundation. Based on data from McCorry (2007). The viaduct that was built over the estuary in the 1800s has modified the tidal regime of the estuary over time, which prevents the inner estuary emptying completely at low tide. thereby creating a lagoon. See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain range of saltmarsh habitats including transitional zones, subject to natural processes including erosion and succession	Based on data from McCorry (2007). At Malahide Estuary there are mosaics of ASM, MSM and *Salicornia* flats. See coastal habitats supporting document for further details
Vegetation structure: vegetation height	Centimetres	Maintain structural variation in the sward	Based on data from McCorry (2007). Livestock grazing is absent from Malahide Estuary. See coastal habitats supporting document for further details
Vegetation structure: vegetation cover	Percentage cover at a representative sample of monitoring stops	Maintain more than 90% of area outside creeks vegetated	See coastal habitats supporting document for further details
Vegetation composition: typical species and sub-communities	Percentage cover at a representative sample of monitoring stops	Maintain range of sub-communities with characteristic species listed in SMP (McCorry and Ryle, 2009)	See coastal habitats supporting document for further details
Vegetation structure: negative indicator species - *Spartina anglica*	Hectares	No significant expansion of common cordgrass (*Spartina anglica*), with an annual spread of less than 1% where it is already known to occur	Based on data from McCorry (2007). *Spartina* is widely distributed throughout the SAC. See coastal habitats supporting document for further details. See coastal habitats supporting document for further details

2120 Shifting dunes along the shoreline with Ammophila arenaria (white dunes)

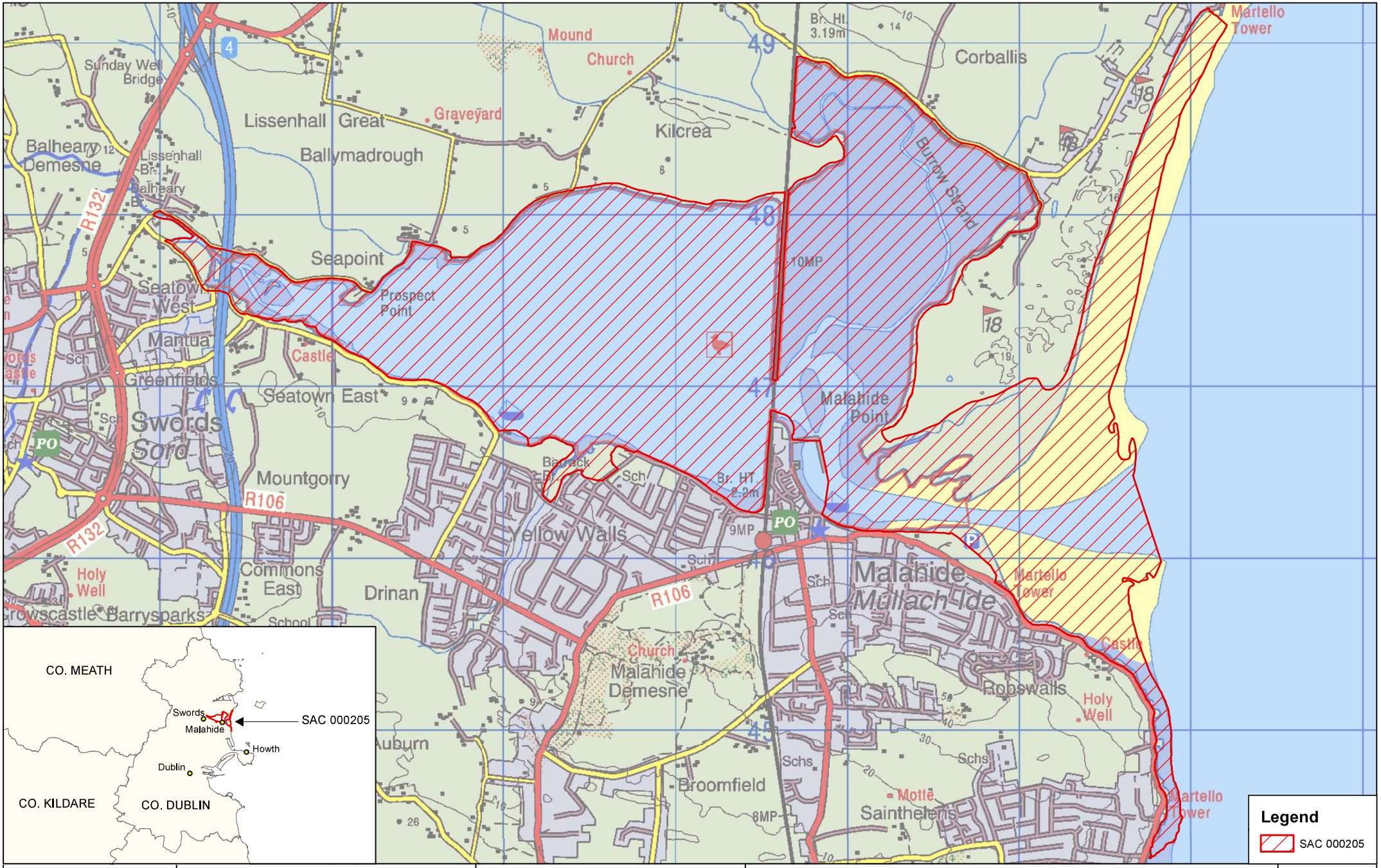
To restore the favourable conservation condition of Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes') in Malahide Estuary SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes including erosion and succession. Total area mapped: 1.80ha. See map 6	Based on data from the Coastal Monitoring Project (CMP) (Ryle et al., 2009). Habitat was mapped from a single sub-site - Malahide Island. Habitat is very difficult to measure in view of its dynamic nature. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline, or change in habitat distribution, subject to natural processes. See map 6 for known distribution	Based on Ryle et al. (2009). At Malahide Island the mobile dunes occur as a thin band along the northeastern edge of the spit. See coastal habitats supporting document for further details
Physical structure: functionality and sediment supply	Presence/ absence of physical barriers	Maintain the natural circulation of sediment and organic matter, without any physical obstructions	Based on Ryle et al. (2009). Dunes are naturally dynamic systems that require continuous supply and circulation of sand. Marram grass (*Ammophila arenaria)* reproduces vegetatively and requires constant accretion of fresh sand to maintain active growth encouraging further accretion. The mobile dunes at Malahide Island are undergoing some erosion along the north and eastern edge as well as some accretion to the south. See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Based on data from Gaynor (2008) and Ryle et al. (2009). At Malahide Island, there are transitional communities between a range of sand dune habitats as well as a range of saltmarsh habitats. See coastal habitats supporting document for further details
Vegetation composition: plant health of dune grasses	Percentage cover	95% of marram grass (*Ammophila arenaria*) and/or lyme-grass *(Leymus arenarius*) should be healthy (i.e. green plant parts above ground and flowering heads present)	Based on Ryle et al. (2009). See coastal habitats supporting document for further details
Vegetation composition: typical species and sub-communities	Percentage cover at a representative number of monitoring stops	Maintain the presence of species-poor communities dominated by marram grass (*Ammophila arenaria*) and/or lyme-grass (*Leymus arenarius*)	Based on Ryle et al. (2009). Sea holly (*Eryngium maritimum*) occurs occasionally throughout the mobile dunes at Malahide Island. See coastal habitats supporting document for further details
Vegetation composition: negative indicator species	Percentage cover	Negative indicator species (including non-natives) to represent less than 5% cover	Based on Ryle et al. (2009). Negative indicators include non-native species; species indicative of changes in nutrient status and species not considered characteristic of the habitat. Sea-buckthorn (*Hippophae rhamnoides*) should be absent or effectively controlled. This species has been planted on the seaward side of the spit as a coastal protection measure by the adjacent golf course. See coastal habitats supporting document for further details

2130 Fixed coastal dunes with herbaceous vegetation (grey dunes)

To restore the favourable conservation condition of Fixed coastal dunes with herbaceous vegetation ('grey dunes') in Malahide Estuary SAC, which is defined by the following list of attributes and targets:

Attribute	Measure	Target	Notes
Habitat area	Hectares	Area stable or increasing, subject to natural processes including erosion and succession. Total area mapped: 21.42ha. See map 6	Based on data from Coastal Monitoring Project (CMP) (Ryle et al., 2009). Habitat was mapped from a single sub-site- Malahide Island. See coastal habitats supporting document for further details
Habitat distribution	Occurrence	No decline, or change in habitat distribution, subject to natural processes. See map 6 for known distribution	Based on data from Ryle et al. (2009). The fixed dune habitat flanks the eastern and southern edge of Malahide Island. See coastal habitats supporting document for further details
Physical structure: functionality and sediment supply	Presence/ absence of physical barriers	Maintain the natural circulation of sediment and organic matter, without any physical obstructions	Physical barriers can lead to fossilisation or over-stabilisation of dunes, as well as beach starvation resulting in increased rates of erosion. Coastal protection works consisting of railway sleepers and chestnut paling have been installed on the seaward side of the spit. In addition, concrete filled plastic barrels and planting of sea buckthorn (*Hippophae rhamnoides*) are measures that have been used for coastal protection by the adjacent golf course. See coastal habitats supporting document for further details
Vegetation structure: zonation	Occurrence	Maintain the range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Based on data from Ryle et al. (2009). At Malahide Island, there are transitional communities between a range of sand dune habitats as well as a range of saltmarsh habitats. This site represents one of the more intact examples of a dune-saltmarsh complex on the northeastern coastline. See coastal habitats supporting document for further details
Vegetation structure: bare ground	Percentage cover	Bare ground should not exceed 10% of fixed dune habitat, subject to natural processes	Based on data from Gaynor (2008) and Ryle et al. (2009). See coastal habitats supporting document for further details
Vegetation structure: sward height	Centimetres	Maintain structural variation within sward	Based on data from Gaynor (2008) and Ryle et al. (2009). Grazing by livestock is absent from the dunes. See coastal habitats supporting document for further details
Vegetation composition: typical species and sub-communities	Percentage cover at a representative sample of monitoring stops	Maintain range of sub-communities with typical species listed in Ryle et al. (2009)	Based on data from Ryle et al. (2009). The protected and Red Data Book species hairy violet (*Viola hirta*) occurs at this site. See coastal habitats supporting document for further details.
Vegetation composition: negative indicator species (including *Hippophae rhamnoides*)	Percentage cover	Negative indicator species (including non-natives) to represent less than 5% cover	Based on data from Ryle et al. (2009). Negative indicators include non-native species, species indicative of changes in nutrient status and species not considered characteristic of the habitat. Sea-buckthorn (*Hippophae rhamnoides*) should be absent or effectively controlled. This species has been planted on the seaward side of the spit as a coastal protection measure by the adjacent golf course. See coastal habitats supporting document for further details
Vegetation composition: scrub/trees	Percentage cover	No more than 5% cover or under control	Based on data from Ryle et al. (2009). At Malahide Island, the fixed dune has been invaded by dog-rose (*Rosa canina*), privet (*Ligustrum* sp.) as well as single trees of turkey oak (*Quercus cerris*). See coastal habitats supporting document for further details



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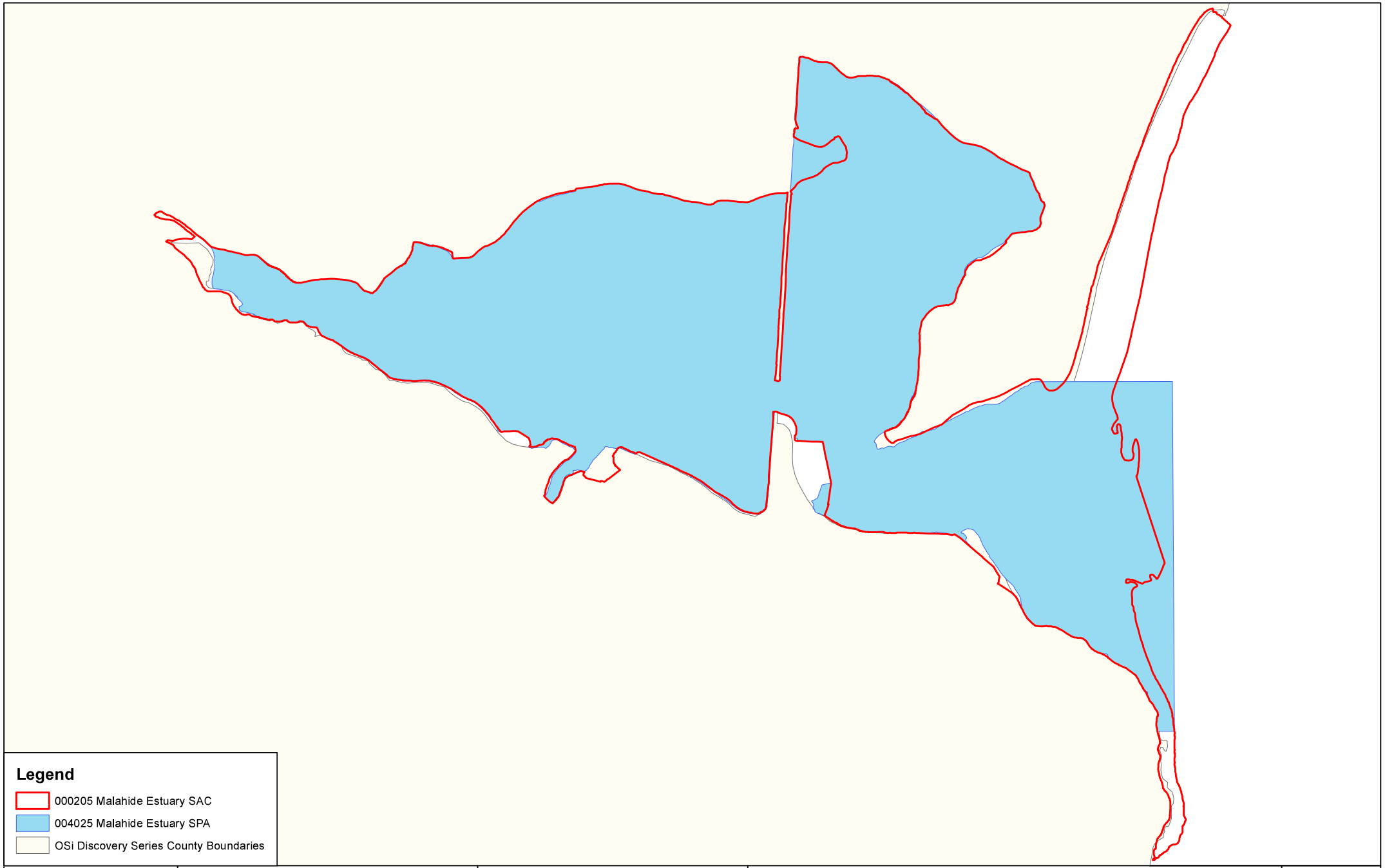
MAP 1:
MALAHIDE ESTUARY SAC
CONSERVATION OBJECTIVES
SAC DESIGNATION

Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE: SAC 000205
CO DUBLIN; version 1.02

Map Version 1
Date: October 2012



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MAP 2:
MALAHIDE ESTUARY SAC
CONSERVATION OBJECTIVES
ADJOINING / OVERLAPPING DESIGNATIONS

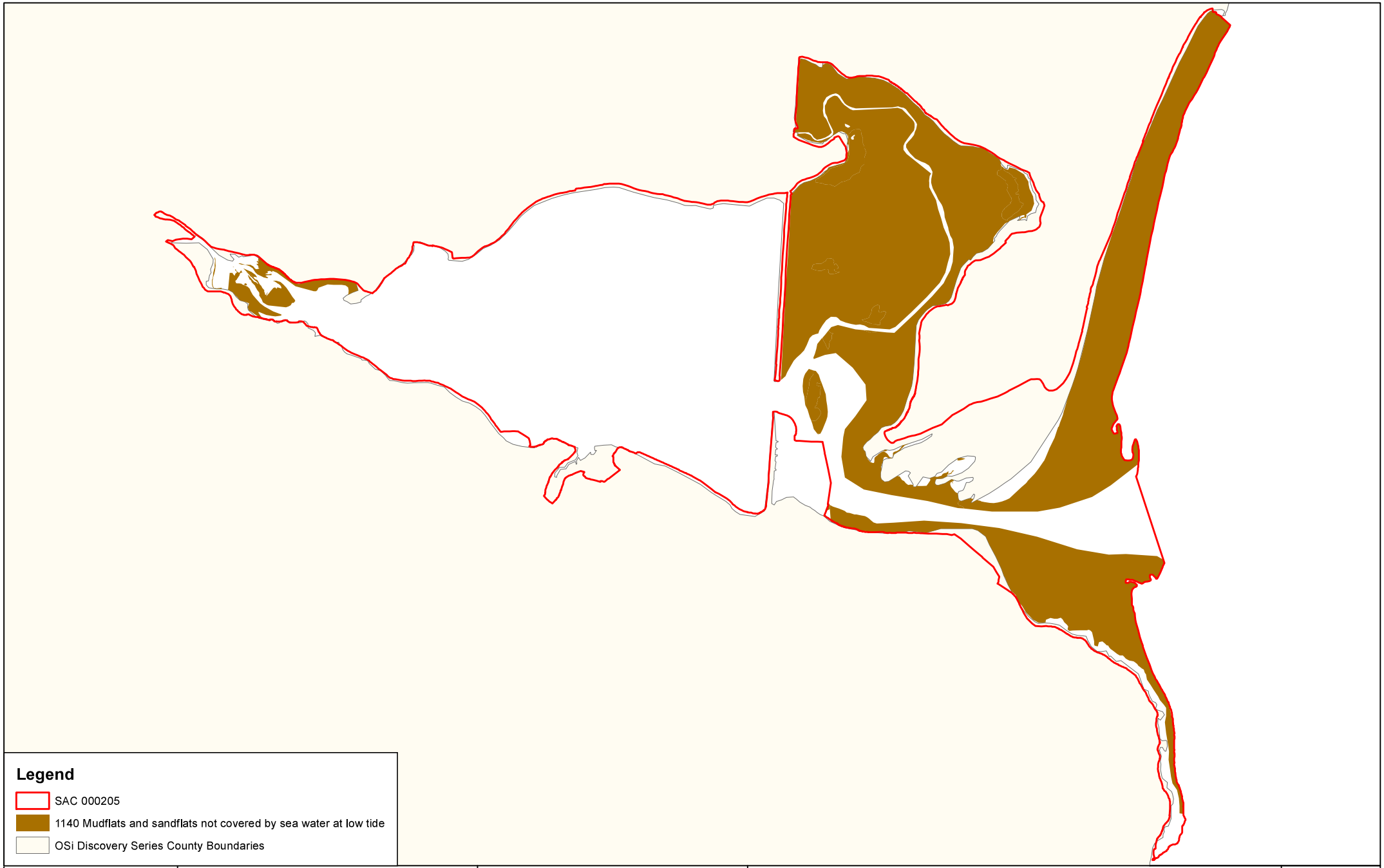
Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE: SAC 000205
CO DUBLIN; version 1.02

0 0.25 0.5 0.75 1 km

N

Map Version 1
Date: October 2012



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MAP 3:
MALAHIDE ESTUARY SAC
CONSERVATION OBJECTIVES
TIDAL MUDFLATS AND SANDFLATS

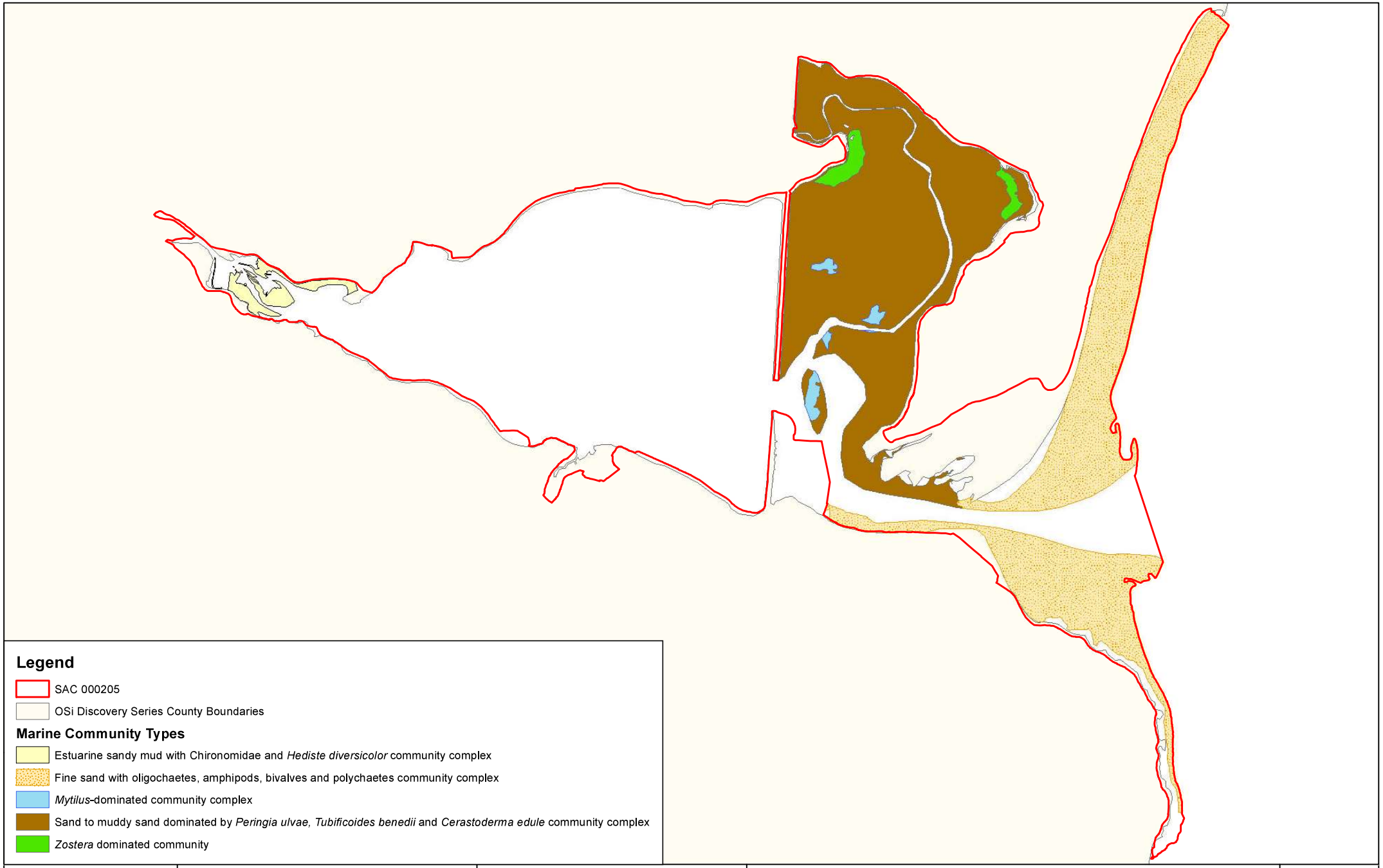
Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE: SAC 000205
CO DUBLIN; version 1.02

0 0.25 0.5 0.75 1 km

N

Map Version 1
Date: October 2012



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MAP 4:
MALAHIDE ESTUARY SAC
CONSERVATION OBJECTIVES
MARINE COMMUNITY TYPES

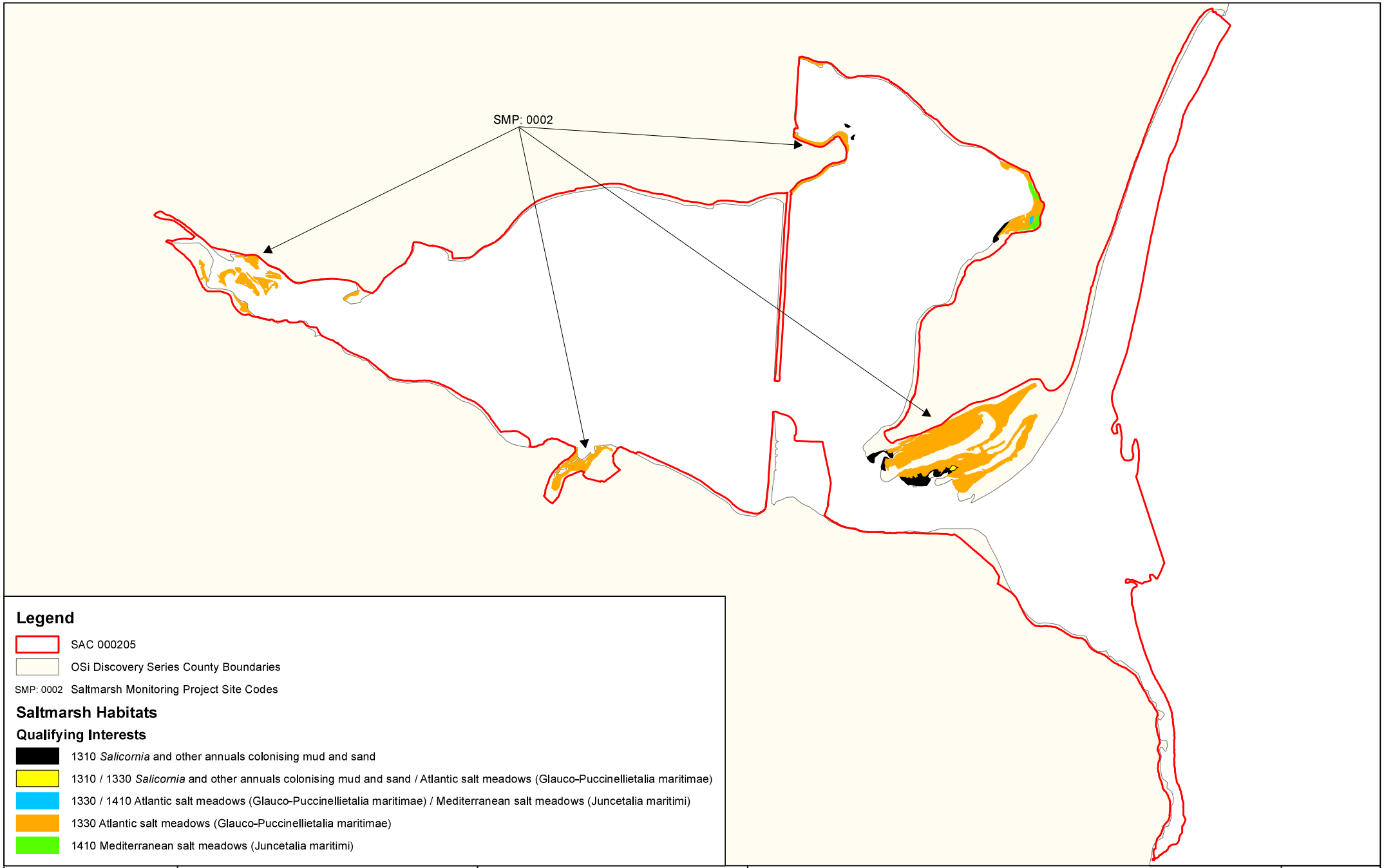
Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE: SAC 000205
CO DUBLIN; version 1.02

0 0.25 0.5 0.75 1 km

N

Map Version 1
Date: October 2012



Legend

SAC 000205

OSi Discovery Series County Boundaries

SMP: 0002 Saltmarsh Monitoring Project Site Codes

Saltmarsh Habitats

Qualifying Interests

1310 *Salicornia* and other annuals colonising mud and sand

1310 / 1330 *Salicornia* and other annuals colonising mud and sand / Atlantic salt meadows (Glauco-Puccinellietalia maritimae)

1330 / 1410 Atlantic salt meadows (Glauco-Puccinellietalia maritimae) / Mediterranean salt meadows (Juncetalia maritimi)

1330 Atlantic salt meadows (Glauco-Puccinellietalia maritimae)

1410 Mediterranean salt meadows (Juncetalia maritimi)

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MAP 5:
MALAHIDE ESTUARY SAC
CONSERVATION OBJECTIVES
SALTMARSH HABITATS

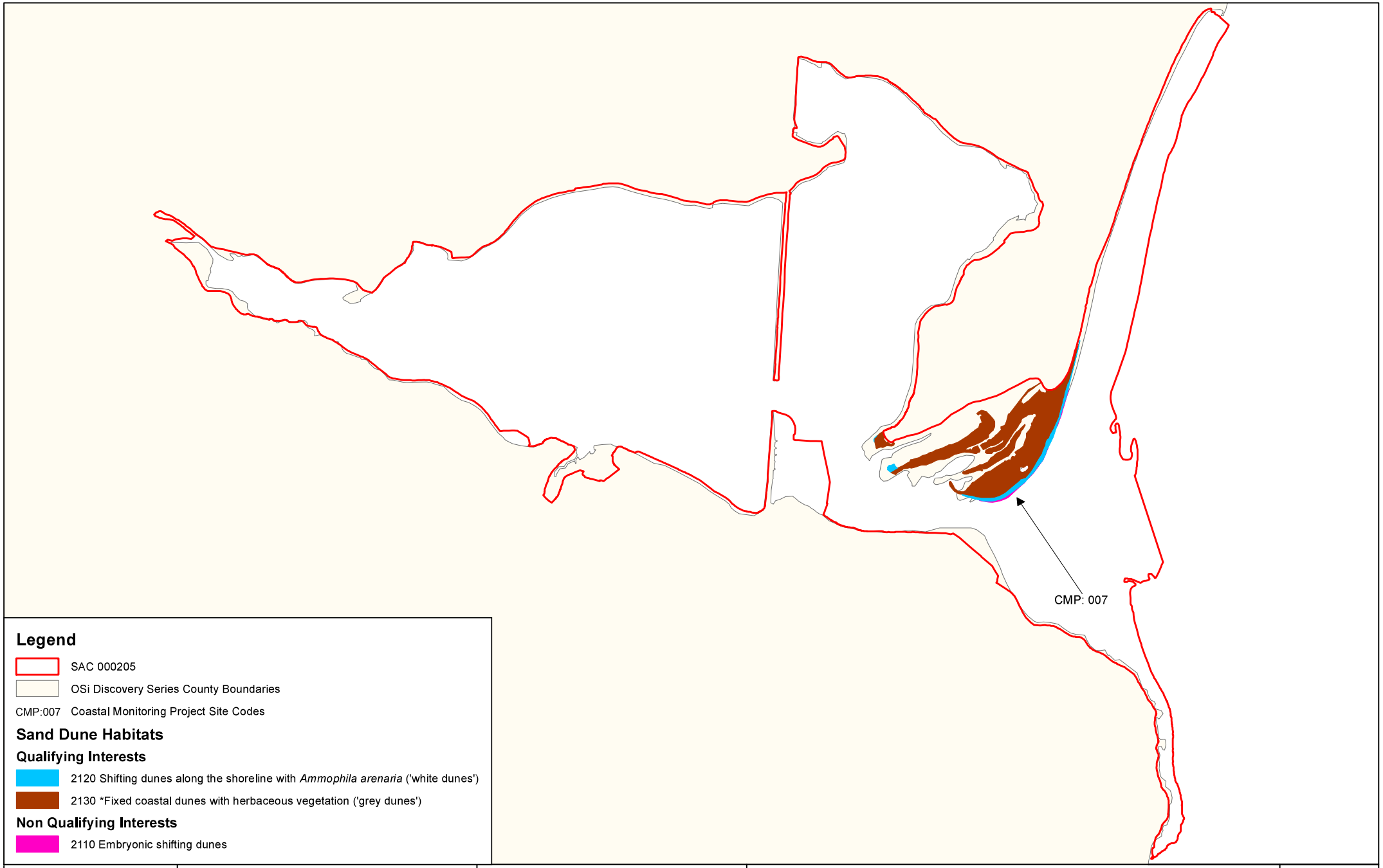
Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE: SAC 000205
CO DUBLIN; version 1.02

0 0.25 0.5 0.75 1 km

N

Map Version 1
Date: October 2012



Legend

SAC 000205

OSi Discovery Series County Boundaries

CMP:007 Coastal Monitoring Project Site Codes

Sand Dune Habitats

Qualifying Interests

2120 Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes')

2130 *Fixed coastal dunes with herbaceous vegetation ('grey dunes')

Non Qualifying Interests

2110 Embryonic shifting dunes

An Roinn Ealaíon, Oidhreachta agus Gaeltachta
Department of Arts, Heritage and the Gaeltacht

MAP 6:
MALAHIDE ESTUARY SAC
CONSERVATION OBJECTIVES
SAND DUNE HABITATS

Map to be read in conjunction with the NPWS Conservation Objectives Document.

SITE CODE: SAC 000205
CO DUBLIN; version 1.02

0 0.25 0.5 0.75 1 km

N

Map Version 1
Date: October 2012

Appendix 4

Lighting Design

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BROADMEADOW WAY
NEWBRIDGE HOUSE TO MALAHIDE
CO DUBLIN

REPORT ON
PROPOSED PUBLIC LIGHTING INSTALLATIONS

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BROADMEADOW WAY
NEWBRIDGE HOUSE TO MALAHIDE
CO DUBLIN

REPORT ON
PROPOSED PUBLIC LIGHTING INSTALLATIONS

1.0 Introduction

It is envisaged that the proposed project would be a flagship scheme for tourism in the Malahide & Donabate area and be a model for recreational walking and cycling in Ireland. It will also exemplify how a sustainable trail can be built and integrated into a national cycle network, public transport, heritage sites, employment centres and local amenities.

The main objectives of this scheme are to:

- Provide an attractive first class pedestrian and cycle route;
- Encourage a larger modal shift (from private to public transport) and promote physical activity among local communities;
- Increase pedestrian and cycle activity in Malahide and Donabate villages
- Provide access to scenic areas normally inaccessible to mobility impaired users.
- Improve access within the Malahide and Donabate area and the Malahide Estuary locally.
- Provide a recreational amenity that can be recognised locally, nationally and internationally as a first rate tourist attraction.

The proposed greenway will allow the two demesnes to act together in advertising their individual attractions and also the link between the two public parks will allow for future joint development of enhanced accessibility proposals.

2.0 Requirement for Lighting of the Trail

It is envisaged that there will be a number of user types who will utilise the Broadmeadow Trail. A proportion of these users will use the trail during the hours of darkness. The projected number of persons who will use the trail is outlined in the traffic report. Examples include:

- A large number of foreign tourists visit the Malahide area throughout the entire year. It is envisaged that a number of these tourists will use the trail to travel to Malahide from the Donabate side or Donabate from the Malahide side to avail of the amenities of Malahide Castle or Newbridge House. These tourists will use this trail with the expectation of being able to travel back to their starting point by use of the trail and it is unlikely that they will be aware of the time constraints if the trail was unlit. An unlit trail will render this return journey undesirable and will effectively make the trail unsafe and undesirable particularly during late autumn and early spring.

- It is anticipated that a large number of domestic tourists will also use the trail. Malahide and Donabate provide popular destinations to the domestic market and the users will also have the expectation of being able to travel back to their starting point by use of the trail and it is unlikely that they will be aware of the time constraints if the trail was unlit.

- Local businesses and leisure attractions will be accessed via the trail by local residents. Examples would be local golf courses at Donabate and Malahide as well as the shopping facilities at Malahide Castle and Malahide Village. Many of these activities will extend into early evening / night time and an unlit trail will render their return journey undesirable thus making the trail unsafe to use and increasing car usage.

- Cyclists from the Donabate area who will use the trail to access the regular DART service from Malahide station to travel to work. Over the period between late autumn and early spring (i.e. winter), commuters will return to Malahide by Dart and will wish to complete their journey by cycling/walking but will not be prepared to do so if the trail is unlit. The only viable alternative would be to change trains to the next northern commuter service stopping at Donabate. This would be a disincentive to utilise cycling / Dart public transport. The other alternative would be for the cyclist to travel around the estuary on the road network (partly unlit) to Donabate which is not practical due to the distance involved and the absence of safe cycle paths along the entire route.

- Pedestrians from the Donabate area who will use the trail to access the regular DART service from Malahide station to travel to work. Over the period between late autumn and early spring, the pedestrians may return to Donabate by the trail. The only viable alternative would be to change trains to the next northern commuter service stopping at Donabate. This would be a disincentive to utilise Dart public transport.

- A lit trail will serve to extend the useful hours of this amenity during all times of the year as users will be aware that the trail will be lit for their return journey.

3.0 Basis of Lighting Design

There is a balance to be struck between the increased amenity and transportation value of the trail and the desire for darkness.

The benefits to be gained by adults and children being able to use the facility after dark must be balanced against the potential environmental impact. This balance is achievable by the use of controlled optics, new sources of illumination, careful placement of lighting equipment and design.

The introduction of new LED light sources has made the above goals easily achievable compared to older conventional light sources. LED light sources are easily controllable using digital signals; for example, they can easily switch on to 100% instantly or dim smoothly to 10% (or less) output and are therefore highly responsive to pedestrian traffic (i.e. the trail can be lit with a 'glow' of light with the lights dimmed at 10% and as soon as the pedestrian is detected, the lights rise to full output.

Of particular relevance to exterior lighting on this trail is the issue of light pollution in all of its forms. Any new lighting installation makes an impact on the night-time environment and this has to be balanced against the needs of the trail users in terms of amenity and safety. Lighting on this trail will extend the use of the trail well into the late evening, contributing to a real and perceived sense of security at night, enhancing the night-time experience for visitors and residents alike.

The trail lighting will also be used as a means to guide people, in much the same way as a road sign or traffic signal.

In addition to the visual impact, there are a number of other aspects that were considered in the development of the lighting design: the creation of a safe and pleasant environment, the appropriate use of energy, ease of maintenance and harmonising the appearance of the lighting equipment with its surroundings.

The trail lighting design will ensure that artificial light is delivered to the point where it is required, and nowhere else. Issues such as brightness, direction and context how being considered in the development of the external lighting design to ensure that light pollution and light spill is avoided.

In the development of the lighting scheme, the following issues were also considered:

- Visual brightness and contrast
- Light colour
- Colour rendering
- Visual clutter

Visual brightness and contrast determines the appearance of the lit installation and its relationship to the surroundings. The brightness of the installation has been addressed by controlling the light output which the directs the light onto the trail. Contrast has been addressed by the colour of the light output.

Colour rendering is the ability of the lighting to reveal the colours of various objects accurately in comparison to their true colours. This is important in facial recognition along the trail and the light source been chosen with good colour rendering ability.

Visual clutter can be defined as a visually chaotic scene, caused by the inclusion of multiple elements of street furniture without consideration of the overall scene, which detracts from the overall quality of the environment. Street furniture contributing to visual clutter can include (but is not limited to) such items as lighting columns, signage, litter bins, pedestrian barriers, planters, benches and bollards.

The proposed lighting scheme addresses the issue of visual clutter along the entire length of the trail by the specification of a common and uniform lighting design with a common mounting height of all luminaires.

4.0 Determination of Areas of Illumination & Light Levels

The trail will be used by pedestrians and cyclists only. The area to be illuminated is the surface of the trail. The design illuminance on the trail surface is proposed to be 7.5 lux with a minimum of 1.5 lux. This illuminance complies with IS EN 13201:2015 Class P3. For comparison purposes, a full moon illuminates the ground surface to approximately 0.1 lux. A bright sunny day results in an illuminance level of in excess of 100,000 lux. The new Donabate Distributor Road design illumination is 15 lux average.

The trail illumination also provides a sense of safety for users and the selection of a 7.5 lux average illuminance level makes it possible to make out facial features of other trail users. This has an added social dimension in identifying trail users to each other as opposed to simply moving dark shapes.

The trail will be used for cyclists and pedestrians and a higher light level is required in a situation in which cycling and pedestrians are using the trail as opposed to a pedestrian only trail. The factors determining the design illumination are travel speed of pedestrians / cyclists, projected intensity of usage, ambient light levels and the requirement for facial recognition.

Light spill onto the water in the estuary had been addressed and minimised in two ways. Firstly, each light fitting will have an optic which will direct light onto the trail surface only. Secondly, the light fitting will be placed such that the rear of the fitting is facing the estuary. The resultant light levels immediately behind the luminaire are 6 lux, 500mm behind the luminaire at 4 lux, 1m behind the luminaire and 2 lux reducing to 0 lux 1.5m behind he luminaire. At an average distance between the luminaire and the water's edge of 2.5m, the spill light onto the water will be zero.

The existing ambient light in the Donabate area as well as across the causeway is mainly a product of passing traffic. Traffic levels on the Hearse Road (R126) are high as this road is the main road into Donabate (approx. population circa 7,500 persons). Testing by the author on a single car travelling along a darkened road with dipped beam and full headlights has indicated a surface illuminance of approximately 20 lux for dipped lights and 30 lux for full beam headlights approximately 4m in front of the car.

The new Donabate Distributor Road will be illuminated to ME3 standard (15 lux average illuminance). The trail will be illuminated to 50% of this level at maximum output from the lighting installation.

The causeway is used by the Commuter and Intercity rail services. This usage introduces a high ambient light level due to the headlights of the trains as well as the spill light from the carriage windows. Services are frequent and are projected to become more frequent with the proposed extension of the DART system to Balbriggan. We would estimate that the illumination as a result of the headlights on a moving train would give similar illumination results than that of the car illustrated above (20 lux for dipped lights and 30 lux for full beam headlights).

Reflected light from a surface is a function of the reflective properties of that surface. The trail will generally have a Dense Bitumen Macadam (DBM) surface finish. These finishes are generally dark in colour or black and these finishes have low reflectance values (less than 10%). There will therefore not be any perceptible 'sky glow' from the trail lighting. A considerable amount of 'sky glow' is visible from the existing villages of Malahide and Donabate.

The height of the proposed luminaire above the trail surface is selected at 1.8m. The current average height for an Irish Male is approximately 1.76m. The luminaire is therefore positioned immediately above this height which will serve to provide some illumination to the pedestrian's face thus aiding in identification of facial features of other trail users.

5.0 Luminaire Design

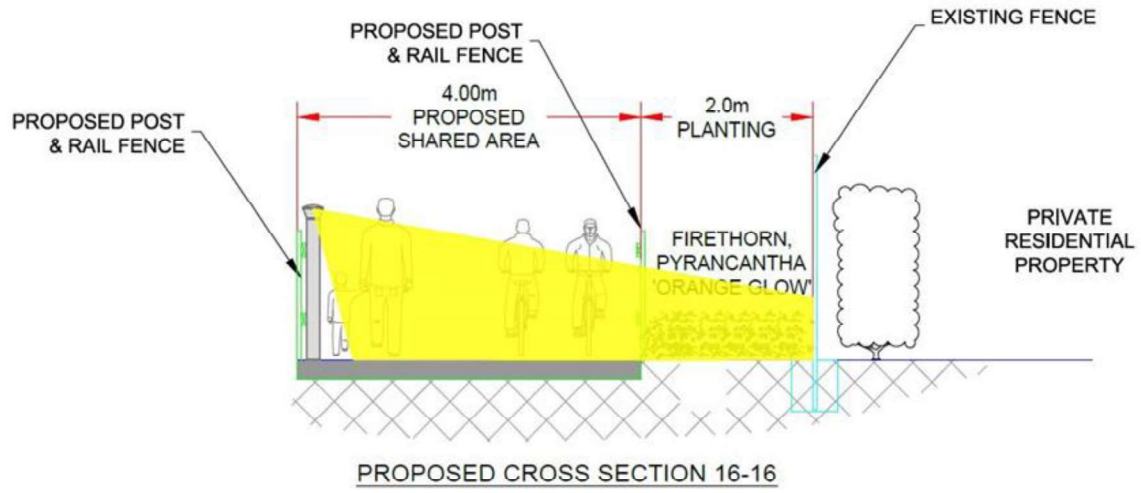
The following factors were taken into account when deciding on the specification of the luminaires:

- The luminaire design and lighting level must be consistent throughout the entire length of the trail.
- Light emission must be directed to the trail surface and light spillage to other surfaces including to the rear of the fitting must be eliminated.
- Luminaires should be high quality and robust.
- Luminaires must have high efficacy (power to lumen output ratios).
- Luminaires must have low maintenance requirements.
- Luminaires must have a constant height throughout the entire length of the trail.
- A minimum number of luminaires only must be used to achieve the required light levels.
- On the causeway, the luminaires must be positioned such that light is directed away from the estuary.
- The luminaire source must be controllable down to 10% of maximum output.
- The luminaire must be capable of being fully controllable by SCADA / PLC controls incorporating presence/absence detection and time scheduling.
- The luminaire shall be minimalist design.

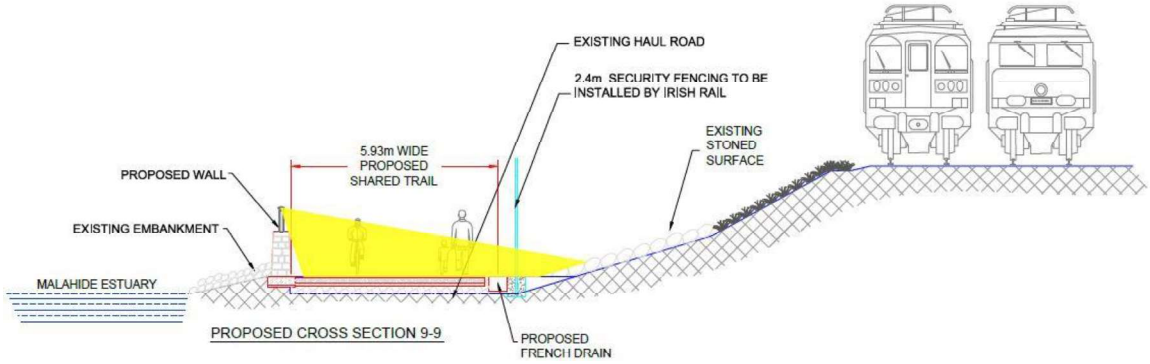
The luminaire chosen is of the asymmetric type. The fitting will have a light emission 180o below the head of the luminaire. However, the luminaire optics will be designed to prevent light emission from the rear of the luminaire (180°). Luminaires will generally be 1.8 meters high along the trail but the luminaires shall be mounted on the causeway wall crossing the estuary. The causeway wall is waist high and therefore the luminaire will be shorter along this section to maintain the 1.8m mounting height for the luminaire. This will ensure consistency of height and illumination levels along the entire length of the trail. The distance between each fitting will be approximately 15m.

The light source for the entire trail will be LED. This source was chosen for its high efficacy (power to lumen output ratio) and long service life (60,000 hours). The LED chip is a high quality unit which is not affected by repeated switching on and off. The luminaire will be manufactured in cast aluminium and rated IP 65 and IK08. The lens will be polycarbonate and the entire finish of the fitting will be RAL 9006. This is a grey colour which will tend to blend into the background during daylight hours over the length of the trail.

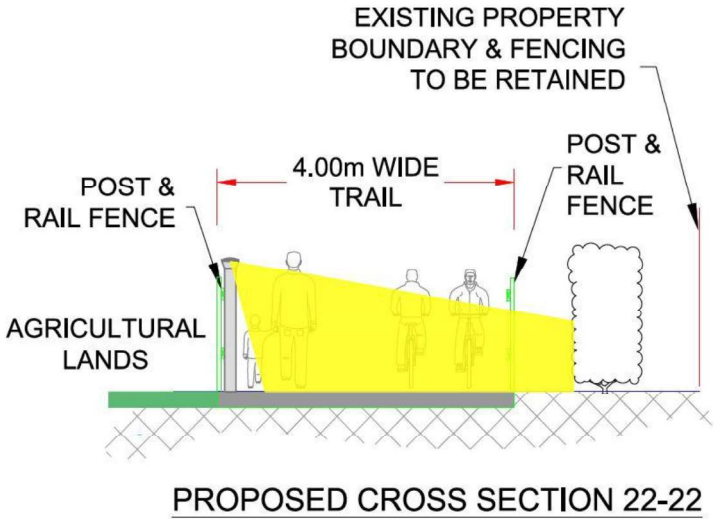
The following sections through the trail at (a) open area and (b) the causeway (c) open area illustrates the position of the luminaire along with an indication of the approximate spread of light across the trail surface.



(a) Proposed Section Through Open Lands with Luminaire Mounted on Side of Trail. Spread of Light from Luminaire Shown in Yellow.



(b) Proposed Section Through Causeway with Luminaire Mounted on Top of Wall. Spread of Light from Luminaire Shown in Yellow.



(c) Proposed Section Through Open Lands with Luminaire Mounted on Side of Trail. Spread of Light from Luminaire Shown in Yellow.

6.0 Control of Lighting Installation

It is proposed that the entire lighting installation be controlled by a PLC (Programmable Logic Controller). All luminaires will be fitted with dimmable control gear (Dali type) which will provide fully adjustable levels from less than 10% to 100% output. Lighting will be switched on by photoelectric cell control. This cell will be used to switch on the lights at a predetermined light level. This will ensure that lighting will only be activated during the hours of darkness.

It is also proposed that the lighting also be controlled by occupant detection. At dusk, the lighting in the Kilcrea area and along the causeway will be switched on at approximately 20% of output by the use of photoelectric cells to determine the availability or lack of daylight. This will ensure that persons wanting to use the trail can clearly see that lighting is available. The lighting along the trail will be controlled in groups on 10No luminaires for control / switching purposes. As soon as a person is detected on any part of the trail, the lighting in that section (10No light fittings) will be brought to 100%. If no persons are detected on the trail following a predetermined period of time, the lighting will then reduce back to 20% of output. Currently, the last trains serving Donabate and Malahide arrive or depart these stations at around midnight. It is envisaged that the lighting of the trail be switched off automatically at around 12:30am. However, if a person is detected on the trail, lighting will be energised to 100% until movement ceases.

Currently, the first morning trains serving Donabate and Malahide arrive or depart these stations around 6am. It is envisaged that the lighting of the trail be switched on at 20% of output at approximately 5.45am. Any movement on the trail will bring the lighting to 100% in the control section (10No luminaires) until the lighting is switched off for the morning under the control of the photoelectric cell (i.e. when sufficient daylight is available).

All of the above sequences may be fully controlled by the use of the PLC. A number of mini pillars containing the electrical supply to the lighting and a controller will be required at intervals along the length of the trail. These mini pillars will be recessed into structures along the trail to minimise visual clutter. Programming and any required reprogramming of the system will be by laptop.

7.0 Luminaire Layout & Resultant Lighting Levels

The following drawings are appended to this report:

- Appendix A – Illustrative Glow Plan of the general area including the effect of the new Donabate Distributor Road and ignoring the effects of passing traffic on unlit roads and passing train traffic on the causeway.

- Appendix B – Illustrative Glow Plan of the general area including the effect of the new Donabate Distributor Road and including the effects of passing traffic on unlit roads and passing train traffic on the causeway.

- Appendix C – Illustrative Glow plan of the area following luminaire installation

- Appendix D - Illuminance levels on typical sections on the surface of the trail.

- Appendix E – Illustrative rendering of resulting lighting levels on the trail following installation in comparison with the resulting lighting levels on the new Donabate Distributor Road.

APPENDIX A

Illustrative Glow Plan of the Area including the effect of the new Donabate Distributor Road and ignoring the effects of passing traffic on unlit roads and passing train traffic on the causeway.


Donabate Golf Club
Balcarrick Golf Club
Donabate
Newbridge Demesne
Island Golf Club
Malahide
SHORELINE
SHORELINE
SHORELINE
SHORELINE
SHORELINE
SHORELINE
SHORELINE
SHORELINE
SHORELINE
SHORELINE
Google

APPENDIX B

Illustrative Glow Plan of the Area including the effect of the new Donabate Distributor Road and including the effects of passing traffic on unlit roads and passing train traffic on the causeway.


Donabate Golf Club
Balcarrick Golf Club
Donabate
Newbridge Demesne
Island Golf Club
Malahide
SHORELINE
SHORELINE
SHORELINE
SHORELINE
SHORELINE
SHORELINE
SHORELINE
SHORELINE
SHORELINE
SHORELINE
Google

APPENDIX C

Illustrative Glow Plan of the area following luminaire installation

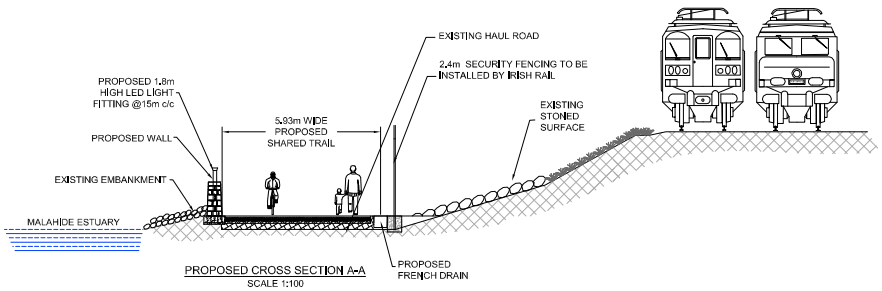

Donabate Golf Club
Balcarrick Golf Club
Donabate
Newbridge Demesne
Island Golf Club
SHORELINE
SHORELINE
SHORELINE
SHORELINE
SHORELINE
SHORELINE
SHORELINE
SHORELINE
SHORELINE
SHORELINE
Malahide
Google

APPENDIX D

Proposed illuminance levels on typical sections on the surface of the trail.

This drawing is produced using the Irish Grid Geographic Coordinate System

A1



PROPOSED CROSS SECTION A-A
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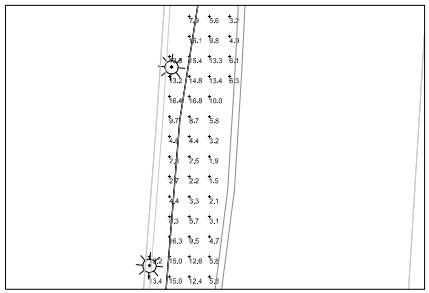

LUX LEVELS AT CROSS SECTION A-A
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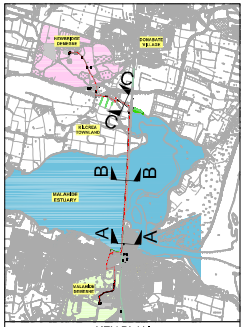

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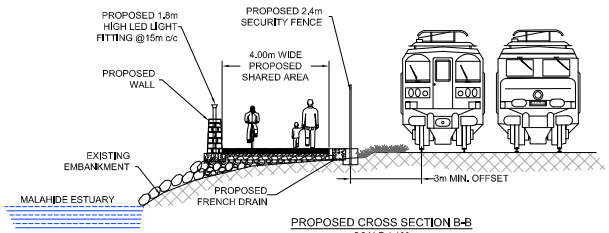

PROPOSED CROSS SECTION B-B
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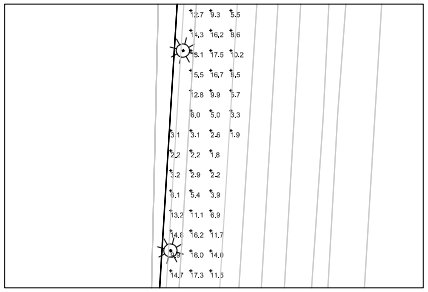

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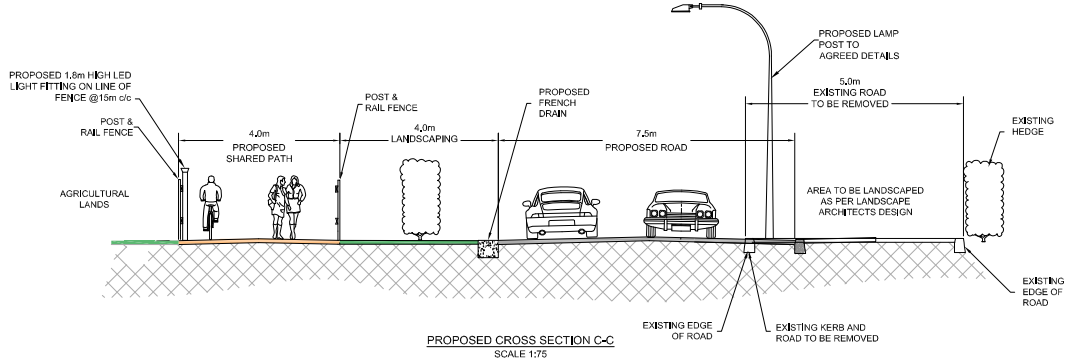

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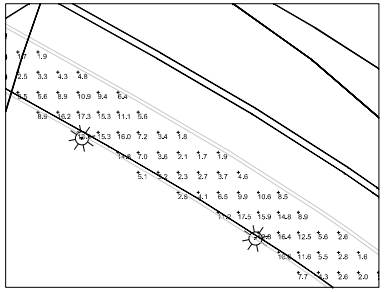

LUX LEVELS AT CROSS SECTION C-C
SCALE 1:200

Clifton Scannell Emerson Associates

Planning | FEB 2018 | CSEA

Revision	Description	Initials	Date

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Fingal County Council

Client

Broadmeadow Way

Project

Lux Levels on Broadmeadow Way

Dwg. Title

Drawn By: AMS | Date: Feb 2018

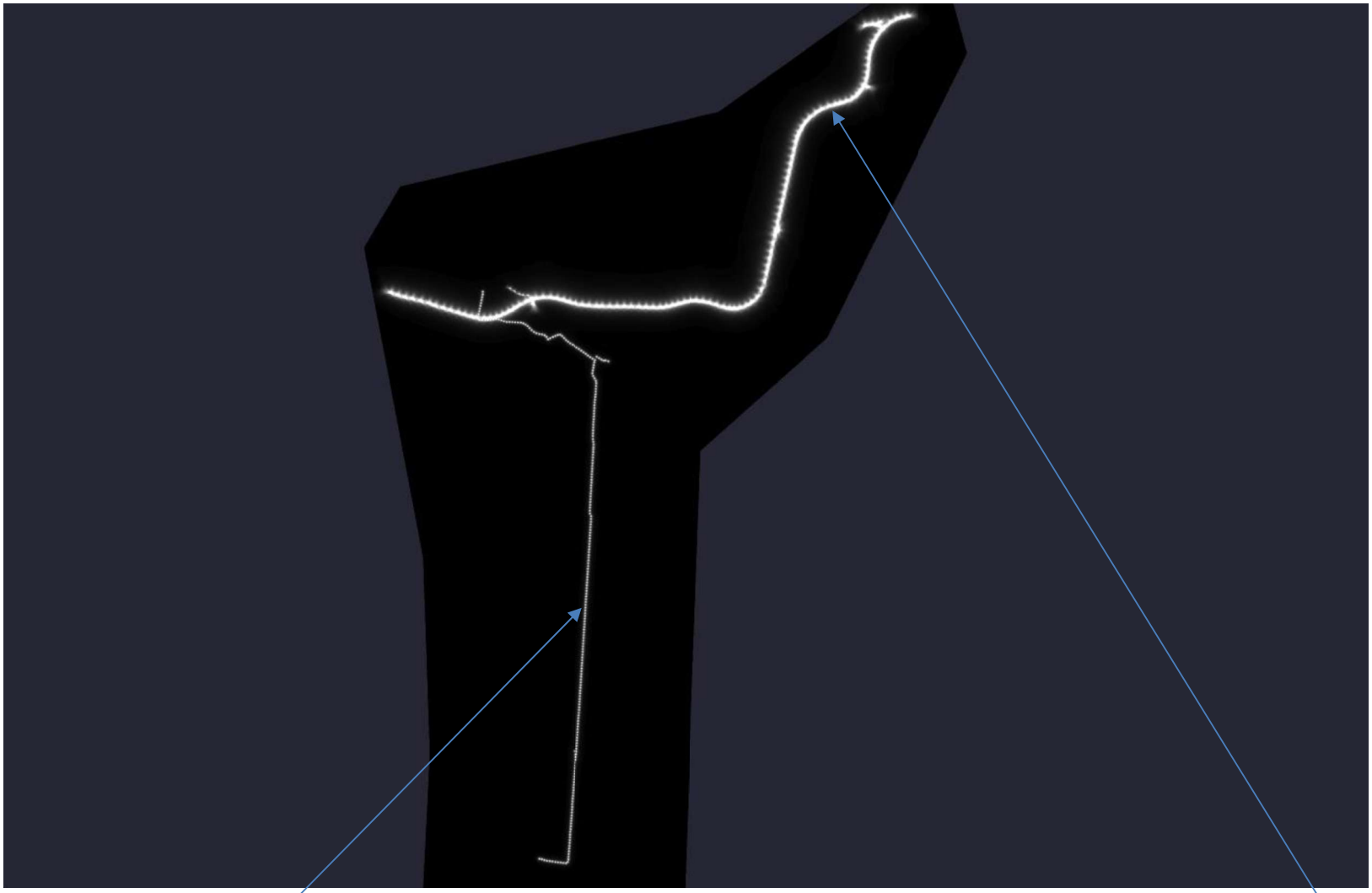
Checked by: PD | Scale: As Shown @ A1

Dwg. Progress: DRAFT

Dwg. No.: 12_160_245

APPENDIX E

Illustrative rendering of resulting lighting levels on the trail following installation in comparison with the resulting lighting levels on the new Donabate Distributor Road.


Broadmeadow Trail
Donabate Distributor Road

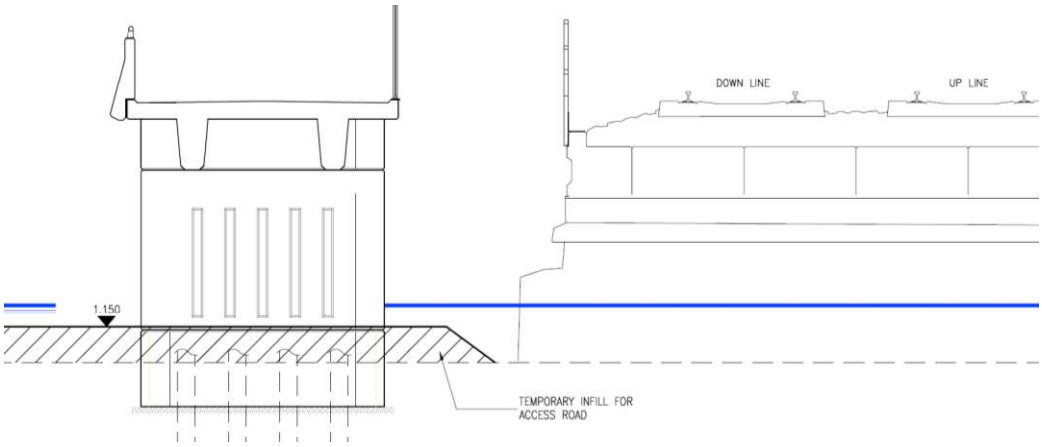
Appendix 5

Malahide Viaduct Reinstatement
Computer Modelling for Environmental Analysis

Malahide Viaduct Reinstatement

Temporary Works

Computer modelling for Environmental Analyses



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July 2015

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Malahide Viaduct Reinstatement

Temporary Works

Computer modelling for Environmental Analyses

July 2015

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TABLE OF CONTENTS

GLOSSARY OF TERMS

Terms	Definition
2-D model	A depth-averaged models that assume uniform velocity and hydrostatic pressure along water depth, and considering vertical velocities and accelerations to be negligible.
3-D model	Process of developing a mathematical representation of any three-dimensional surface of object via specialized software or in laboratory.
Armouring	Protective covering (e.g. rocks) used to prevent erosion damage to coastal and fluvial structures, banks, beds and beaches.
Attenuating	Gradual reduction
Bathymetry	A study of underwater depth of lake or ocean floors, and usually refers to the measurement of ocean depth through depth sounding.
Bed roughness	(see roughness coefficient)
Breach of defences	A structural failure at a flood defence allowing water to flow through.
Boundary condition	Conditions applied on the model open boundaries.
Catchment	The area that is drained by a river or artificial drainage system.
Climate change	Long-term variations in global temperature and weather patterns, which occur both naturally and as a result of human activity, primarily through greenhouse gas emissions.
Coastal erosion	The gradual wearing away of the coastline through a combination of wave attack and, in the case of coastal cliffs, slope processes (e.g. high groundwater levels). This may include cliff instability, where coastal processes result in the periodic reactivation of landslide systems or promote rock falls.
Coastal flooding	Flooding from the sea which is caused by higher than normal sea levels and/or high waves resulting in these a overflowing onto the land.
Computer model	(see mathematical model)
Continuity	The fundamental law of hydrodynamics, which states that, for incompressible fluids and for flow independent of time, the sun of differential changes in flow velocities in all directions must ne zero.
Conveyance function	When a river overflows its banks, it continues to flow over the flood plain, conveying water down-stream, as well as storing water where the flood plain may be obstructed and releasing it slowly.
Coriolis force	Directed normal to the direction of the movement and proportional in magnitude to the speed of the moving body.
Design iterations	Various trial designs which were tested and evaluated.
Model domain	Spatial area comprised in models.
Enhanced weir	Modified weir to provide long term stability and safety.
Environmental Impact Assessment (EIA)	Pursuant to EU Directive 85/ 337/ EEC (as amended in 1997), EIA is a legislative procedure used for identifying the environmental effects of development projects to be applied to the assessment of the environmental effects of certain public and private projects which are likely to have significant effects on the environment.
Erosion	A process of weathering and transport of solids (sediment, soil, rock and other particles) in the natural environment or their source and deposits them elsewhere.
Estuary	The mouth of a river, subject to tidal effects, where fresh water and sea water mix.

Terms	Definition
Estuarial flooding	Flooding from an estuary, where water level may be influenced by both river flows and tidal conditions, with the latter usually being dominant.
Exposure	Quantification of the receptors that may be influenced by a water.
Fetch	The area of water in which waves are generated by a wind having a fairly constant direction and speed. Sometimes used synonymously with "fetch length," the horizontal distance over which a wind generates waves.
Finite-difference model	A digital computer model based upon a rectangular grid that sets the boundaries of the model and the nodes where the model will be solved.
Flooding (or inundation)	Flooding is the overflowing of water onto land that is normally dry. It may be caused by overtopping or breach of banks or defences, inadequate or slow drainage of rainfall, underlying groundwater levels or blocked drains and sewers. It presents a risk only when people, human assets and ecosystems are present in the areas that flood.
Floodplain	A floodplain is any low-lying area of land next to a river or stream, which is susceptible to partial or complete inundation by water during a flood event.
Fluvial flooding	Flooding from a river or other watercourse.
Flume	An open channel constructed of wood, steel, or reinforced concrete and used to convey water for various purposes, including grade control.
Froudian criteria	A type of hydraulic modelling where model results are extrapolated to prototype (e.g. river or estuary) using scaling laws based on similarity of Froude Number in model and prototype.
Froude number	A hydraulic number representing the ratio of inertia forces and gravity forces action upon water, and making it possible to distinguish between subcritical and supercritical flow velocities.
GCM	Global Climate Model.
Gabions	Rock-filled wire cages used on streams for erosion control and construction of dams and other structures.
Geometrical similarity	Similarity of shape and the geometric characteristics can usually be described by a series of lengths and angles.
Geotechnical	Study of soils and rocks.
Groundwater flooding	Flooding caused by groundwater escaping from the ground when the water table rises to or above ground level.
Hybrid models	Combining two or more models (e.g. physical and mathematical) in a solution method is hybrid modelling. Hybrid models attempt to use the best modelling methods available for each "part" of hydraulic problems.
Hydraulic	Study of flow in rivers, canals, pipes and structures using fundamental laws and equations.
Hydraulic characteristic	Hydraulic performance such as relationship between water level and flow rate.
Hydraulic control	A point in open channel river or estuarine flow where there is a definite relationship between water level and flow rate.
Hydraulic jump	A phenomenon in the science of hydraulics which is frequently observed in open channel flow such as rivers and spillways. When liquid at high velocity discharges into a zone of lower velocity, a rather abrupt rise (a step or standing wave) occurs in the liquid surface.
Hydrology	The study of the occurrence, distribution and chemistry of all waters of the earth.
Hydrostatic	Conditions when the pressure on a fluid at rest is isotropic; i.e., it acts with equal magnitude in all directions.
Laboratory model	(see physical model)

Terms	Definition
Manning's number	A resistance coefficient used in the Manning equation for uniform steady flow.
Mathematical model	A model that simulates a system's behaviour by a set of equations, perhaps together with logical statements, by expressing relationships between variables and parameters.
Model calibration	The process by which the independent variables of a digital computer model are varied in order to calibrate a dependent variable against a known value.
Model verification	The process by which a computer model that has been calibrated is tested to see if it can generate a transient response that matches the known history of the water body.
Modelling	The simulation of physical or abstract phenomenon or system with another system believed to obey the same physical laws or abstract rules of logic, in order to predict the behaviour of the former by experimenting with the latter.
Neap tides	When the Moon is at first quarter or third quarter, the Sun and Moon are separated by 90° when viewed from the Earth, and the solar gravitational force partially cancels the Moon's. At these points in the lunar cycle the tide's range is at its minimum.
Non uniform flow	If at a given instant, the velocity or depth is not the same at every point the flow is non-uniform.
Numerical model	(see mathematical model)
Overtopping of defences	Failure of a flood defence or exceedance mechanism, when flood water reaches levels that are higher than the flood defence level and flows over the top of the structure. While the structure may remain stable, however, erosion of the landward face of the defence could cause the defence to collapse.
Permeability	The property of a porous substance, as rock or a membrane, of allowing the flow of a fluid through it.
Physical model	A smaller or larger physical copy of an object. The geometry of the model and the object it represents are often similar in the sense that one is a rescaling of the other. In such cases the scale is an important characteristic.
Reno mattresses	A low profile flexible wire basket filled with stones and used to control scour.
Roughness coefficient	A dimensionless parameter appearing in Manning's equation for uniform steady flow in open canals, related to surface irregularity and material retardance of the wetted perimeter.
Run-off	The flow of water, caused by rainfall, from an area which depends on how permeable the land surface is. Run-off is greatest from impermeable areas such as roofs, roads and hard standings and less from vegetated areas – moors, agricultural and forestry land.
Runoff coefficient	A parameter (0 to 1) which quantifies the degree of permeability of surfaces.
Scour	The removal of sediment around or near structures located in flowing water.
Seepage	The slow movement of water though small cracks, pores, or interstices of a material, in or out of a body if surface or subsurface water.
Sensitivity analysis	A study of how the variation (uncertainty) in the output of a mathematical model can be apportioned, qualitatively or quantitatively, to different sources of variation in the input of a model.

Terms	Definition
Simulation	A technique of representing the real world by a computer program; "a simulation should imitate the internal processes and not merely the results of the thing being simulated".
Source	Source refers to a source of hazard (e.g. the sea, heavy rainfall).
Spatial resolution	Defines the density of information produced from the flood risk assessment process across the area of interest. A mosaic of flood risk data produced by different tools and base data, with a range of certainty in the output.
Spring tides	Around new and full moon when the Sun, Moon and Earth form a line, the tidal force due to the Sun reinforces that due to the Moon. The tide's range is then at its maximum.
Steady state	A fluid motion in which the velocities at every point of the field are independent of time in either magnitude or direction.
Toe	The lower portion of a channel bank or where a levee slope meets the ground or river bed.
Topography	The configuration of a surface and the relations among its man-made and natural features.
Turbulent flow	Flow of water, agitated by cross-currents and eddies, as opposed to laminar flow. Any particle may move in any direction with respect to any other particle, and the head loss is approximately proportional to the second power of the velocity.
Uniform flow	Flow of water with no change in depth or any other element of flow (ie cross-sectional area, velocity, and hydraulic gradient) from section to section along a canal.
Unsteady flow	Flow in which the velocity changes, with time, in magnitude or direction.

1 Introduction

The computer modelling of the Malahide Weir and the Broadmeadows estuary have been explained in detail in previous Technical Papers by University College Cork in 2010 [1,2,3,4,5]. The As-Constructed 2010/2011 design of the Malahide Weir was based on those Technical Papers. In the design of weir profile in 2010 the requirements of NPWS were also adopted to reinstate the Broadmeadows Estuary to its historic condition. An important requirement was that the birdlife feeding and breeding grounds, on the mud-flats area at the western end of the estuary, be restored and have the same periods of time submerged and exposed during the tidal cycle as had existed previously. The mud-flats are on a very shallow gradient so consequently a small variation in water level has an effect over a wide area. A conservative design approach was taken in the mathematical model to ensure that the NPWS requirements were met.

To strengthen the weir stability the stone material was added to both the eastern and western faces of the weir, which considerably widened the weir width. Having strengthened and re-profiled the top face of the weir in accordance with the submission to NPWS it was found that the weir performance had 'over-shot' the target. The Broadmeadows estuary retained a lesser volume of water than before and considerably more area of mud-flats was exposed throughout the tidal cycle.

As the water levels within the Broadmeadows estuary for As-Constructed 2010/2011 weir were found to be lower than historic water levels, a revised mathematical model was developed in October 2011 [6]. In November 2011 the NPWS approved the application to adjust the weir. On the basis of the New Design Weir [6] the adjustment works were carried out in 2012 in order to improve the hydraulic effect of the weir on the wider estuary.

The performance of the New Design Weir was hydraulically tested and elaborated in University College Cork report from July 2012 [7]. A comparison of the recorded and historic water levels showed that the weir replicates the hydrodynamic conditions on entire Broadmeadows estuary and throughout the tidal cycle that occurred before the collapse of the weir.

Figure 1. New Design Weir at Malahide Viaduct during ebb tide, looking west

There is now a need for construction of a greenway on the western weir side. For the footbridge construction it is necessary to create a temporary access adjacent to the western face of the railway viaduct, extending across the full length of the viaduct. This temporary access will be constructed on the top of the weir and the road surface level will be elevated above the original weir level to a level of +1.15mOD.

As the increase of weir crest level will affect the hydrodynamic conditions of inner estuary and the mud-flats exposure during the tidal cycle, a 2-D computer model of the temporary works was developed. This report '*Malahide Viaduct Reinstatement: Temporary Works - Computer modelling for Environmental Analyses'* gives computer results and simulations for the New Design Weir (from 2011) and for the weir with temporary works in place. The Report includes:

- Set-up of a detailed Mike21 computer model for the weir with temporary works in place
- Analysis of estuary hydrodynamics at neap and spring tides
- Water extent analysis at neap low and spring low

The main aim of computer modelling was to determine the hydrodynamic performance of the weir with temporary works in place and to check the mud-flats exposure at the inner estuary. The performance was analysed by comparing water levels and water extent for the Temporary Works Weir and the New Design Weir. The water levels for the Temporary Works were also compared to the 2010 data on spring and neap water levels. The 2010 water

levels are related to the weir in the emergency conditions that prevailed after viaduct collapse with an access road constructed at similar top surface level as the temporary infill.

This study involved the analysis of the hydrodynamics of the inner and the entire Broadmeadow estuary for the Temporary Works and the New Design Weir by comparing water levels at four control points. The dynamics of the inner estuary was analysed at control point 3-1, located closer to the motorway bridge, and control point 3-2, located in the western estuary (Appendix 1, Appendix 2). In such a way, the dynamics of the inner estuary (points 3-1, 3-2) could be compared to the dynamics on the weir (point 1-1) and to the eastern estuary (point 1-2).

2 Computer model for Temporary Works

2.1 SET-UP OF A DETAILED MIKE21 COMPUTER MODEL FOR THE TEMPORARY WORKS

As presented in *Technical Paper 4* the Mike21 model of the Broadmeadow estuary was set-up on four complementary computational domains (see Appendix 9), as follows:

- A basic 9.9m grid resolution domain for the entire estuary area
- A 3.3m sub-grid domain at the inner estuary
- A sub-grid domain around the weir at 3.3m grid spacing
- A 1.1m grid spacing domain for the weir crest

The Mike21 model has two open boundaries: upper as inflow boundary from the Broadmeadow and Ward Rivers, and lower as the tidal boundary at the bay inlet (see Appendix 1 and Appendix 2).

The Mike 21 model of the weir crest (a 1.1m grid spacing domain) for Temporary Works was set-up on the basis of the New Design Weir but to include temporary infill for access road (Appendix 5 and Appendix 6). The temporary infill will be placed on the western face of the viaduct with surface level at +1.15mOD.

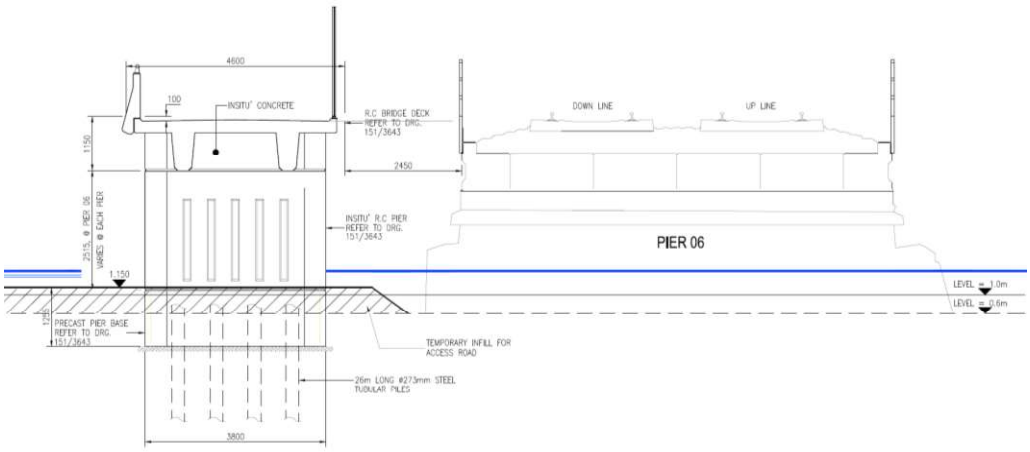


Figure 2. East-west elevation profile of the temporary infill

The infill for access road will level the weir profile on the entire length of the weir and in approx. width of 13.3m (Appendix 5 and Appendix 6). The weir profile along the viaduct centreline and along the eastern side will be unchanged (Appendix 7). The top infill at +1.15mOD is actually the lowest that

levels the weir profile (Appendix 8) and as such makes the minimum changes for the weir geometry.

Presented infill of the weir crest, together with the original bathymetry surveys, are combined into a single database with bed level specified relative to Ordnance Datum (Malin Head). A computer modelled DEM of the New Design Weir crest is shown in Appendix 3 and Appendix 4, and of the Temporary Works crest is shown in Appendix 5 and Appendix 6.

2.2 MIKE21 MODEL PARAMETERS

Using the detailed Mike21 model, simulations were performed for the entire Broadmeadow estuary. Two open boundaries are located on the Broadmeadow River (upper boundary) and on the bay inlet (lower boundary), as shown in Appendix 1. Computer simulations for the neap and spring tides were performed by using recorded water levels at control point 1-2 as the lower boundary condition, and a constant river inflow of 0.5m^3/s for neap and 1.0m^3/s for spring tides as the upper boundary condition.

The model parameters for Temporary Works were overtaken from the computer simulations for the New Design Weir, except that additional bed roughness value was used for the temporary infill. Computer simulations were performed by using bed roughness values on the outer (9.9m spacing) and middle (3.3m spacing) domains at $n_{9.9m}$=$n_{3.3m}$=0.03, together with a constant Smagorinsky coefficient at s=0.50. For the weir crest (1.1m spacing), a bed roughness value $n_{1.1m}$ is: $n_{1.1m}$ = 0.090 for neap tides (shallower depths) and $n_{1.1m}$ = 0.066 for spring tides.

Several initial test runs were simulated in order to estimate the bed roughness for the temporary infill. The infill will be most probably made of the crushed stones, so the test simulations were performed by using bed roughness values of 0.035, 0.025 and 0.015 for the infill area. Having obtained the test results the adopted value of bed roughness value for the infill area is 0.025.

3 Model results for Temporary Works

3.1 ESTUARY HYDRODYNAMICS DURING NEAP TIDES

Appendix 11 shows water levels during neap tides for New Design Weir (magenta), for Temporary Works (orange) and recorded levels in April 2010 (green). The first two figures show water levels at the weir (WSE 1-1 and WSE 1-2). Although the water levels at control point 1-2 on the eastern side are similar (New Design Weir, Temporary Works and April 2010), the water levels at control point 1-1 on the western side are the highest for the Temporary Works. The water levels on the western side (WSE 1-1) are around +0.80mOD for the New Design Weir and +0.95mOD for Temporary Works, and at constant level of +1.20mOD for the Temporary Works.

As the neap tide level in the estuary of +1.20mOD for the Temporary Works is 0.05m higher than the top infill level of +1.15mOD, the computed water levels for the neap tides are found to be reliable. The temporary infill will raise the invert levels of weir crest channels by 0.55m (from +0.60mOD to +1.15mOD), so 0.40m water level increase from the New Design Weir +0.80mOD to +1.20mOD for the Temporary Works is found to be realistic.

April 2010 recordings during neap tides (Appendix 11, second figure) show constant water level decrease on the western weir side (WSE 1-1), and most likely is a result of water seepage through the weir profile. Such decrease is not evident for the Temporary Works (orange), which may suggests that the water level of +1.20mOD in the estuary for the Temporary Works at neap tides are slightly conservative and could be somewhat lower.

The 3rd figure in Appendix 11 shows water levels in the estuary during neap tides at the weir (WSE 1-1) and on the inner estuary (WSE 3-1 and WSE 3-2). For the New Design Weir water surface slopes from the +0.90mOD at the inner estuary to +0.80mOD at the weir, while for the Temporary Works water level is constant at +1.20mOD on the entire estuary. This implies that there would be an additional back-up in the estuary during neap tides for the Temporary Works.

The 4th figure in Appendix 11 shows flow velocities in the estuary during neap tides at the weir (Vel 1-1) and on the inner estuary (Vel 3-1 and Vel 3-2). The increase of water levels at inner estuary results in the decrease in flow velocities from 0.20m/s of the New Design Weir to 0.05m/s for the Temporary Works (Vel 3-1).

3.2 ESTUARY HYDRODYNAMICS DURING SPRING TIDES

Appendix 12 shows water levels during spring tides for New Design Weir (magenta), for Temporary Works (orange) and recorded levels in March 2010 (green). The first two figures show water levels at the weir (WSE 1-1 and WSE 1-2). Although the water levels at control point 1-2 on the eastern side are similar (New Design Weir, Temporary Works and April 2010), the water levels at control point 1-1 show different behaviour. The peak flood tide levels in the estuary (WSE 1-1) are the same for the New Design Weir and for the Temporary Works (around +1.72mOD), and are lower than March 2010 recordings (around +1.80mOD). The spring lows for the Temporary Works are increased by 0.20m when compared to the spring lows for both the New Design Weir and the March 2010 recordings.

The 3rd figure in Appendix 12 shows water levels in the estuary during spring tides at the weir (WSE 1-1) and on the inner estuary (WSE 3-1 and WSE 3-2). Water levels for points 3-1 and 1-1 show no water surface slopes in the estuary for both the New Design Weir and the Temporary Works. Apart from the water level increase for the Temporary Works there will be no significant change of estuary hydrodynamics during spring tides.

The 4th figure in Appendix 12 shows flow velocities in the estuary during spring tides at the weir (Vel 1-1) and on the inner estuary (Vel 3-1 and Vel 3-2). The increase of water levels at inner estuary results in the decrease in flow velocities from 0.10m/s the New Design Weir to 0.05m/s for the Temporary Works (Vel 3-1).

3.3 EXPOSURE AT NEAP LOW AND SPRING LOW

The morphology of the inner estuary can be divided into two parts: the upper and the lower part. The upper part has generally higher ground levels, and it is characterised by distinctive streams together with well defined and steeper channel banks. In the lower part streams are shallow, and the channel banks are less defined and shallow. This morphological difference gives different hydrodynamics and water extent at these two parts of the inner estuary.

During a four-day simulated tidal event (12th to 16th March 2011), neap low in the western Broadmeadow estuary occurred on the 15th March, at 06:09

hours (Appendix 11), resulting in maximum land exposure for the simulated neap tide period. Appendix 13 shows water surface maps on the inner estuary at neap low for the New Design Weir (magenta) and the Temporary Works (orange). The 3rd figure shows a comparison of water surfaces between two geometry cases. It can be seen that in the upper part of the inner estuary the water extent is similar between two geometry cases. In the lower part it can be seen that land exposure for the Temporary Works is significantly smaller compared to the New Design Weir.

For the simulated tidal event of the 19th to 21st March 2011, the spring low in the western Broadmeadow estuary occurred on the 20th March 2011, at 09:34 hours (Appendix 12), resulting in a maximum land exposure for the simulated spring tide period. Appendix 14 shows water surface maps on the inner estuary at spring low for the New Design Weir (magenta) and the Temporary Works (orange). The 3rd figure shows a comparison of water surfaces between two geometry cases. It can be seen that there is no significant land exposure difference between the two geometry cases in the lower part. In the upper part the land surface is somewhat less exposed for the Temporary Works compared to the New Design Weir.

4 Conclusions

1. The top of the temporary infill at +1.15mOD provides minimal changes to the New Design Weir while enables a reasonable amount of access to the footbridge during tidal cycle.

2. Several computer simulations have been carried out for spring and neap tides to test the weir performance with the temporary infill. Computed water levels at the weir and in the estuary for the Temporary Works during neap and spring tides are found to be realistic.

3. The access road construction will raise the neap and spring tide water levels in the Broadmeadows estuary and will raise the volume of water retained within the estuary during the tidal cycle. A consequent effect will be that the mud-flats on the inner estuary will be submerged for a longer period of time during the tidal cycle.

4. The weir profile currently in place (New Design Weir) must be maintained into the future. Therefore, whatever temporary works are to be carried out when constructing the footbridge must, on completion of those works, reinstate the weir to its current profile and in accordance with the approval granted by NPWS from November 2011.

5 References

[1] Eamon McKeogh, Damir Bekic, *Malahide Viaduct Reinstatement: Technical Paper 1 - Collapse Mechanism and Initial Emergency Works*, Flood Study Group University College Cork, May 2010.

[2] Eamon McKeogh, Damir Bekic, *Malahide Viaduct Reinstatement: Technical Paper 2 - Physical Models*, Flood Study Group University College Cork, May 2010.

[3] Eamon McKeogh, Damir Bekic, *Malahide Viaduct Reinstatement: Technical Paper 3 - Computer Models and Hybrid Modelling*, Flood Study Group University College Cork, May 2010.

[4] Eamon McKeogh, Damir Bekic, *Malahide Viaduct Reinstatement: Technical Paper 4 - Computer modelling for Environmental Analyses*, Flood Study Group University College Cork, May 2010.

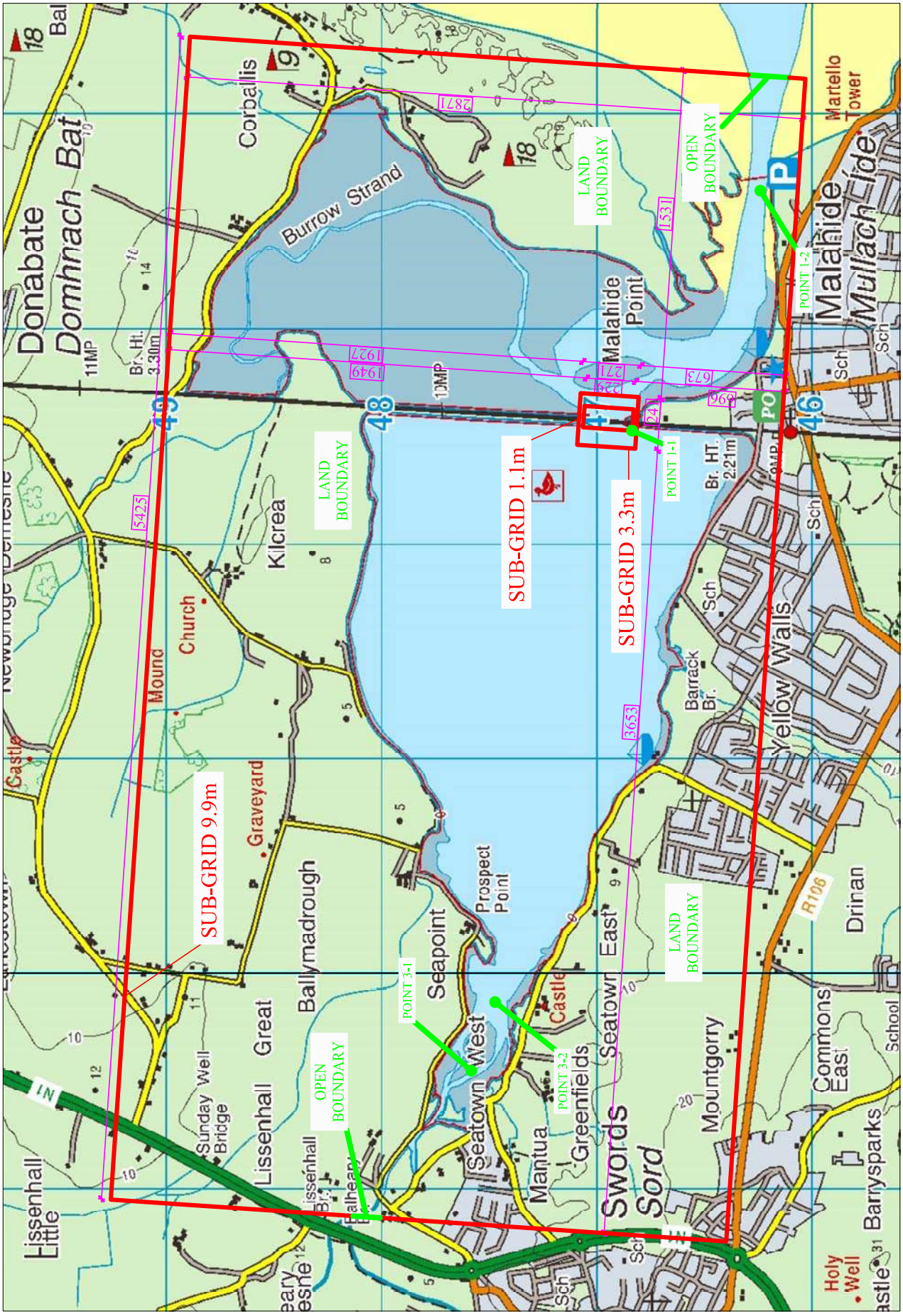
[5] Eamon McKeogh, Damir Bekic, *Malahide Viaduct Reinstatement: Technical Paper 5 - Final Design and Performance Simulations*, Flood Study Group University College Cork, July 2010.

[6] Eamon McKeogh, Damir Bekic, *Malahide Viaduct Reinstatement: New Design Weir - Computer modelling for Environmental Analyses*, Flood Study Group University College Cork, October 2011.

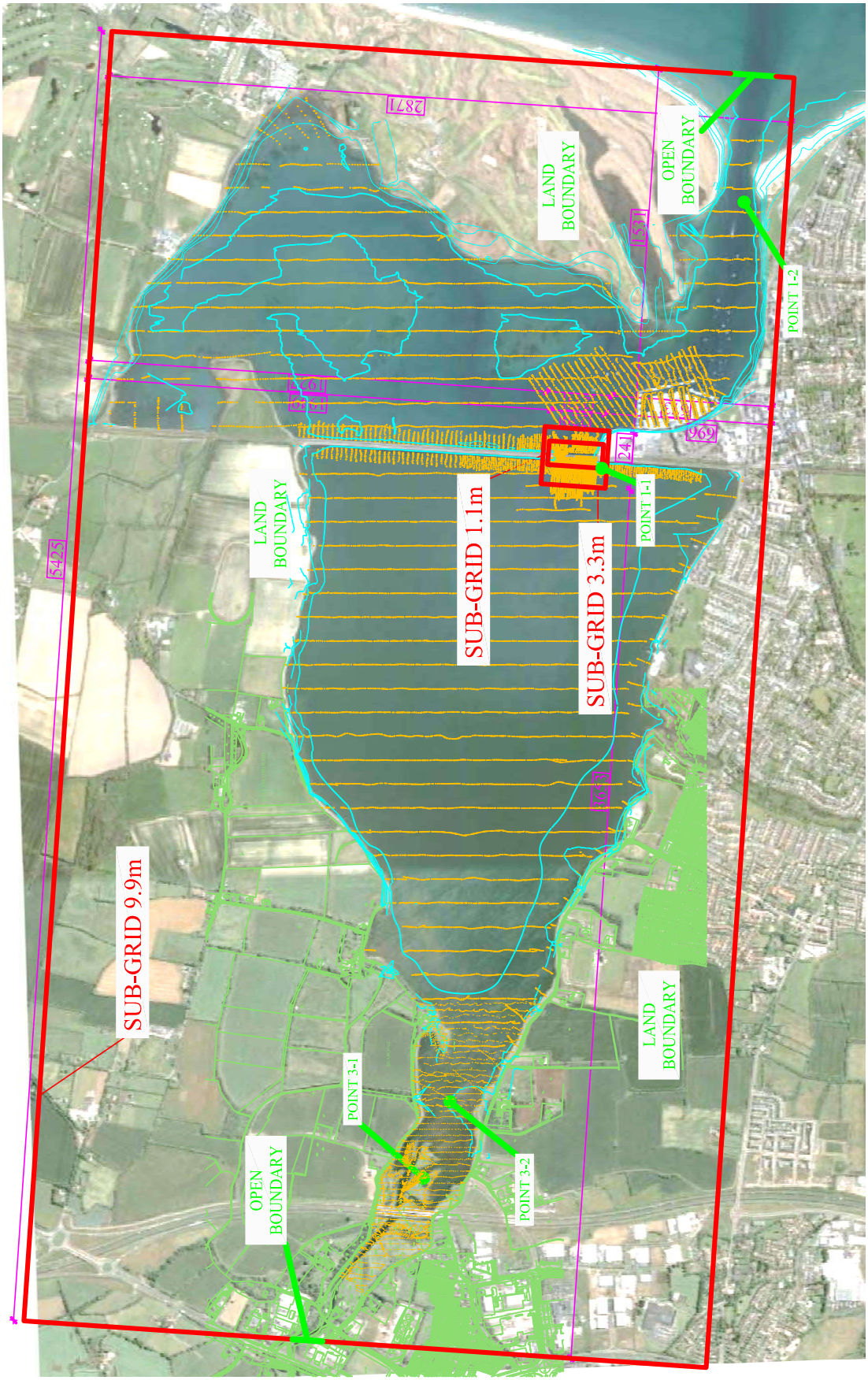
[7] Eamon McKeogh, Damir Bekic, *Monitoring of Malahide Viaduct - Report on water level recordings*, Flood Study Group University College Cork, July 2012.

6 Appendices

Appendix 1	Broadmeadows estuary with extents of model domains on OS map
Appendix 2	Broadmeadows estuary with field survey data on Google Earth
Appendix 3	New Design Weir - DEM with locations of cross-sections
Appendix 4	New Design Weir - DEM detail
Appendix 5	Temporary Works - DEM with locations of cross-sections
Appendix 6	Temporary Works - DEM detail
Appendix 7	New Design Weir and Temporary Works - Elevation profile for cross-sections
Appendix 8	New Design Weir and Temporary Works - Elevation profile for Viaduct central axis
Appendix 9	Refined Mike21 model
Appendix 10	Water levels in 2010 at control points 1-1, 1-2
Appendix 11	Hydrodynamic at neap tides
Appendix 12	Hydrodynamic at spring tides
Appendix 13	Exposure at neap low
Appendix 14	Exposure at spring low



fluvio R&D Limited Hydrological and Hydraulic Engineering	MALAHIDE VIADUCT REINSTATEMENT	
	Broadmeadow estuary with extents of model domains on OS map	Scale 1:25000
		Appendix 1



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MALAHIDE VIADUCT REINSTATEMENT

Broadmeadow estuary with field survey data on Google Earth

Scale 1:25000

Appendix 2

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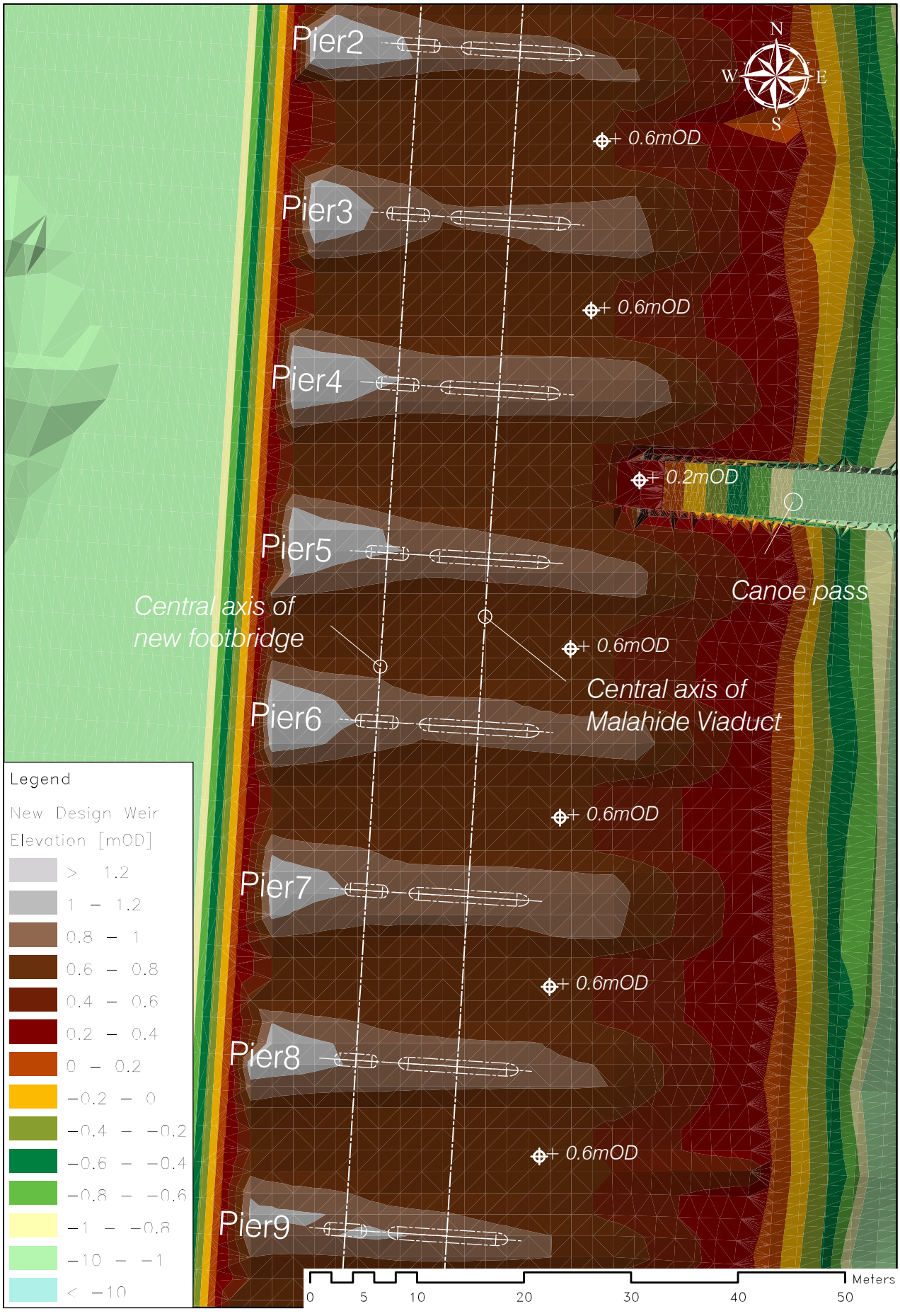
MALAHIDE VIADUCT REINSTATEMENT

New Design Weir – DEM
with locations of cross-sections

Scale 1:1000

Appendix 3



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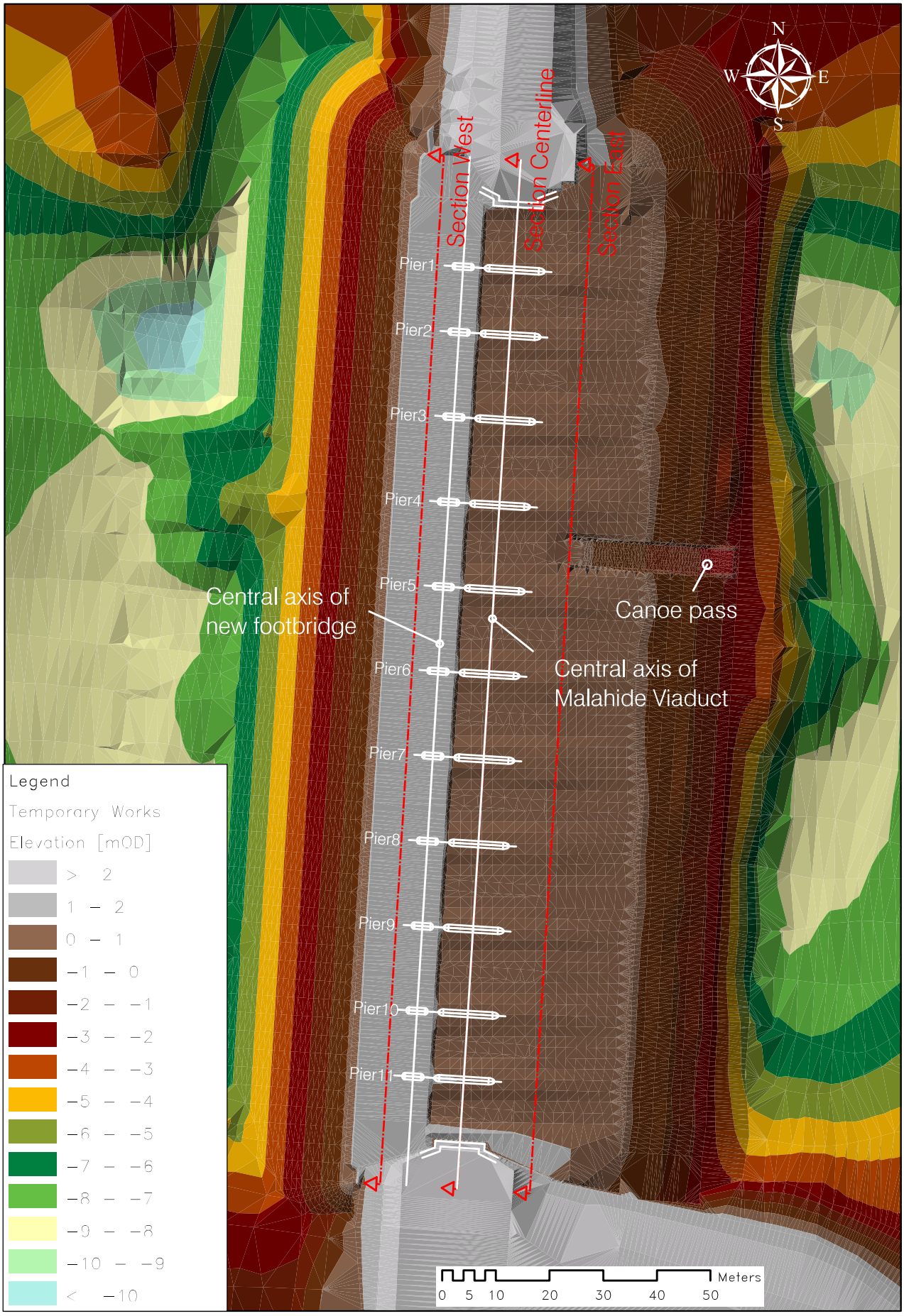
MALAHIDE VIADUCT REINSTATEMENT

New Design Weir – DEM detail

Scale 1:500

Appendix 4



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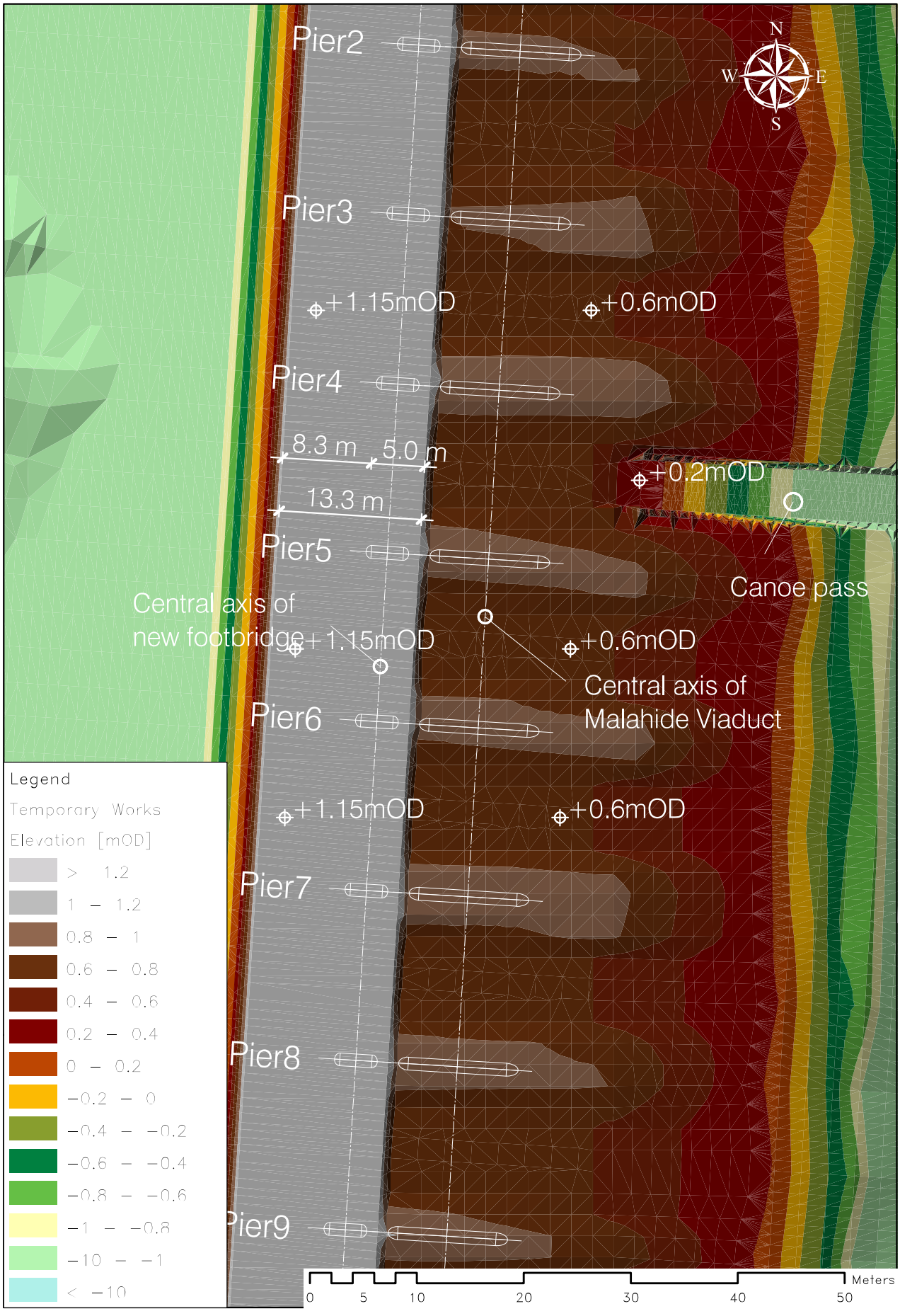
MALAHIDE VIADUCT REINSTATEMENT

Temporary Works
DEM with locations of cross-sections

Scale 1:1000

Appendix 5



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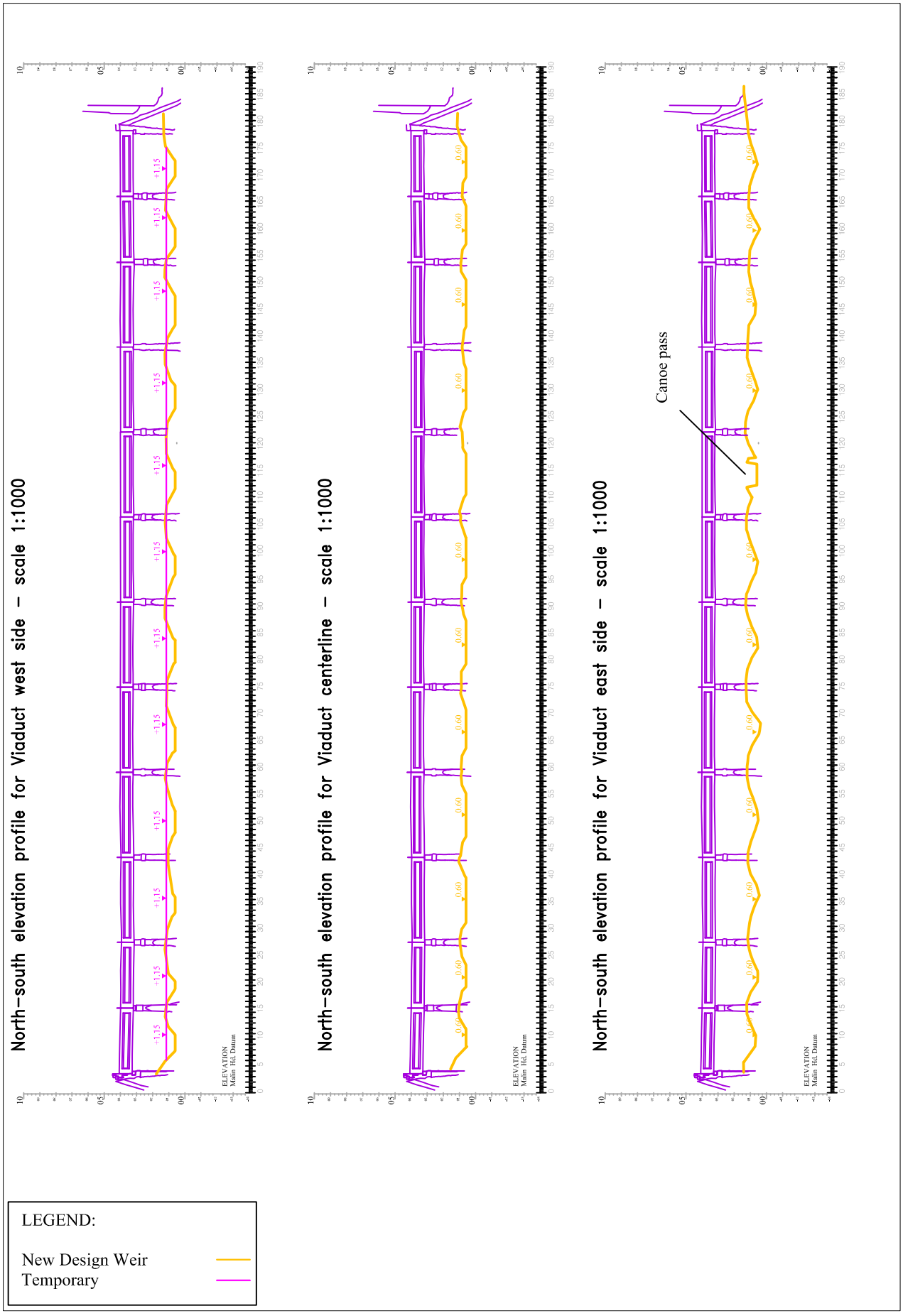
MALAHIDE VIADUCT REINSTATEMENT

Temporary Works – DEM detail

Scale 1:500

Appendix 6



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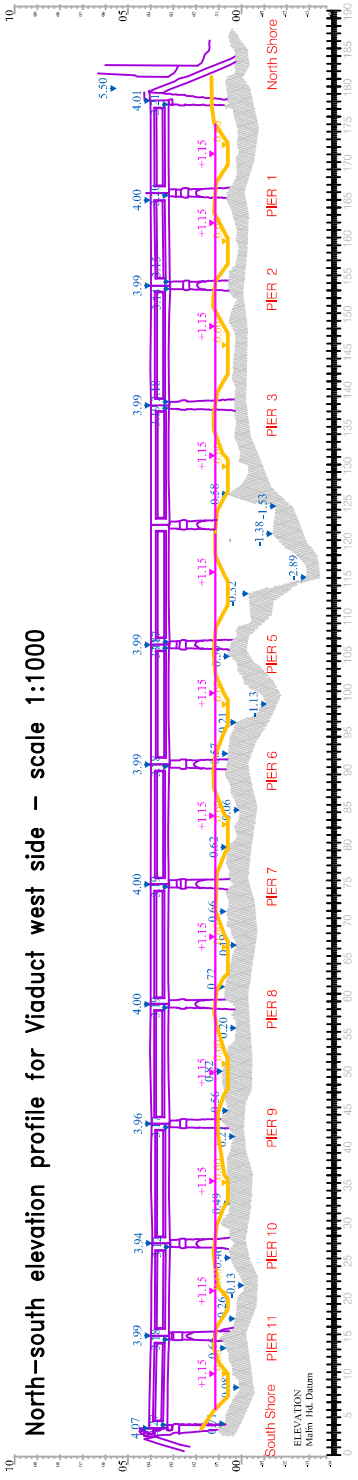
MALAHIDE VIADUCT REINSTATEMENT

New Design Weir and Temporary Works
- Elevation profile for cross-sections

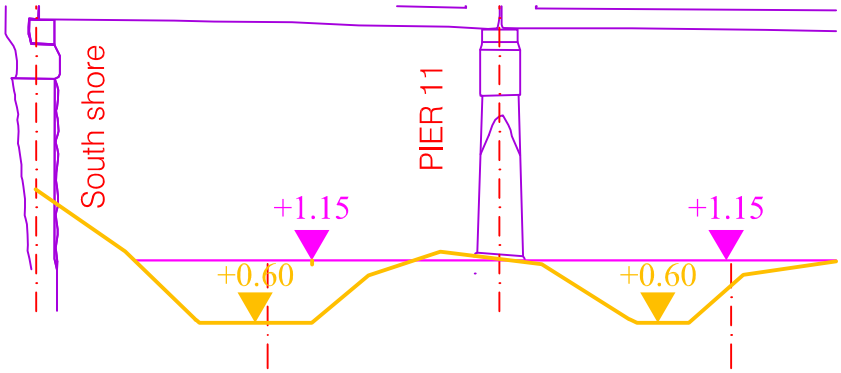
Scale 1:1000

Appendix 7

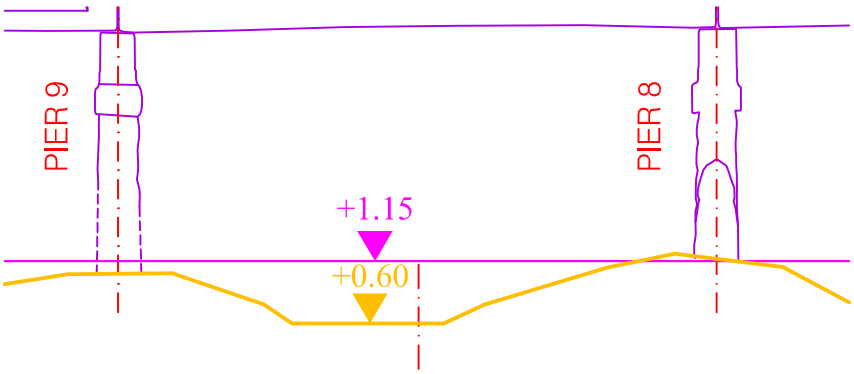
North–south elevation profile for Viaduct west side – scale 1:1000



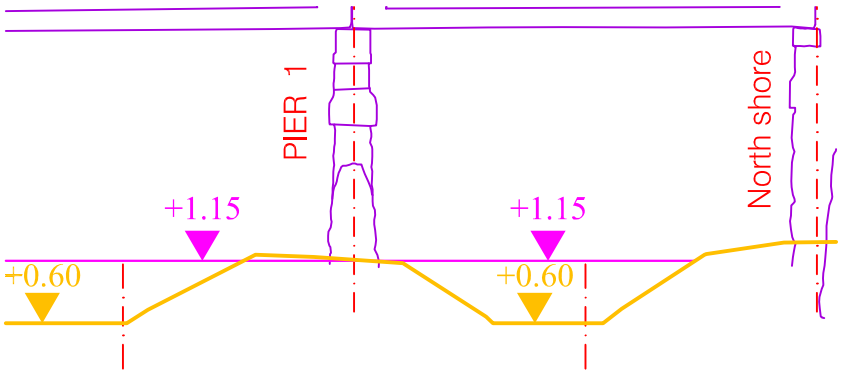
North–south elevation profile at South shore – scale 1:200



North–south elevation profile at piers 8&9 – scale 1:200



North–south elevation profile at North shore – scale 1:200



LEGEND:

New Design Weir
Temporary

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MALAHIDE VIADUCT REINSTATEMENT

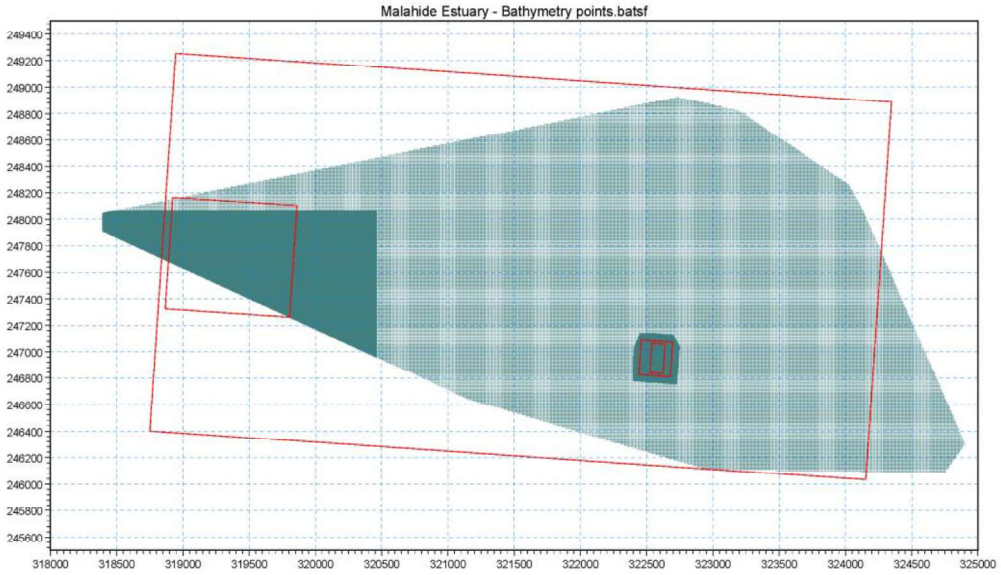
New Design Weir and Temporary Works
- Elevation profile for Viaduct central axis

Scale 1:1000
1:200

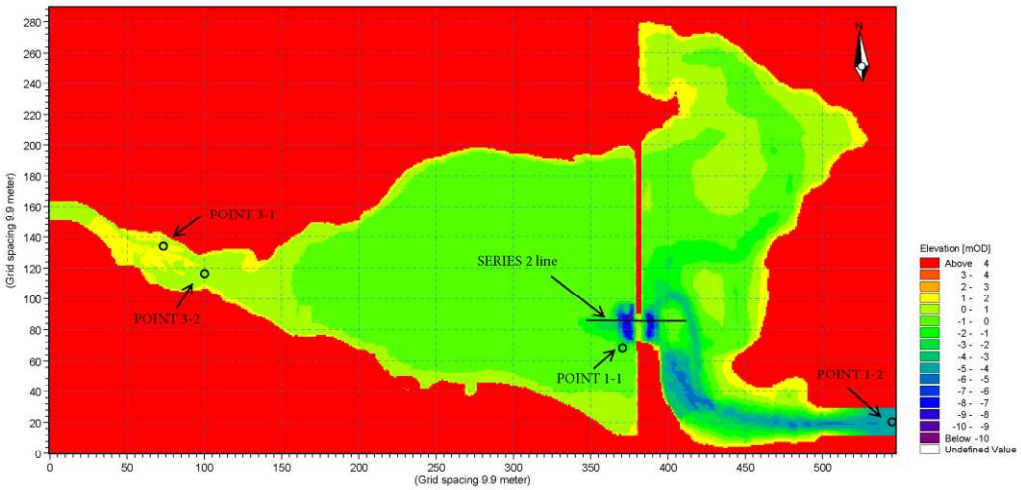
Appendix 8

Appendix 9 Refined Mike21 model

Mike21 sub-grid domains and DEM points

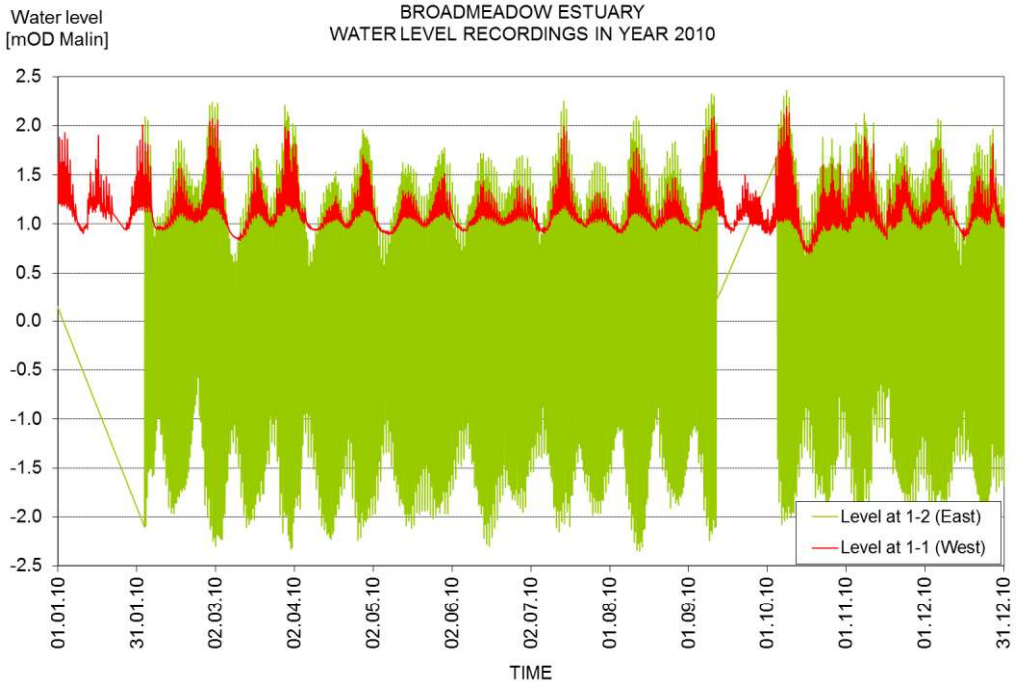


Mike21 sub-grid domain 9.9m resolution with control points

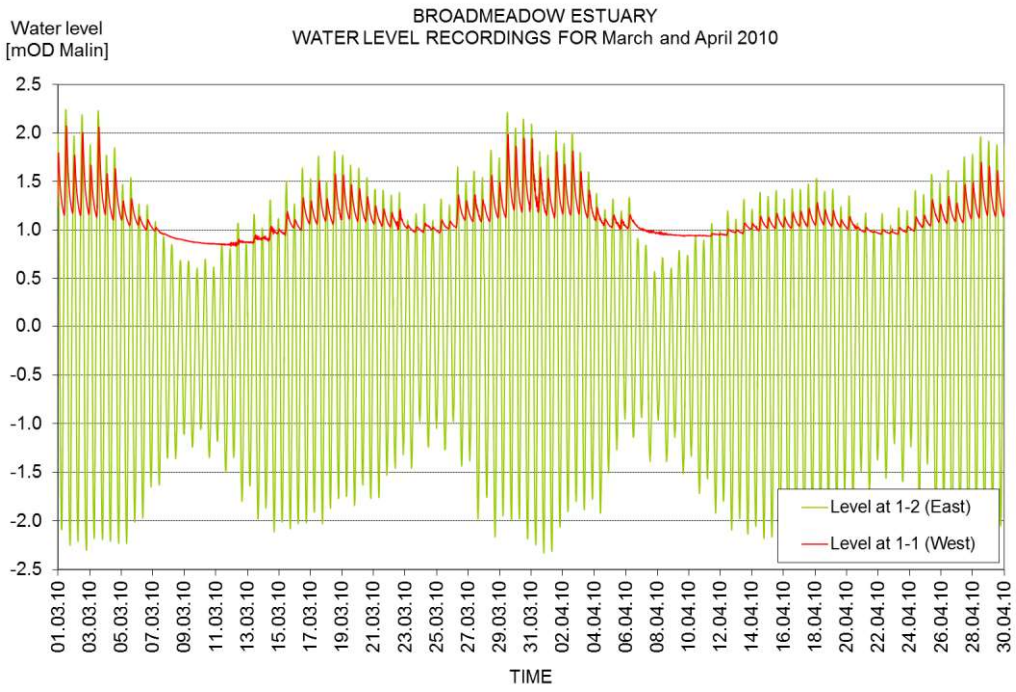


Appendix 10 Water levels in 2010 at control points 1-1, 1-2

Water level recordings in 2010



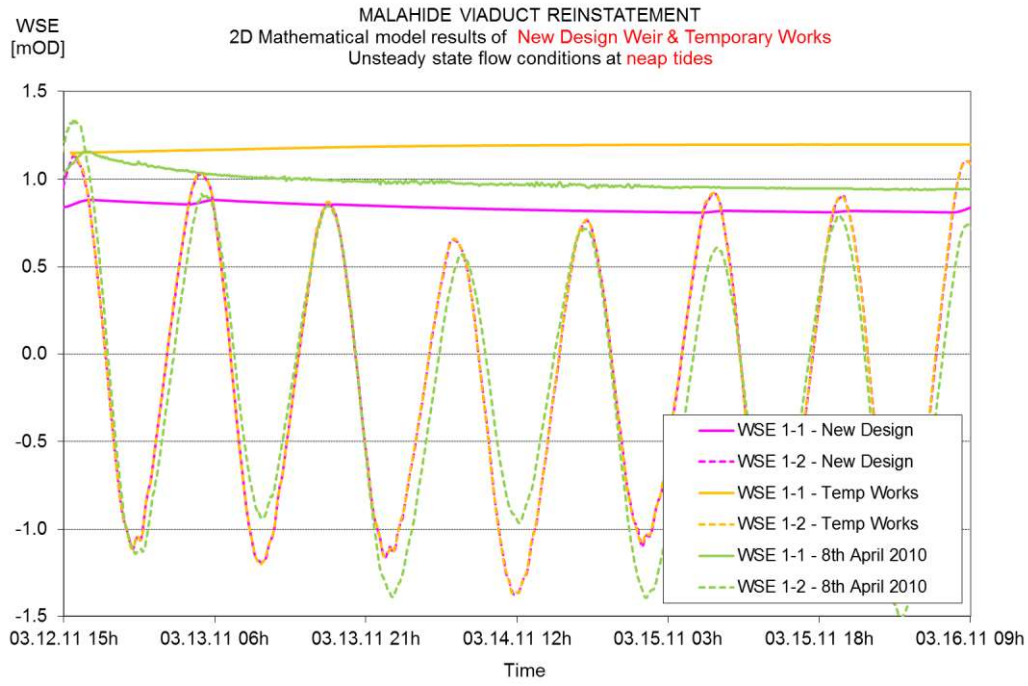
Water level recordings in March and April 2010

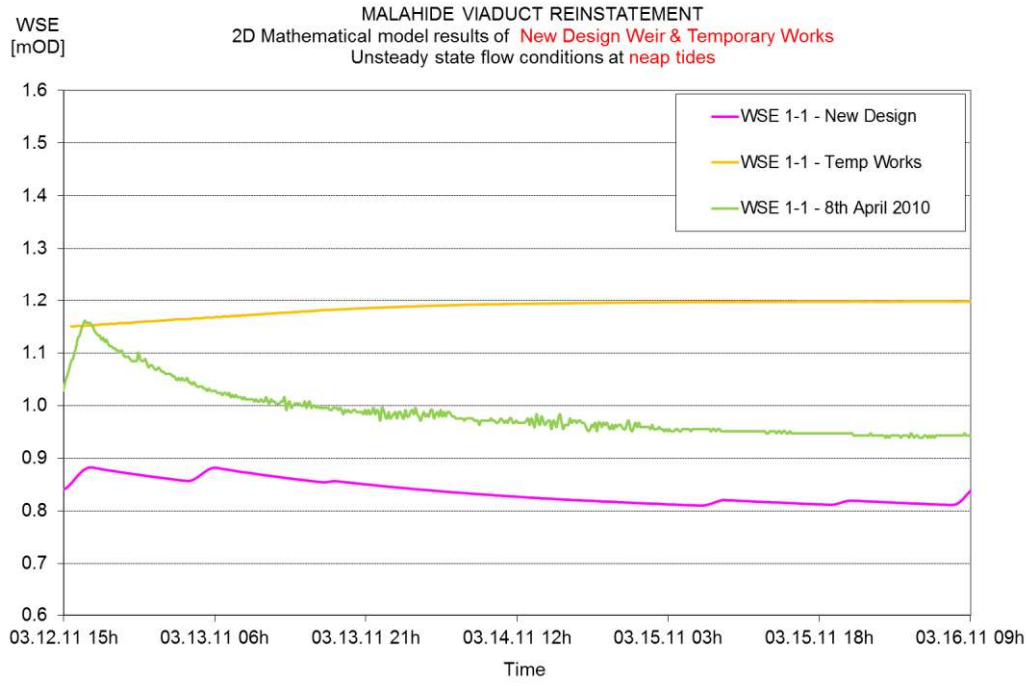


Appendix 11 Hydrodynamic at neap tides

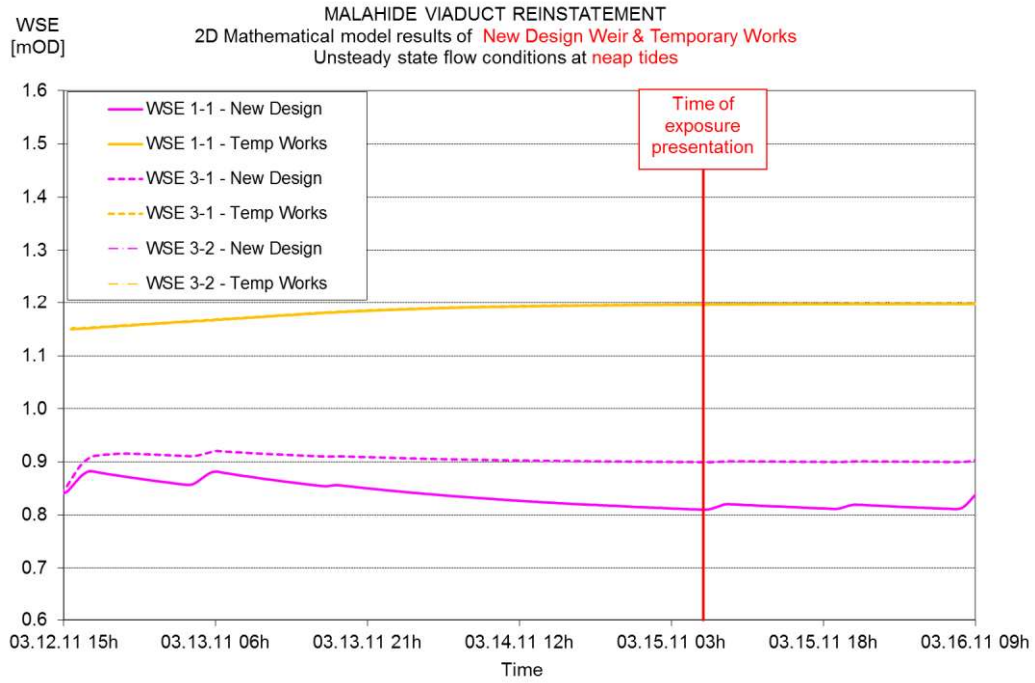
West boundary conditions: Q_{west} = 0.5m^3/s
East boundary conditions: WSE_{east} = Recorded water levels
Manning roughness values: $n_{9.9m}$ = $n_{3.3m}$ = 0.03; $n_{1.1m}$ = 0.09 and 0.025
Smagorinsky coefficient: s = 0.5

Water levels at the weir (control points 1-1 and 1-2)

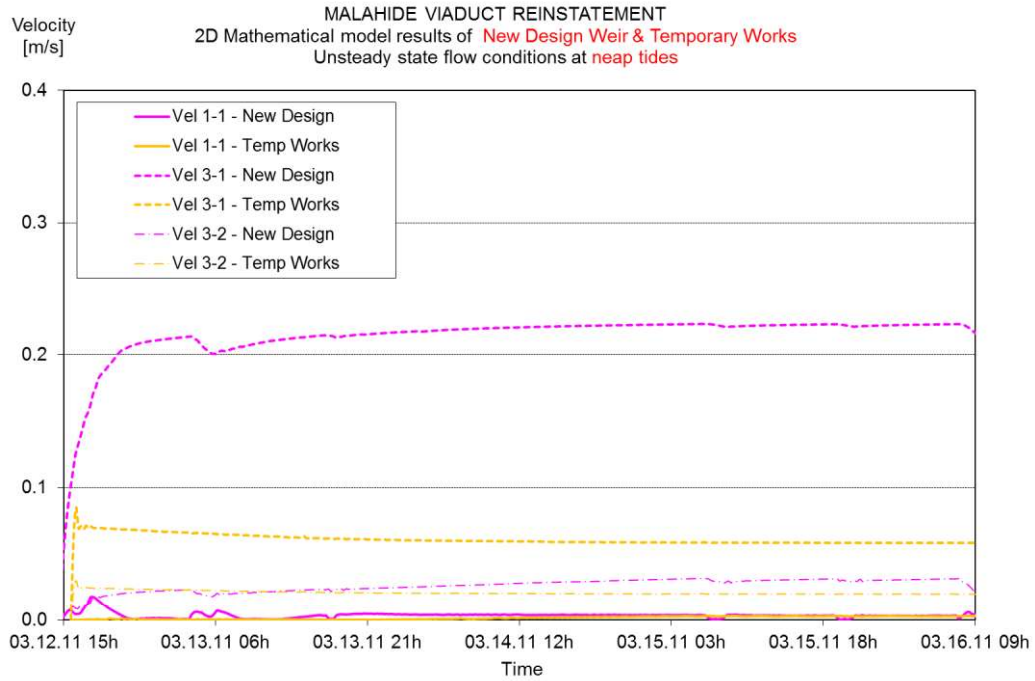




Water levels at the weir (control point 1-1) and on the inner estuary (control points 3-1 and 3-2)



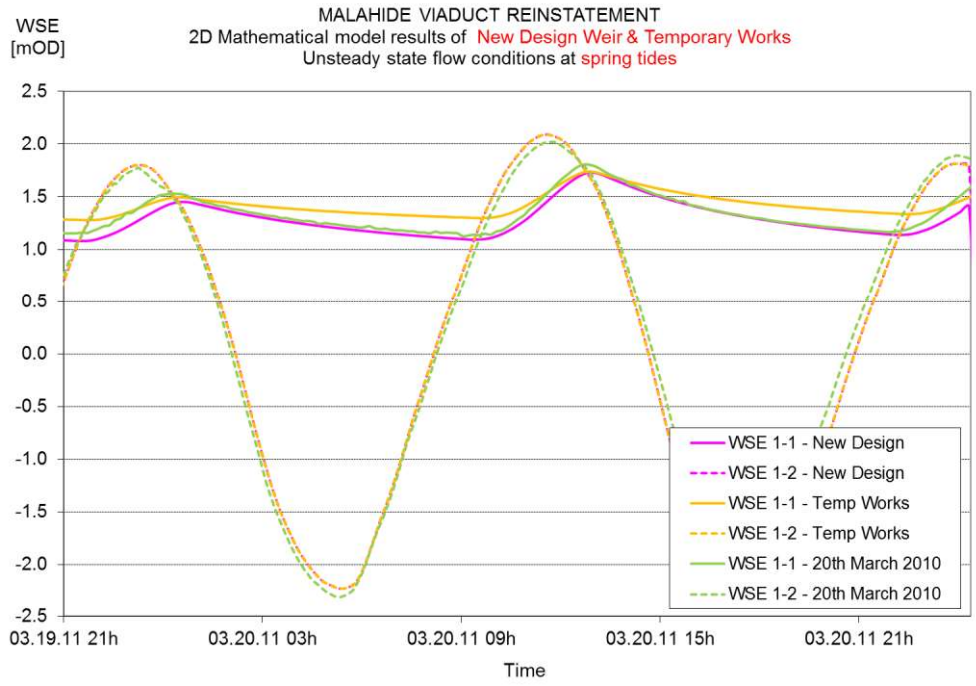
Flow velocities at the weir (control point 1-1) and on the inner estuary (control points 3-1 and 3-2)

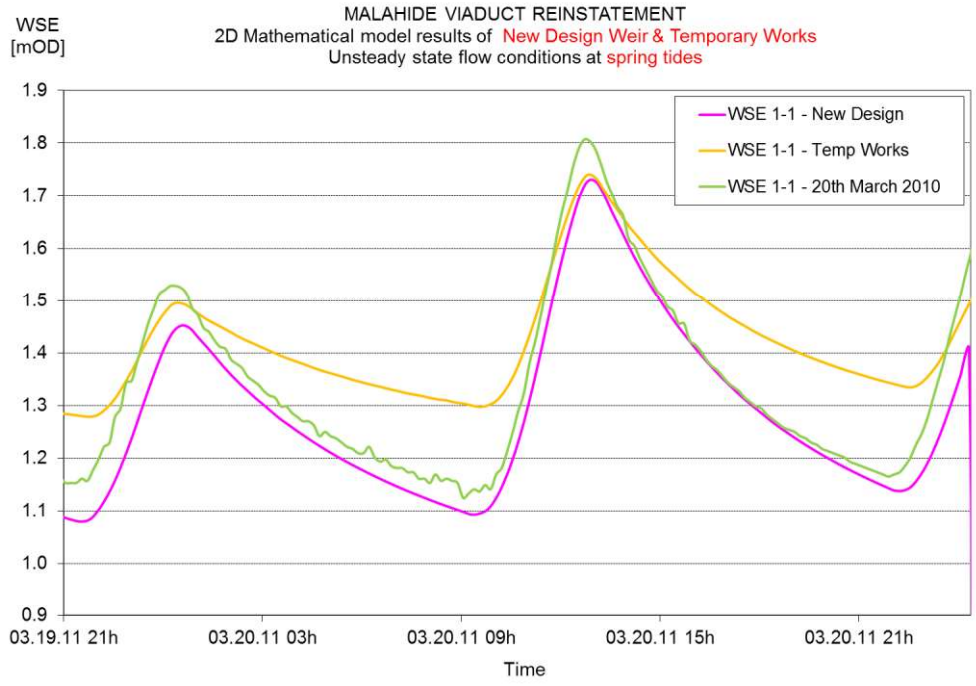


Appendix 12 Hydrodynamic at spring tides

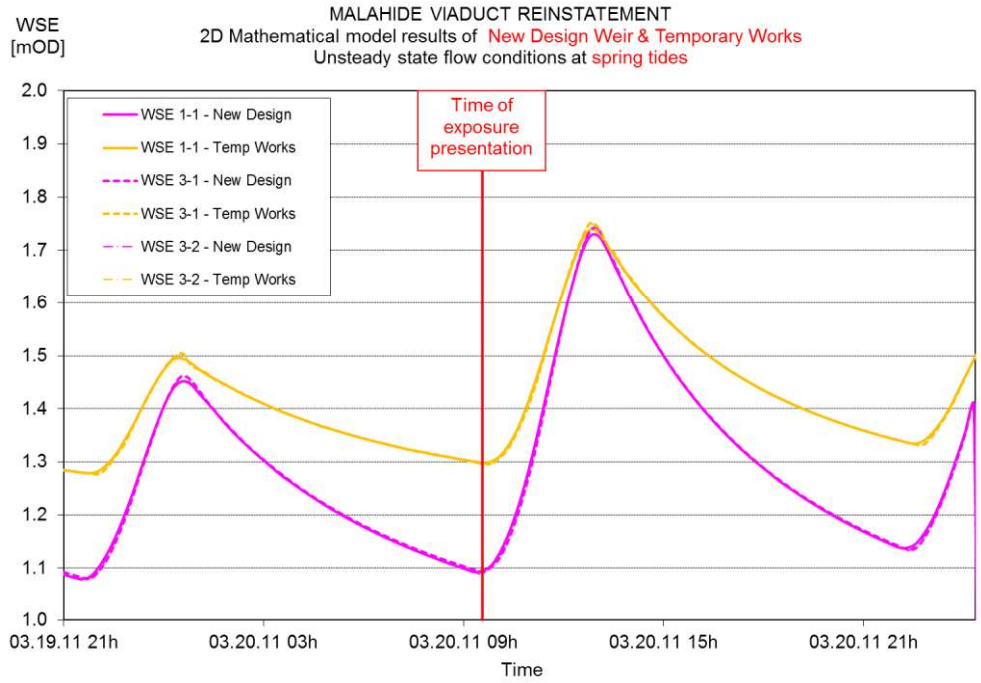
West boundary conditions: Q_{west} = 1.0m^3/s
East boundary conditions: WSE_{east} = Recorded water levels
Manning roughness values: $n_{9.9m}$ = $n_{3.3m}$ = 0.03; $n_{1.1m}$ = 0.066 and 0.025
Smagorinsky coefficient: s = 0.5

Water levels at the weir (control points 1-1 and 1-2)

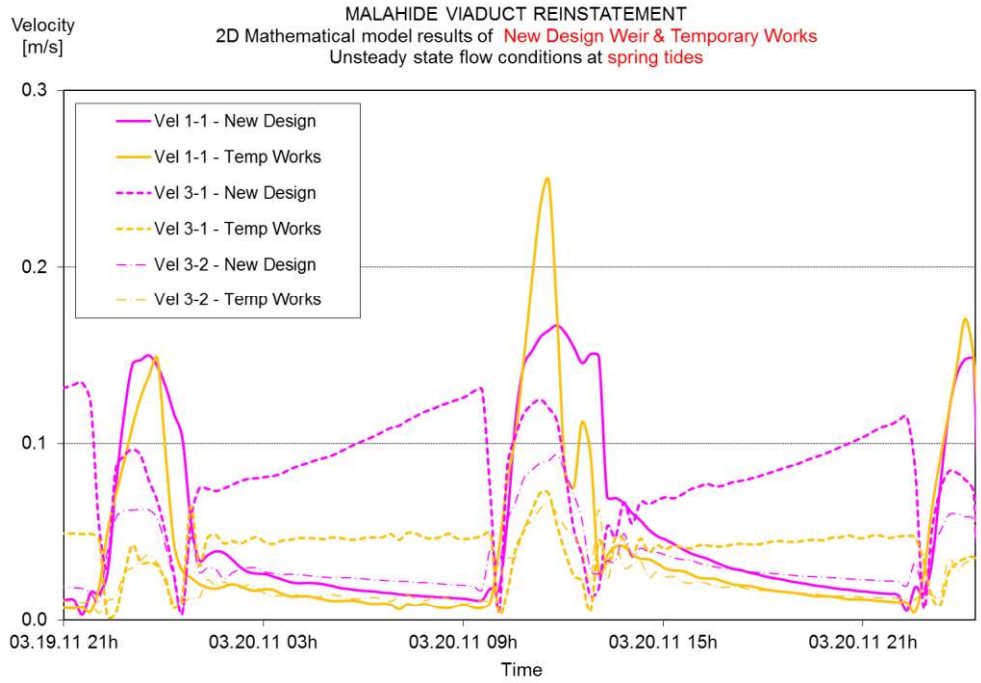




Water levels at the weir (control point 1-1) and on the inner estuary (control points 3-1 and 3-2)



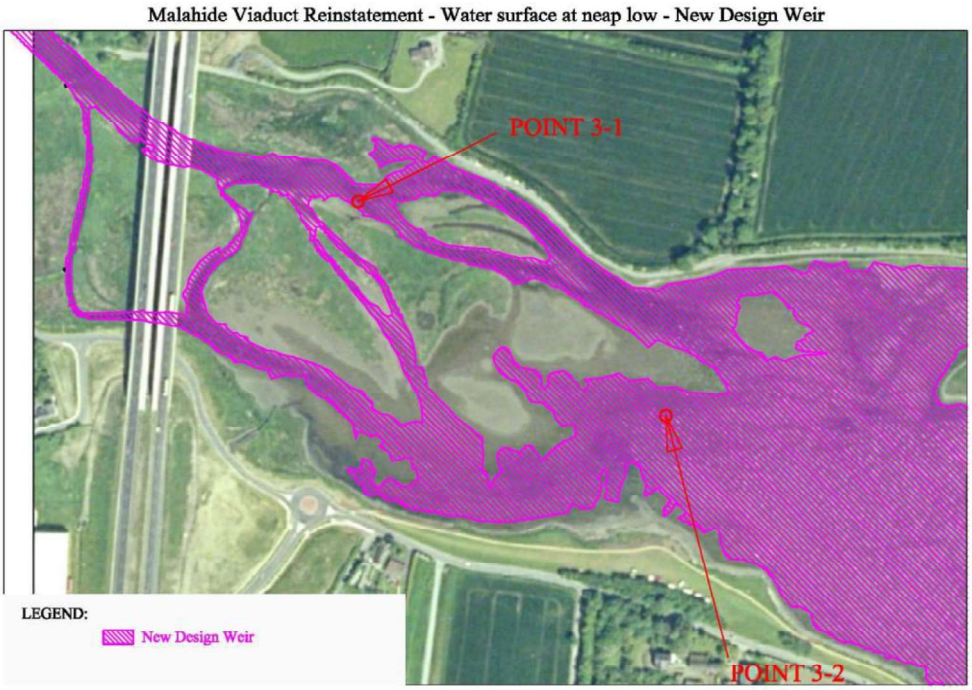
Flow velocities at the weir (control point 1-1) and on the inner estuary (control points 3-1 and 3-2)



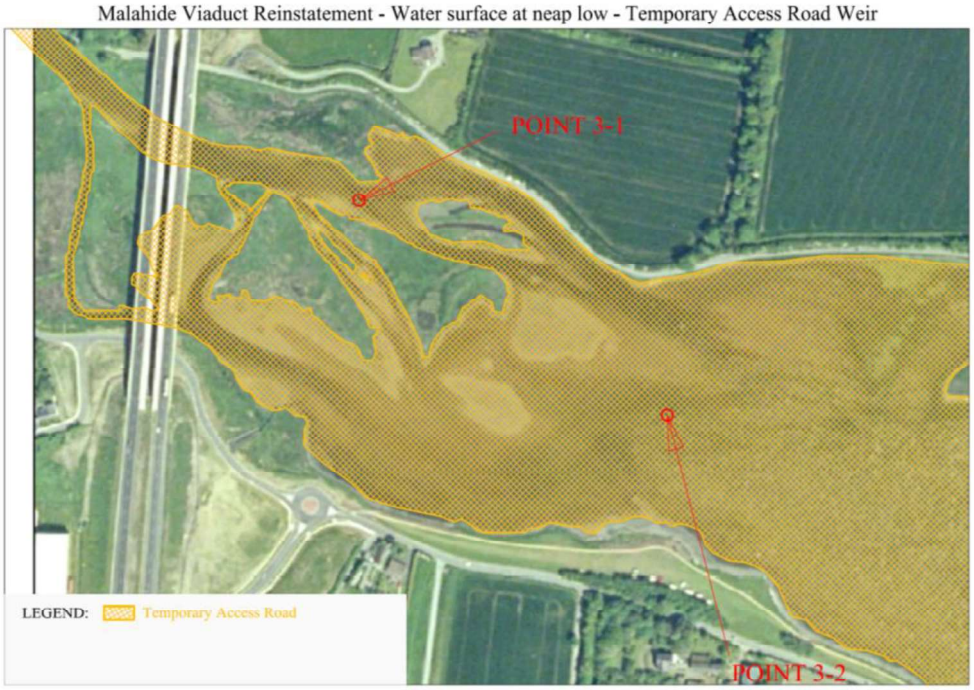
Appendix 13 Exposure at neap low

Time of presentation: 15th March 2011, 06:09 hrs

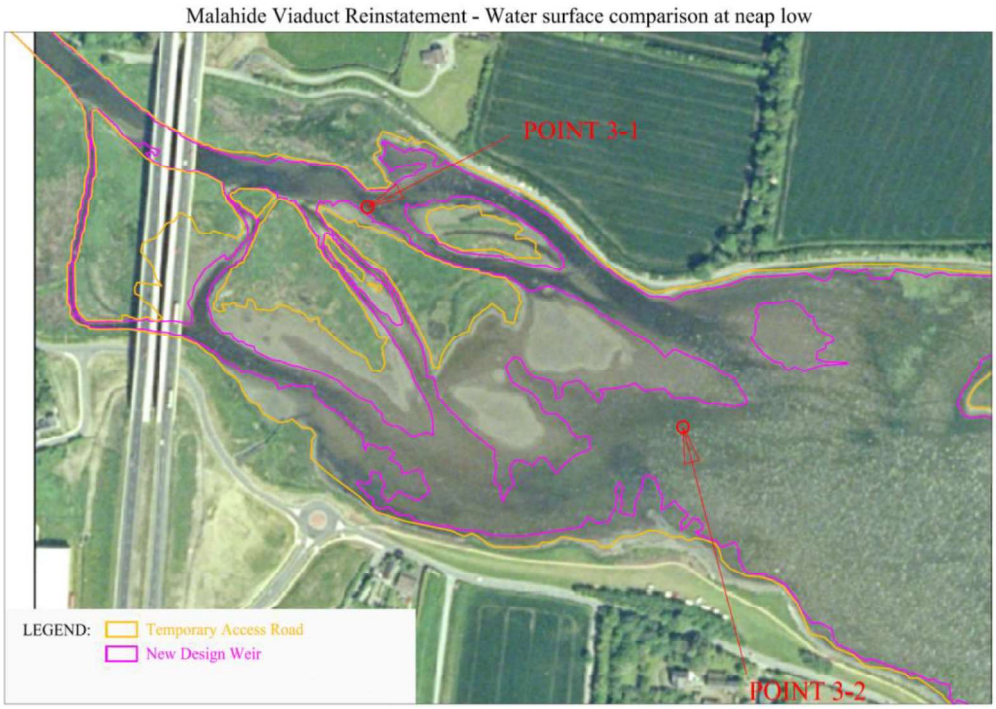
Water surface for New Design Weir



Water surface for Temporary Access Road Weir



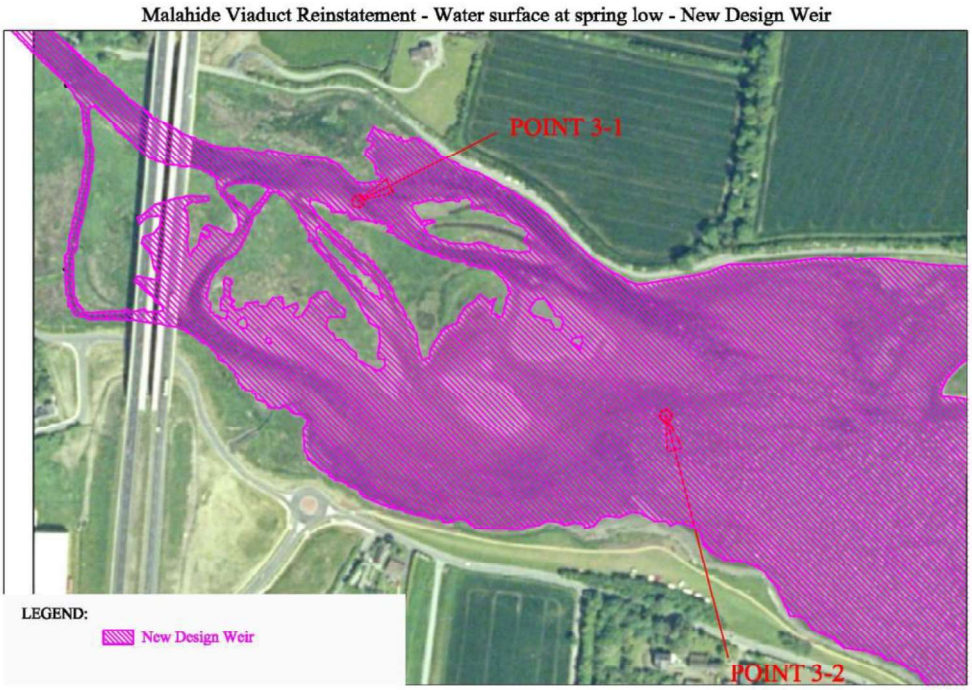
Water surface comparison for neap low



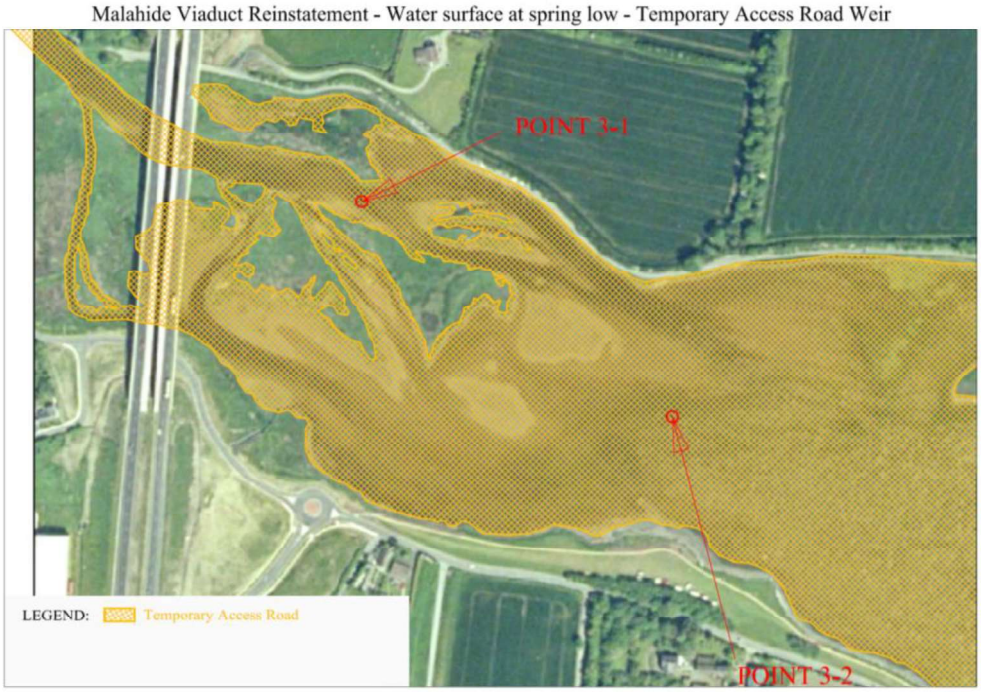
Appendix 14 Exposure at spring low

Time of presentation: 20th March 2011, 09:34 hrs

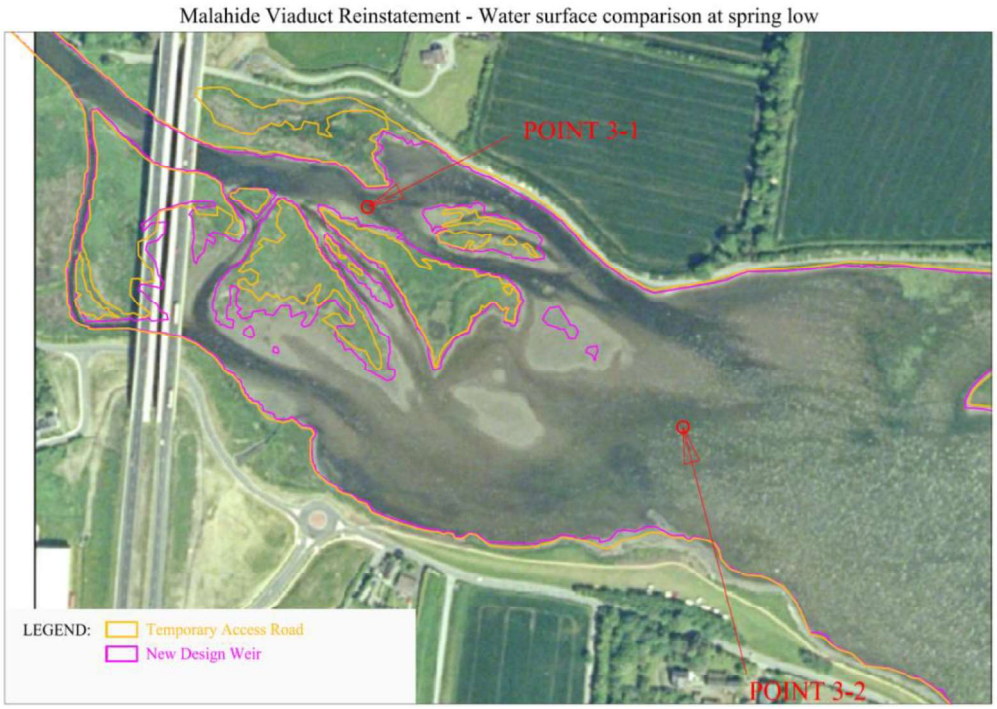
Water surface for New Design Weir



Water surface for Temporary Access Road Weir



Water surface comparison for spring low



Appendix 6

Aquatic Environment - Methodology and Plates 1 to 7

(A) Soft Sediment Survey, Malahide Weir Maintenance Track (September 2009)

A soft sediment survey was undertaken in September 2009 which covered the sites within the footprint of the weir maintenance track. Fieldwork was carried out on the 21st September 2009. All sampling stations were positioned using a differential GPS (Trimble Geo XM). A complete list of stations sampled are presented in Table 1 and these stations are displayed on a map (Figure 1).

Overall species abundances and diversity would be considered low with four stations returning no fauna and diversity would be considered low across all sites (Table 1). The sites in closest proximity to the maintenance track (S1-S8) had considerably lower abundances than those closest to the weir development (S9-S12). The most faunally abundant sites (S11 and S12) were present immediately to the west of the weir at Malahide. These sites are in mixed shell gravel exposed to a greater degree of water movement than the more southerly sites. The sites present in the vicinity of the track consist of low faunal diversity and abundances. Moreover, the fauna present in the area consist primarily of oligochaetes (with the exception of S9 – which contains coarser material and is dominated by keelworm, *Pomatoceros lamarcki*).

Biotope Classification

Data from the survey was compared against data for the latest JNCC Biotope classification scheme (Conor *et al.*, 2004). Results from all surveys undertaken during the present survey indicate the presence of several distinct habitats.

The area of the access track along the western side of the southern causeway has been classified as SS.SMu.SMuVS.OlVS (Oligochaetes in variable or reduced salinity infralittoral muddy sediment). This biotope is usually found towards the edges of tidal channels in estuaries where current velocities allow for the deposition of silt and the establishment of the infaunal communities identified here. This biotope is present across most of the access track route (from Grabs 1-8). This corresponds with results obtained in another survey of the Broadmeadow Estuary (Aquafact, 2008) which covered a much greater footprint than the survey reported here. Results from that survey indicated that the same habitat type is located along large parts of the southeastern area of the Broadmeadow Estuary extending well beyond the footprint of the trackway.

The remaining grab sites surveyed along the inner estuary (Grabs 9-12) consist of species and sediment, which are consistent with the SS.SCS.CCS.PomB (*Pomatoceros triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles). This biotope is characterised by a few robust, fast growing species, which are able to colonise benthos and are subjected to being regularly moved by wave and tidal action. The main cover organisms tend to be restricted to tube worms (*Pomatoceros* sp.) and barnacles (*Balanus crenatus*) both of which were recorded at these locations.

Table 1. Positions of subtidal biological sampling stations. All sampling locations are given in Irish National Grid. Sites highlighted in green fall within the footprint of the weir maintenance track development.

Subtidal Grab Stations	Co-ordinates (Irish National Grid)	
	Easting (m)	Northing (m)
S1	322507.571	246367.090
S2	322478.311	246374.105
S3	322471.502	246415.946
S4	322507.378	246454.032
S5	322506.994	246572.468
S6	322482.778	246575.019
S7	322492.349	246727.322
S8	322521.951	246729.182
S9	322528.983	246832.255
S10	322486.733	246842.925
S11	322510.098	246948.660
S12	322501.300	246960.564

Figure 1. Map showing locations of subtidal grab samples along the inner estuary at Malahide, Co. Dublin.

(B) Aquatic Habitats – Methodology

Sub-tidal Grab Sampling

A total of 12 stations were sampled by means of a 0.025m^2 Van-Veen Grab for benthic faunal and particle size analysis. At all sites, samples were taken where there was sufficient penetration of the Van-Veen grab.

At each station:

- 1 x 0.025m^2 Van-Veen grabs were deployed for samples for benthic faunal analysis, and the samples were transferred to separate, labelled, 10 litre buckets (12 samples).
- 1 x 0.025m^2 Van-Veen grab from which 100g of well-mixed sediment was transferred to a sealed plastic container for granulometric and organic carbon analysis (12 Samples).

Sample Processing

Granulometric Analysis

Granulometric analysis was carried out on oven dried sediment samples from each station. The sediment was passed through a series of nested brass test sieves with the aid of a mechanical shaker. The brass sieves chosen were 4mm, 2mm, 1mm, 500µm, 250µm, 125µm and 63µm. The sediments were then divided into three fractions: % Gravel (>2mm), % Sand (<2.0mm >63µm) and % Silt-Clay (<63µm). Further analysis of the sediment data was undertaken using the Gradistat package (Blott & Pye, 2001).

Organic Matter Analysis

Organic matter was estimated using the Loss on Ignition (LOI) method. One gram of dried sediment was ashed at 450˚C for 6 hours and organic carbon was calculated as % sediment weight loss.

Biological Sample Processing

On returning to the laboratory all faunal samples were sieved on a 1.0mm sieve within 24 hours of collection. Samples were preserved in 4% buffered formalin to which an organic dye (Rose-Bengal) had been added. All fauna were identified to the lowest taxonomic level possible using standard keys to northwest European fauna.

Pre-Construction Assessment Results

Results from the sediment analysis indicates that the sediment is dominated by fine sands and muds (Table 2 and Figure 2).

Grab Data

A total of 15 taxa were encountered in the grab samples along the western shore of the southern arm of the viaduct (Table 3). All species encountered are common in Irish coastal waters.

Table 2 Sediment characteristics for all subtidal grab samples.

Site ID	% Gravel	% Sand	% Mud	% LOI	Sediment Textural Group
Grab 1	2.3	45.8	51.9	3.7	Slightly gravelly sandy mud
Grab 2	0	85.9	14.1	1.7	Muddy sand
Grab 3	0	44.3	55.7	4.9	Sandy Mud
Grab 4	0.9	27.9	71.2	8.0	Slightly gravelly sandy mud
Grab 5	22.7	23.6	53.8	7.9	Gravelly mud
Grab 6	0	51.1	48.9	5.7	Muddy sand
Grab 7	0	40.4	59.6	6.0	Sandy mud
Grab 8	0	48.9	51.1	7.4	Sandy mud
Grab 9	33.7	24.9	41.4	2.2	Muddy gravel
Grab 10	93.3	4.4	2.3	5.6	Gravel

Table 3 Abundance data (per 0.025m^2) for all grab samples taken in the inner estuary at Grab sites 1-12. Sites highlighted in green are taken within the footprint of the weir maintenance track development.

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Chironomdae sp.	0	0	1	0	0	0	0	0	0	0	0	0
Diptera larvae	0	1	2	0	0	0	0	0	0	0	0	0
Crangon	0	1	1	0	0	0	0	0	0	0	0	0
Carcinas maenas	0	0	0	0	1	0	0	0	1	1	0	0
Gammarus sp.	0	0	0	0	0	0	0	0	1	0	0	0
Melita palmata	0	0	0	0	0	0	0	0	0	0	1	0
Balanus crenatus	1	0	0	0	3	0	0	0	0	2	7	33
Mytilus edulis	0	0	0	0	0	0	0	0	0	0	1	0
Pomatoceros lamarcki	0	0	0	0	0	0	0	0	28	7	58	27
Tharyx sp.	2	7	0	0	0	0	0	0	0	0	14	4
Capitella capitata	2	2	0	0	0	0	0	0	0	0	0	0
Eteone longa	0	0	0	0	0	0	0	0	0	0	1	0
Heterochaeta costata	1	0	0	0	0	0	0	0	0	0	0	3
Oligochaetae	0	0	1	0	0	0	0	0	0	0	0	0
Tubificoides benedii	1	0	0	0	0	0	0	0	0	1	17	0

Table 4 Primary and derived diversity indices for all grab samples in the inner part of Malahide Estuary. Sites highlighted in green are located within the footprint of the weir maintenance track development.

	S1	S2	S3	S4	S5	S6
Number of Species	5	4	4	0	2	0
Number of Individuals	7	11	5	0	4	0
Margellef's Dominance Index	2.06	1.25	1.86	****	0.721	****
Shannon-Wiener Index	1.55	1.03	1.33	****	0.562	****
Pielou's Evenness	0.963	0.746	0.961	****	0.811	****
	S7	**S8**	**S9**	**S10**	**S11**	**S12**
Number of Species	0	0	3	4	7	4
Number of Individuals	0	0	30	11	99	67
Margellef's Dominance Index	****	****	0.588	1.25	1.31	0.713
Shannon-Wiener Index	****	****	0.291	1.03	1.22	1.02
Pielou's Evenness	****	****	0.265	0.746	0.626	0.738

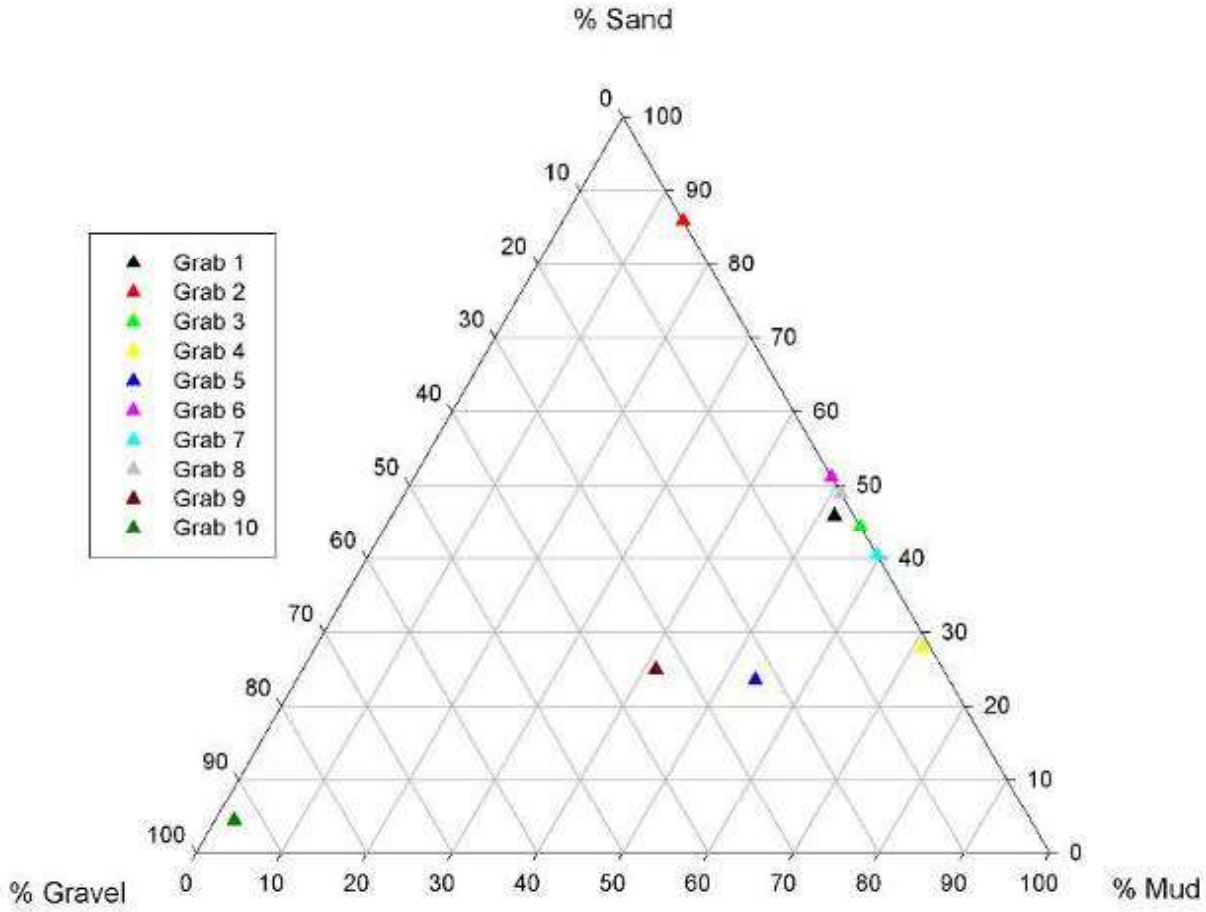


Figure 2 Ternary plot of particle size analysis along the subtidal grab sampling stations within and adjacent to the footprint of the weir maintenance track.

(C) Aquatic Environment – Plates 1 to 7

Plate 1: View of the exposed mud and sand flats of Malahide Estuary (outer) to the left of the railway embankment and of the lagoon-like Malahide Estuary (inner) to the right. View south toward Malahide.

Plate 2: View of distinct vertical zonation pattern along Malahide railway embankment – outer (eastern) face.

Plate 3: View of the tidal flaps on the River Pill outlet beneath the railway embankment viewed from the Malahide Estuary side.

Plate 4: The channel on the River Pill within the Malahide estuary at low tide viewed from its outlet under the railway embankment. Note the extensive adjoining mudflats.

Plate 5: View of the fringing saltmarsh (*Spartina*) at the top of the shore close to the Pill River outlet to the Malahide Estuary.

Plate 6: View of Pill River at kick sample site just upstream of road bridge.

Plate 7: View of Pill River channel at approximate position of proposed pedestrian bridge crossing point - view upstream.