10 NOISE & VIBRATION

10.1 INTRODUCTION

This chapter contains an assessment of the likely noise and vibration impact resulting from the proposed remediation of the East Tip at Haulbowline Island. The proposed development will require an approximate 18-month construction programme (see Chapter 6 ' Project Construction) to remediate the site for its future use as amenity and recreational area (see Chapter 5 'Project Description').

The construction phase of the proposed development has been examined to assess which activities have the potential to result in noise and vibration impacts. Noise and vibration impacts will arise at the East Tip and along the proposed haul route during the construction phase, but these will be temporary in nature. Similarly the proposed end use for the East Tip was examined to determine any noise and vibration impacts. However, there will be no significant noise and vibration impacts as a result of the proposed end use for the East Tip. The project description is not outlined in detail in this chapter except where it is necessary to outline aspects of the proposed development that relate to the assessment of potential noise and vibration impacts (refer to Chapter 5 'Project Description' and Chapter 6 'Project Construction').

This assessment was completed by RPS Group. This chapter should be read in conjunction with Figure 10.1 and Appendix L: Noise Survey Results. The potential impact of noise and vibration from the proposed development on terrestrial and marine ecology is examined in Chapter 14 'Ecology' of this EIS.

10.2 METHODOLOGY

The following sections outline the methodology used in this assessment, which included:-

- Review of relevant noise guidance documents.
- Consultation with the Navy, who are the nearest sensitive receptor.
- Baseline noise monitoring in accordance with the Environmental Protection Agency (EPA) *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Schedules Activities* (NG4) (2011).
- Review of proposed construction activities (outlined in Chapter 6' Project Construction') and the proposed end use (outlined in Chapter 5 'Project Description') to understand the potential impacts of the proposed development and to inform noise prediction modelling in accordance with the relevance guidance documents as outlined in Section 10.2.1.
- A review of the traffic impact assessment (see Chapter 8 'Traffic and Transport') in order to determine the likely traffic noise impact from vehicles travelling to and from the proposed development site.
- A review of proposed construction activities (outlined in Chapter 6 'Project Construction') with a view to determining the potential vibration impact associated with this stage of the proposed development.

10.2.1 Relevant Noise Guidance Documents

10.2.1.1 Environmental Protection Agency (EPA) Office of Environmental Enforcement (OEE) - Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4), 2011

NG4 is the most recent Irish guidance document in relation to noise survey and assessment and as such is the most relevant Irish guidance document for the purposes of this assessment. The document relates primarily to noise surveys and assessments for EPA licensed facilities but in the absence of any other directly applicable guidance documents, it also is pertinent for the purposes of noise surveys and assessments accompanying planning applications.

The EPA published two earlier documents in relation to the survey, assessment and management of noise emissions from licensed facilities, namely the *Environmental Noise Survey Guidance Document* (commonly referred to as NG1-2003) and *Guidance Note for Noise in Relation to Scheduled Activities - 2nd Edition* (commonly referred to as NG2-2006). These two documents have been withdrawn with the publication of NG4.

NG4 provides detailed consideration of a range of noise related issues including basic background to noise issues, various noise assessment criteria and procedures, noise reduction measures, Best Available Techniques (BAT) and the detailed requirements for noise surveys. As the future use of the East Tip will require an EPA Waste Licence, the background noise survey completed as part of this assessment conforms to the attended measurement procedure detailed in Table 5 of NG4. NG4 has been used as a reference document for undertaking the noise assessment for the East Tip Remediation EIS.

Other EPA guidelines such as *Guidelines on the Information to be Contained in Environmental Impact Statements [2002]* and *Advice Notes on Current Practice (in the Preparation of Environmental Impact Statements) [2003]* have been referred to in the preparation of this Noise and Vibration Chapter.

10.2.1.2 British Standard BS5228:2009 Noise and Vibration Control on Construction and Open Sites

This British standard consists of two parts and covers the need for protection against noise and vibration of persons living and working in the vicinity of construction and open sites. The standard recommends procedures for noise and vibration control in respect of construction operations and aims to assist architects, contractors and site operatives, designers, developers, engineers, local authority environmental health officers and planners.

Part 1 of the standard provides a method of calculating noise from construction plant, including:-

- Tables of source noise levels;
- Methods for summing up contributions from intermittently operating plant;
- A procedure for calculating noise propagation;
- A method for calculating noise screening effects; and
- A way of predicting noise from mobile plant, such as haul roads.

The standard also provides guidance on legislative background, community relations, training, nuisance, project supervision and control of noise and vibration.

10.2.1.3 British Standard 8233:1999 Sound Insulation and Noise Reduction for Buildings - Code of Practice

BS 8233:1999 provides guidance values for a range of ambient noise levels within residential and commercial/industrial properties as shown in Table10.1 below.

Table 10.1: Internal Ambient Noise Levels for Living Spaces

Criterion	Typical Situation	Design Range dB $L_{Aeq,t}$	
		Good	Reasonable
Residential			
Reasonable resting/sleeping conditions	Living Rooms	30	40
	Bedrooms	30	35
Industrial/Commercial/Office			
Reasonable industrial working conditions	Light Engineering	65	75
	Garages, Warehouses	65	75
Reasonable speech or telephone communications	Corridor	45	55
	Cafeteria, Canteen, Kitchen	50	55
	Washroom, Toilet	45	55
Reasonable conditions for study and work requiring concentration	Meeting Room, Executive Office	35	40
	Staff Room	35	45

The threshold limits described in Table 10.1 above will serve as a reference point for assessing the likely noise impacts from the proposed development on the various land uses in the vicinity of the proposed development.

10.2.1.4 British Standard BS4142:1997 - Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas

BS4142: 1997 describes a method of determining the level of a noise of an industrial nature, together with procedures for assessing whether the noise in question is likely to give rise to complaints from persons living in the vicinity. In general, the likelihood of complaint in response to a noise depends on factors including the margin by which it exceeds the background noise level, its absolute level, time of day, change in noise environment, etc., as well as local attitudes to the premises and the nature of the neighbourhood.

The standard has been used in this assessment in relation to whether noise from plant/equipment associated with the proposed development is likely to give rise to complaints in the residential units nearest the proposed development.

10.2.1.5 World Health Organisation (WHO) Guidelines for Noise

In the World Health Organisation (WHO) Guidelines for Community Noise (1999), a L_{Aeq} threshold daytime noise limit of 55 dB is suggested for outdoor living areas in order to protect the majority of people from being seriously annoyed. A second daytime limit of 50 dB is also given as a threshold limit for moderate annoyance.

The guidelines suggest that an internal L_{Aeq} not greater than 30 dB for continuous noise is needed to prevent negative effects on sleep. This is equivalent to a façade level of 45 dB L_{Aeq}, assuming open windows or a free-field level of about 42 dB L_{Aeq}. If the noise is not continuous, then the internal level required to prevent negative effects on sleep is a $L_{Amax,fast}$ of 45 dB. Therefore, for sleep disturbance, the continuous level as well as the number of noisy events should be considered.

The WHO *Night Noise Guidelines for Europe* was published in 2009 on the back of extensive research completed by a WHO working group. Considering the scientific evidence on the threshold of night noise exposure indicated by $L_{night,outside}$ as defined in the Environmental Noise Directive [2002/49/EC] (implemented in Ireland under the Environmental Noise Regulations 2006, SI140/2006, an $L_{night,outside}$ of 40dB should be the target of the night noise guideline (NNG) to protect public, including the most vulnerable groups such as children, the chronically ill and the elderly. An interim target of 55dB is recommended where the NNG cannot be achieved. These guidelines are applicable to Member States of the European Region and may be considered as an extension to the previous WHO Guidelines for Community Noise (1999).

In 2012, the WHO published the *Methodological Guidance for Estimating the Burden of Disease from Environmental Noise*. This document outlines the principles of quantitative assessment of the burden of disease from environmental noise, describes the status in terms of the implementation of the European Noise Directive and reviews evidence on exposure-response relationships between noise and cardiovascular diseases.

10.2.1.6 UK Department of Transport (Welsh Office) - Calculation of Road Traffic Noise [CRTN]

This Calculation of Road Traffic Noise (CRTN) guidance document outlines the procedures to be applied for calculating noise from road traffic. The document consists of three different sections, covering a general method for predicting noise levels at a distance from a highway, additional procedures for more specific situations and a measurement method for situations where the prediction method is not suitable. The prediction method constitutes the preferred calculation technique but in a small number of cases, traffic conditions may fall outside the scope of the prediction method and it will then be necessary to resort to measurement. The prediction method has been used in this instance to determine the likely noise impact from traffic flow increases as a result of the proposed development. This prediction methods in the CRTN are the basis for the calculation of road traffic noise as included in the Irish National Roads Authority Guidelines for the treatment of Noise and Vibration on National Road Schemes (2004).

10.2.2 Vibration

On account of the large number of vehicle movements and heavy plant associated with construction of the proposed development, there is potential for vibration impacts associated with these plant movements. Vibration threshold values discussed below are presented in the context of potential vibration effects from the earthworks movements and transport to/from the site. As there are no dedicated Irish guidance documents dealing with vibration, the following paragraphs relate to the relevant British Standards.

Limits of transient vibration, above which cosmetic damage could occur, are given numerically in Table 10.2 (Ref: BS5228-2:2009). Minor damage is possible at vibration magnitudes which are greater than twice those given in Table 10.2, and major damage to a building structure can occur at values greater than four times the tabulated values (definitions of the damage categories are presented in BS7385-1:1990).

Table 10.2: Transient Vibration Guide Values for Cosmetic Damage (Ref BS5228-2:2009)

Type of Building	Peak Particle Velocity (PPV) (mm/s) in Frequency Range of Predominant Pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings.	50 mm/s at 4 Hz and above.	50 mm/s at 4 Hz and above.
Unreinforced or light framed structures. Residential or light commercial buildings.	15 mm/s at 4 Hz increasing to 20 mm/S at 15 Hz.	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above.

British Standard BS 7385 (1993) *Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration* indicates that cosmetic damage should not occur to property if transient vibration does not exceed 15mm/s at low frequencies rising to 20mm/s at 15Hz and 50mm/s at 40Hz. These guidelines refer to relatively modern buildings and therefore, these values should be reduced to 50% or less for more sensitive buildings.

The human body is an excellent detector of vibration, which can become perceptible at levels which are substantially lower than those required to cause building damage. The human body is most sensitive to vibration in the vertical direction (foot to head). The effect of vibration on humans is guided by British Standard 6472:1992. This standard does not give guidance on the limit of perceptibility, but it is generally accepted that vibration becomes perceptible at levels of approximately 0.15 to 0.3 mm/s.

BS 6472 defines base curves, in terms of root mean square (rms) acceleration, which are used to assess continuous vibration. Table 5 of the Standard states that in residential buildings, the base curve should be multiplied by 1.4 at night and by 2 to 4 during the daytime to provide magnitudes at which the probability of adverse comment is low.

In order to assess human exposure to vibration, ideally, measurements need to be undertaken at the point at which the vibration enters the body, i.e. measurements would need to be taken inside properties. However, various conversion factors have been established to convert vibration levels measured at a foundation to levels inside buildings, depending on the structure of the building.

Where vibration is intermittent or occurs as a series of events, the use of Vibration Dose Values (VDVs) is recommended in BS 6472 for the assessment of subjective response to vibration. The VDVs at which it is considered there will be a low probability of adverse comment are drawn from BS 6472 and presented in Table 10.3.

Table 10.3: Threshold Values for the Evaluation of Disturbance due to Vibration

Place	Daytime 16 Hour VDV ($ms^{-1.75}$)	Night-time 8 Hour VDV ($ms^{-1.75}$)
Critical Working Area	0.11	0.09
Residential	0.22 – 0.43	0.13
Office	0.43	0.36[1]
Workshops	0.87	0.73

These VDV thresholds do not apply unless night-time work was a regular activity at these premises.

Vibration from the proposed construction works and construction traffic are discussed in Section 10.4 in the context of the vibration guideline levels outlined above.

10.2.3 EIS Scoping and Consultation

Due to the location of the proposed development next to the Naval Base, RPS consulted with the Navy to understand the locations of any noise sensitive receptors and to discuss existing noise sources on Haulbowline Island. RPS met representatives of the Navy to discuss the proposed development and potential noise impacts associated with it. The Navy representatives highlighted where noise sensitive receptors are present within the Navy site and these have been incorporated into the Noise and Vibration Assessment.

As part of the consultation process for the proposed developments, responses received from the Health Services Executive (North Lee Environmental Health), the Environmental Protection Agency, the National Parks and Wildlife Service and An Bord Pleanála made references to potential noise impacts. As part of the process of completing the Noise and Vibration Assessment for the proposed developed, all of the comments received from consultees have been considered and incorporated into this Noise and Vibration Assessment.

10.2.4 Methodology for the baseline Noise Monitoring

Noise monitoring was conducted in the vicinity of the proposed development site in order to characterise the noise environment in the study area. The purpose of the noise monitoring survey was to record noise levels in the vicinity of the nearest noise sensitive receptors.

Five noise monitoring locations were selected to represent the nearest sensitive receptors to the proposed development site (See Figure 10.1). Noise sensitive receptors include residential properties and any non-residential buildings that may have particular sensitivities to increased noise levels (e.g., hospitals, nursing homes, educational facilities, establishments/laboratories/workshops where high precision tasks are performed, etc.). In the case of this particular assessment, workshops associated with the Base have been included as sensitive receptors on account of their proximity to the proposed development. The five noise monitoring locations are described in the bullet points below:-

- N1 - Representative of the noise environment in the Naval Base;
- N2 - Representative of the noise environment at the National Maritime College;
- N3 - Representative of the noise environment at the nearest residential property to the south of the proposed site;
- N4 - Representative of the noise environment at the nearest residential properties in White Point; and
- N5 - Representative of the noise environment at the nearest resdiential properties in Cobh.

Noise monitoring was undertaken at each location as per outlined in Section 7 (including Table 5) of NG4 (See Section 10.2.1.1). Table 5 of NG4 outlines the minimum survey duration periods to be used for noise monitoring surveys for day, evening and night-time periods. While the proposed development will primarily involve daytime activities, noise monitoring was completed for day, evening and night-time periods to ensure that there was a complete noise baseline in the event of any regular requirement for noise monitoring as part of the operation of the site under a Waste Licence. The noise monitoring survey satisfied the minimum requirements for a noise survey as outlined in Table 5 of NG4, which are outlined in Table 10.4 below. Subjective noisy events were recorded during each logging period.

Table 10.4: Recommended Minimum Survey Durations (Ref: NG4)

Period	Minimum Survey Duration
Daytime (07:00 - 19:00hrs)	4 hour survey with a minimum of 3 sampling periods at each noise monitoring location.
Evening (19:00 - 23:00hrs)	2 hour survey with a minimum of 1 sampling periods at each noise monitoring location.
Night-time (23:00 - 07:00hrs)	3 hour survey with a minimum of 2 sampling periods at each noise monitoring location.

Noise monitoring was carried out on-site using a Bruël & Kjær 2250 Hand Held Analyzer and a Bruël & Kjær Type 4231 Sound Level Calibrator. This instrumentation conforms to the requirements for integrating averaging sound level meters (Type 1) as specified in BS EN 60804. The sound level meter was accurately calibrated before use.

Measurements were made at a height of 1.2 – 1.5m above ground level. The weather conditions were in accordance with the requirements of *BS7445: Description and Measurement of Environmental Noise* and *ISO 1996: Acoustics - Description, Measurement and Assessment of Environmental Noise*. The following parameters were recorded during each monitoring period:-

L_{Aeq} The continuous equivalent A-weighted sound pressure level. This is an "average" of the sound pressure level.

L_{Amax} This is the maximum A-weighed sound level measured during the sample period.

L_{Amin} This is the minimum A-weighted sound level measured during the sample period.

L_{A10} This is the A-weighted sound level that is exceeded for noise for 10% of the sample period.

L_{A90} This is the A-weighted sound level that is exceeded for 90% of the sample period.

10.3 EXISTING ENVIRONMENT

Noise monitoring was carried out by RPS at the proposed development site on 06/11/12 and 07/11/12. The noise monitoring locations are illustrated in Figure 10.1. The noise measurements attained during each monitoring period are displayed in Table 10.5 below.

Table 10.5: Summary of Noise Monitoring Survey

Location	Period	Time	Elapsed Time	Measured L_{Aeq} dB(A)	Measured L_{Amax} dB(A)	Measured L_{Amin} dB(A)	Measured L_{A10} dB(A)	Measured L_{A90} dB(A)
N1	Day	12:41	0:15	58	78	43	54	44
N1	Day	13:56	0:15	48	71	42	49	45
N1	Day	15:09	0:15	51	80	42	48	44
N1	Evening	20:56	0:15	41	59	38	42	39
N1	Evening	22:36	0:15	40	52	38	41	39
N1	Night	23:00	0:15	41	61	37	42	39
N1	Night	0:05	0:15	38	59	35	39	37
N1	Night	0:21	0:15	38	55	36	39	37
N2	Day	13:11	0:15	47	70	43	47	44
N2	Day	14:19	0:15	48	71	43	49	44

Location	Period	Time	Elapsed Time	Measured L_{Aeq} dB(A)	Measured L_{Amax} dB(A)	Measured L_{Amin} dB(A)	Measured L_{A10} dB(A)	Measured L_{A90} dB(A)
N2	Day	15:33	0:15	45	55	41	47	42
N2	Evening	21:18	0:15	42	74	35	43	37
N2	Night	23:21	0:15	42	62	35	40	36
N2	Night	0:44	0:15	41	59	32	43	35
N3	Day	13:33	0:15	63	81	43	67	45
N3	Day	14:42	0:15	63	82	42	64	45
N3	Day	15:55	0:15	64	84	42	67	45
N3	Evening	21:41	0:15	55	81	35	48	37
N3	Night	23:42	0:15	51	78	37	45	40
N3	Night	1:04	0:15	38	51	34	39	36
N4	Day	12:16	0:15	48	65	41	49	44
N4	Day	13:06	0:15	46	65	38	48	41
N4	Day	13:56	0:15	46	69	38	46	41
N4	Day	14:12	0:15	45	63	39	46	42
N4	Evening	21:35	0:15	45	58	32	48	37
N4	Evening	22:23	0:15	51	69	31	51	35
N4	Night	23:14	0:15	47	64	32	49	37
N4	Night	0:11	0:15	41	75	31	40	33
N5	Day	11:43	0:15	53	70	47	53	49
N5	Day	12:42	0:15	52	67	47	54	49
N5	Day	13:33	0:15	50	68	46	52	48
N5	Evening	21:10	0:15	47	68	41	50	43
N5	Evening	22:00	0:15	43	64	40	44	42
N5	Evening	22:46	0:15	44	54	41	45	42
N5*	Night	23:45	0:15	54	55	54	54	54
N5	Night	0:34	0:15	49	77	42	52	43
N5	Night	0:50	0:15	44	53	42	45	43

* All parameters give similar results on account of dominant noise source being constant engine noise from a moored tugboat in close proximity to measurement location.

Subjective observations were recorded during each measurement period to determine the dominant audible noise sources during each period. Appendix L: Noise Survey Results includes a detailed summary of all subjective observations recorded during the noise monitoring survey (it should be noted that the maximum levels recodeed at N4 and N5 were due to the door of a car closing and tug boat, respectively). It was observed during the daytime noise monitoring survey that there was regular gunshot noise coming from the firing range in the Naval Base. Consultation with the Naval Base revealed that this activity takes place on a daily basis during daytime hours only and hence is part of the existing noise environment. While this type of noise can increase the 'average' noise level (i.e. L_{Aeq}) and the maximum noise levels (i.e. L_{Amax}), it will not significantly alter the background noise level (i.e. L_{A90}).

10.4 POTENTIAL IMPACTS

The assessment of impacts is based on the details provided in Chapter 5 'Project Description', Chapter 6 'Project Construction' and Chapter 8 'Traffic and Transport'.

10.4.1 Construction Stage

10.4.1.1 Impact from Transport Movements to and from the East Tip

A Traffic Impact Assessment (TIA) was completed for the proposed development in order to characterise the baseline traffic levels in the study area for the purposes of determining the likely traffic impact from the proposed development. The TIA is included in Chapter 8 'Traffic and Transport' of the EIS. In order to determine the likely traffic noise impact from vehicles travelling to and from the proposed development site, traffic flow information in the form of 24-hour Annual Average Daily Traffic (AADT) values and percentage heavy goods vehicles (%HGV) was obtained from this assessment.

The proposed development will result in construction traffic of 14.3 HGVs per hour in each direction along the N28 route (i.e. 28.6 vehicle movements per hour) between the hours of 09:30 and 18:00. This combines to give a total of 243 HGV journeys per day. This information has been used along with the baseline traffic flow information from the traffic consultants to determine how the AADT flows and the %HGV flows will change along the N28 route as a result of the proposed development. A series of 10 different portions of the N28 route in the Shanbally and Ringaskiddy areas (i.e. most affected by the proposed development) have been assessment to determine the likely noise impact on the nearest sensitive receptors as a result of traffic noise increases along the N28 route. The first portion of the N28 route to be assessed is the section of road up until the junction with the R610 road and this is followed by every significant portion of road along the N28 up until the entrance to Haulbowline Island. Table 10.6 below shows the increase in traffic levels, the increase in %HGVs and the increase in traffic noise levels along each of the ten portions of the N28 route as a result of the proposed development. All predictions to determine traffic noise levels have been completed on the basis of the standard prediction methods included in the UK Department of Transport (Welsh Office) guidance document *Calculation of Road Traffic Noise (CRTN), 1988, as referenced in the National Roads Authority (NRA) Guidelines for the Treatment of Noise and Vibration on National Road Schemes (2004).*

Table 10.6: Traffic Noise Level Increases on Local Roads as a Result of Proposed Development

Road Link	Baseline AADT	% Increase in AADT with Proposed Development	Baseline %HGV	%HGV with Proposed Development	Increase in Road Traffic Noise with Proposed Development [dB]
1 (N28 to Junction with R610)	12,420	2%	6.4%	8.2%	0.6
2 (N28 from R610 Junction to Raffeen)	12,720	2%	6.0%	7.8%	0.6
3 (N28 from Raffeen to Shanbally Mews Junction)	10,615	2%	6.7%	8.8%	0.6
4 (N28 from Shanbally Mews to Marian Terrace)	12,420	2%	5.8%	7.6%	0.6
5 (N28 from Marian Terrace to R613 Junction)	9,290	3%	7.0%	9.4%	0.7
6 (N28 from R613 to Warren's Court Junction)	7,465	3%	9.0%	11.9%	0.8

Road Link	Baseline AADT	% Increase in AADT with Proposed Development	Baseline %HGV	%HGV with Proposed Development	Increase in Road Traffic Noise with Proposed Development [dB]
7 (N28 from Warren's Court to Old Post Office Road_1)	6,500	4%	3.8%	7.3%	1.2
8 (N28 - Old Post Office Road Junction 2)	5,337	5%	3.4%	7.6%	1.4
9 (N28 from Old Post Office Road to Shamrock Place	5,440	4%	3.4%	7.5%	1.2
10 (L2545 to Haulbowline Island)	2,315	10%	2.3%	11.6%	2.9

Table 10.6 demonstrates that traffic noise level increases along the N28 road as a result of the proposed development will be under 1dB(A) or marginally above 1dB(A) on all portions of the road other than the last portion of the road which connects to Haulbowline Island. A traffic noise level increase on the last portion of the N28 road (i.e. Portion 10 in Table 10.6) of 2.9dB(A) is predicted, the larger noise level increase being a result of the lower overall traffic flows along this section of the road making the construction noise traffic to and from the proposed site more significant.

In terms of the significance of these traffic noise level increases, it is generally accepted that a change of 3dB(A) is the minimum perceptible under normal conditions (Ref: UK *Planning Policy Guidance Note 24 [PPG24] - Planning and Noise*). On this basis, the traffic noise level increases associated with the proposed development along the N28 road portions 1-9 in Table 10.6 are well below the level where they could be perceptible to people living along these routes. Therefore, the traffic noise impacts at sensitive receptors adjacent to road portions 1-9 is negligible.

In the context of the 3dB(A) change discussed above, the traffic noise level increase of 2.9dB(A) for the portion of road accessing Haulbowline Island is at a level where it is reaching the perceptible range. There are a small number of properties adjacent to the L2545 that travels to Haulbowline Island and they will experience this minor noise level increase as a result of traffic movements to and from the proposed development site. While there will be a perceptible noise level increase along this portion of the road, the road traffic noise along this portion of the road will remain low in the context of the higher noise levels currently experienced adjacent to road portions 1-9.

10.4.1.2 Impact from Construction Activities at the East Tip

The construction activities at the East Tip site will last approximately 18 months as outlined in Chapter 6 ‘Project Construction’. The activities taking place at the site during this 18 month period will vary greatly in terms of numbers of vehicles/plant operational, types of activities taking place and areas of work. Therefore, the noise levels emitted from the site will vary constantly. Table 10.7 below gives an approximate timetable of activities and the expected plant/equipment required for the proposed development.

Table 10.7: Approximate Programme of Activities for Proposed Development and Estimated Plant to be Used During Construction

Programme	Construction Activity	Plant & Equipment
Months 1 and 2	Mobilisation Remedial roadworks required prior to importation of materials (month 1) Demolition and Site Clearance Removal of Waste off site Regrading of site and side slopes Commence processing of material on site Commence importation of topsoil/subsoil/rock armour/vertical barrier materials/geosynthetic materials Creation of Stockpile areas Temporary surface water management	Excavators x 3 (one with ripping tooth and one with rock breaker) Dumpers x 3 Crusher x 1, Screener x 1 Dozer x 2 Road sweeper x 1 Power hose x 1 Tractor and Bowser x 1
Months 2 to 4	Continue processing of material on site Continue regarding of site Construction of Perimeter Engineered Structure (PES)/tidal protection i.e. rock armour/Pull back of waste at foreshore & associated temporary works Continue Importation of topsoil/subsoil/rock armour/PES and vertical barrier materials/geosynthetic materials Ongoing pavement remedial works as necessary	As Months 1 to 2 Piling Rig x 1 if applicable
Month 5 to 10	Continue processing of material on site Placement of Rock Armour to Vertical Barrier – may happen in tandem with PES construction Removal of temporary works e.g. coffer dam if constructed Regrading of surface of site Preparation of surface for lining Application of regulation layer Placement of Liner including anchoring in PES Placement of Surface Water Geocomposite Placement of subsoil Continue Importation of topsoil/subsoil (if required quantity not met to date) Ongoing pavement remedial works as necessary	As month 2
Months 11 to 14	Construction of Surface Water Drainage System Continue Importation of topsoil (if required quantity not met to date) Ongoing pavement remedial works as necessary	Excavators x 3, Dumpers x 3 Specialist Surfacing Plant Dozer x 2 Road sweeper x 1 Power hose x 1 Tractor and Bowser x 1
Months 14 to 18	Continue Importation of topsoil (if required quantity not met to date) Topsoiling Landscaping Footpath construction & improvement Construction of car park Construction of pavement layers for the access road (from the public carpark to the amenity site (excluding the bridge). Construction of footpaths, kerbs etc. Construction of pathways, recreational Areas etc.	Dozer x 2 Excavators x 3, Dumpers x 3 Mini-digger x 1, Small Dumper x 1 Excavators x 1 , Dumpers x 1 , Dozer x 1 Piling Rig x 1 Specialist Surfacing Plant Specialist Kerbing Machine Mini-digger x 1, Small Dumper x 1, Excavators x 1 Dozer x 1 Road sweeper x 1 Power hose x 1 Tractor and Bowser x 1

This programme outlined in Table 10.7 is indicative and subject to change as the contractor chosen to complete the works will determine the final programme and activity schedule to achieve the goal of the project. However, the indicative programme set out above serves as a good basis for conducting a noise impact assessment for activities from the proposed development site.

In order to complete a worst-case noise impact assessment of the programme above, it is necessary to determine what the noisiest stages of the construction phase will be. The simplest and most robust means of ensuring a worst-case scenario is assessed is to assume all items of plant/equipment are active at the same time. Where there are multiple numbers of vehicles or items of plant active, the maximum number of items to be employed is assumed in this assessment. To ensure the most conservative approach, the assessment will also assume that all items of plant/equipment are active at the nearest boundary of the proposed development site to the relevant noise sensitive receptor.

Based on the programme outlined in Table 10.7, Table 10.8 contains typical noise levels from various construction plant that will be used at the proposed development site. Table 10.9 contains typical combined construction noise levels for various construction phase activities as outlined in Chapter 6. This table also includes a combined noise level representing all activities being operational at the same location at the same time. This will be used for the purposes of the worst-case noise assessment of the proposed works.

In Table 10.9, two dozers are assumed in the calculation of the 'Clearing Site' category and two empty and one filling dump truck are assumed for the 'Distribution of Materials' category. Three excavators are included in the 'Demolition' category.

Table 10.8: Noise Levels from Construction Plant (Ref: BS 5228:2009)

Activity/Plant (Reference from Annex C, BS 5228:2009)	Power Rating (kW)	Equipment Size, Weight (Mass), Capacity	Activity Equivalent Continuous Sound Pressure Level L_{Aeq} at 10m (dB)
Demolition: Breaking up concrete - pulverizer mounted on excavator (C1 - Ref 3)			80
Demolition: Breaking up brick - breaker mounted on excavator (C1 - Ref 9)	121	(15t) 1 650kg breaker	90
Demolition: Dumping brick rubble - tracked excavator loading dump truck (C1 - Ref10)	228	44t	85
Demolition: Breaking up / cutting steel - tracked excavator (C1 - Ref 16)	205	40t	82
Demolition: Breaking windows - lump hammer (C1 - Ref 20)			81
Clearing Site: Dozer (C2 - Ref 1)	142	20t	75
Clearing Site: Tracked excavator (C2 - Ref 3)	102	22t	78
Clearing Site: Wheeled backhoe loader (C2 - Ref 8)	62	8t	68
Ground Excavation: Dozer (C2 - Ref 12)	142	20t	81
Ground Excavation: Tracked excavator (C2 - Ref 14)	226	40t	79
Ground Excavation: Wheeled loader (C2 - Ref 27)	193	-	80
Crusher: Tracked Semi Mobile Crusher (C9 - Ref14)	310	90t	90
Screener: Screen stockpiler (C10 Ref 14)	56	15t	81
Distribution of Material: Dump Truck (tipping fill) (C2 - Ref 30)	306	29t	79
Distribution of Material: Dump Truck (empty) (C2 - Ref 30)	306	29t	87
Rolling & Compaction: Roller (C2 - Ref 38)	145	18t	73
Piling: Sheet Steel Piling - Vibratory (C3 - Ref 8)		52t, 14m length	88
Piling (Fender): Pre-Cast Concrete Piling - Hydraulic Hammer (C3 - Ref 1)	145	16m length, 5t hammer	89
Pumping Water: Water pump (C2 - Ref 45)	20	6 in	65
General: Road Sweeper (C4 Ref - 90)	70		76

Table 10.9: Combined Noise Levels from Various Construction Activities (Ref: BS5228:2009)

Activity	L_{Aeq} @ 10 m	L_{Aeq} @ 40 m	L_{Aeq} @ 80 m	L_{Aeq} @ 160 m	L_{Aeq} @ 320 m
Demolition	92	80	74	68	62
Clearing Site	81	69	63	57	51
Ground Excavation	85	73	67	61	55
Distribution of Materials	90	78	72	66	60
Crusher	90	78	72	66	60
Screener	81	69	63	57	51
Rolling & Compaction	73	61	55	49	43
Piling	92	80	74	68	62
Pumping Water	65	53	47	41	35
Combined Total for All Activities	**98**	**86**	**80**	**74**	**68**

Based on the overall combined worst-case noise level from the proposed development site (i.e. 98dB[A] at 10m as per Table 10.9), noise calculations have been undertaken to determine the worst-case predicted noise levels from the proposed development at a range of the nearest noise sensitive receptors. In some instances, a single location has been selected to be representative of a group of sensitive properties. Table 10.10 includes all worst-case predicted noise levels based on the distance from the nearest portion of the proposed site boundary to the relevant noise sensitive receptor. In order to ensure a worst-case scenario is assessed, distance attenuation has been predicted in Table 10.10 on the basis of hard ground attenuation between the source and receiver (i.e. it assumes ground surface reflects noise and no absorption takes place). The hard ground distance attenuation equation F1 from Annex F of BS5228:2009 was used for the purposes of determining distance attenuation.

Table 10.10: Worst-Case Predicted Noise Levels from Construction Plant at Nearest Noise Sensitive Properties

Nearest Property (See Fig 10.1)	Worst-Case L_{Aeq} @ 10m (dBA)	Distance from Construction Boundary (m)	Distance Attenuation [Barrier Attenuation] (dBA)	Predicted Worst-Case Construction Noise (dBA)
1 - Waters Edge Hotel, Lower Road	98	710	-37	61
2 - Woodbank, Lower Road	98	890	-39	59
3 - The Rectory, Lake Road	98	870	-39	59
4 - 20 Whitepoint Moorings, Point Road	98	1,010	-40 [-10]	48
5 - White Point Road	98	1,080	-41 [-10]	47
6 - Whitepoint Drive House, White Point Rd	98	1,050	-40 [-10]	48
7 - Naval Base	98	340	-31	67
8 - Martime College	98	610	-36	62
9 - Martime College location 2	98	780	-38	60
10 - Ring House	98	1,340	-43 [-10]	45
11 - 15 Westbourne Place	98	770	-38	60
12 - 9 Westbourne Place	98	790	-38	60
13 - 1 Westbourne Place	98	840	-38	60
14 - 17 Westbourne Place	98	860	-39	59
15 - Naval Base - Dockyard Workshop	98	10	0	98
16 - Naval Base - Dockyard Workshop 2	98	13	-2	96
17 - Naval Base - Dockyard Workshop 3	98	22	-7	91
18 - Naval Base - Recruits Accommodation	98	65	-16 [-20]*	62

* Figure derived from the fact that there are many buildings acting as noise barriers between proposed site and recruits accommodation building.

Table 10.10 illustrates that there is potential for elevated noise levels at the nearest noise sensitive receptors to the proposed development based on worst-case noise level predictions from the proposed construction works. Assuming a background noise level in the 40s dB(A) at all of the nearest noise sensitive properties (See Table 10.4), worst-case predicted noise levels in the 50s and 60s dB(A) as outlined in Table 10.10 will be considerably above the background noise level (L_{A90}) at the nearest properties.

In terms of potential noise impacts at the Naval Base, the most significant noise impact is likely to be on the dockyard workshops that are located in close proximity to the proposed site. The worst-case predicted noise levels outlined for receptors 15-17 are worst-case external noise levels, however all Naval Base personnel will be working within these buildings and hence availing of the significant noise attenuation offered by the building shells.

These predicted worst-case noise levels are above the general daytime noise criterion of 55dB as specified in the EPA Guidance document *Guidance Note for Noise: Licence Applications, Surveys and Assessments (NG4).* This criterion generally applies to fixed permanent industrial sites that are subject to EPA licences, which does not strictly apply to the temporary activities (albeit the works associated with the proposed development will last approximately 18 months). The predicted worst-case noise levels are also above the WHO noise threshold level of 55dB(A) for serious annoyance. In addition to this, the worst-case predicted noise levels are sufficiently above the background noise levels (L_{A90}, See Table 10.4) in many of the nearest noise sensitive receptor so as to constitute a significant likelihood of complaint in relation to the methodology described in BS4142:1997.

The paragraph above describes how there is potential for the proposed construction works to result in worst-case predicted noise levels above noise threshold limits (i.e., NG4, WHO, BS 4142:1997, etc.) generally applied to fixed permanent industrial activities. While this is the case, it must be kept in mind what the basis is for the worst-case predictions and the fact the proposed works will be temporary in nature. Worst-case noise level predictions were calculated on the basis that all items of plant listed in Table 10.8 will operate simultaneously at the nearest point of the site boundary to the respective noise sensitive receptor. Clearly, this cannot happen and, in reality, the majority of the items of plant will operate sporadically and at various different locations throughout the site (and not all at once). On this basis, the worst-case predicted noise level is a significant overestimation of the likely noise level likely to be emitted from the proposed site.

Despite the fact that the proposed development relates to a temporary activity and that the predicted worst-case noise levels indicated in Table 10.10 are a significant overestimation of likely noise levels from the site, it is still clear that there is the potential for significant noise level increases at a number of the nearest noise sensitive receptors without noise mitigation measures in place. Section 10.5 outlines noise mitigation measures that will reduce noise from the proposed development to the lowest possible levels.

There may be on limited occasions a requirement to complete some night-time works specifically on the foreshore area to avail of optimum tidal conditions. Such activities will be very limited in number, will be completed in full collaboration with all of the relevant authorities and residents and will have strict noise control measures in place to reduce noise levels from the works to the lowest possible levels.

10.4.1.3 Impact from Access Road Construction Works

It is proposed that a new access road will be constructed from the access bridge on Haulbowline Island leading to the entrance of the East Tip site. Table 10.11 shows typical noise levels associated with plant involved in road construction. A total combined noise level for all plant is also included in Table 10.11.

Table 10.11: Noise Levels from Road Construction Plant (Ref: BS 5228:2009)

Activity/Plant (Reference from Annex C, BS 5228:2009)	Power Rating (kW)	Equipment Size, Weight (Mass), Capacity	Activity Equivalent Continuous Sound Pressure Level L_{Aeq} at 10m (dB)
Road Roller (Ref: C5 - 19)	95	22t	80
Vibratory Roller (Ref: C5 - 20)	98	8.9t	75
Asphalt Paver [+ tipper lorry] (Ref: C5 - 30)	112	12t hopper	75
Wheeled Excavator [trenching] (Ref: C5 - 34)	51	7t	70
Electric Water Pump (Ref: C5 - 40)	15	6 in	68
Combined			**83**

Based on the above combined noise levels from road construction, the predicted worst-case noise level from road construction works at the nearest noise sensitive receptors is included in Table 10.12 below.

Table 10.12: Worst-Case Predicted Noise Levels from Road Construction at Nearest Noise Sensitive Properties

Nearest Property (See Fig 10.1)	Worst-Case L_{Aeq} @ 10m (dBA)	Distance from Construction Boundary (m)	Distance Attenuation [Barrier Attenuation] (dBA)	Predicted Worst-Case Construction Noise (dBA)
1 - Waters Edge Hotel, Lower Road	83	1,030	-40	43
2 - Woodbank, Lower Road	83	1,022	-40	43
3 - The Rectory, Lake Road	83	1,246	-42	41
4 - 20 Whitepoint Moorings, Point Road	83	990	-40 [-10]	33
5 - White Point Road	83	981	-40 [-10]	33
6 - Whitepoint Drive House, White Point Rd	83	902	-39 [-10]	34
7 - Naval Base	83	240	-28	55
8 - Martime College	83	479	-34	49
9 - Martime College location 2	83	581	-35	48
10 - Ring House	83	1,101	-41 [-10]	32
11 - 15 Westbourne Place	83	1,085	-41	42
12 - 9 Westbourne Place	83	1,101	-41	42
13 - 1 Westbourne Place	83	1,141	-41	42
14 - 17 Westbourne Place	83	1,154	-41	42
15 - Naval Base - Dockyard Workshop	83	<10	0	83+
16 - Naval Base - Dockyard Workshop 2	83	<10	0	83+
17 - Naval Base - Dockyard Workshop 3	83	27	-9	74
18 - Naval Base - Recruits Accommodation	83	36	-11 [-20]*	52

* Figure derived from the fact that there are many buildings acting as noise barriers between proposed site and recruits accommodation building

Table 10.12 illustrates that worst-case predicted noise levels from road construction will be significantly lower than that from the main construction works at the East Tip. The road construction works will not result in any additional noise impact at the majority of the noise sensitive receptors considered as they are more than 10dB(A) less than the worst-case predicted noise levels from the East Tip construction works. The only instance where the proposed road works may increase the overall noise impact is in the case of the Naval Dockyard workshops adjacent to the proposed site.

10.4.1.4 Impact from Footpath Improvements

To improve pedestrian access to the East Tip, it is proposed that new footpaths will be constructed from the entrance of the National Maritime College to the bridge accessing Haulbowline Island. Some additional footpaths will also be upgraded. Table 10.13 shows typical noise levels associated with plant involved in footpath construction. A total combined noise level for all plant is also included in Table 10.13.

Table 10.13: Noise Levels from Footpath Construction Plant (Ref: BS 5228:2009)

Activity/Plant (Reference from Annex C, BS 5228:2009)	Power Rating (kW)	Equipment Size, Weight (Mass), Capacity	Activity Equivalent Continuous Sound Pressure Level L_{Aeq} at 10m (dB)
Vibratory Roller (Ref: C5 - 20)	98	8.9t	75
Asphalt Paver [+ tipper lorry] (Ref: C5 - 30)	112	12t hopper	75
Wheeled Excavator [trenching] (Ref: C5 - 34)	51	7t	70
Electric Water Pump (Ref: C5 - 40)	15	6 in	68
Combined			**79**

Based on the above combined noise levels from footpath construction, the predicted worst-case noise level from footpath construction works at the nearest noise sensitive receptors is included in Table 10.14 below.

Table 10.14: Worst-Case Predicted Noise Levels from Footpath Construction at Nearest Noise Sensitive Properties

Nearest Property (See Fig 10.1)	Worst-Case L_{Aeq} @ 10m (dBA)	Distance from Construction Boundary (m)	Distance Attenuation [Barrier Attenuation] (dBA)	Predicted Worst-Case Construction Noise (dBA)
1 - Waters Edge Hotel, Lower Road	79	1,562	-44	35
2 - Woodbank, Lower Road	79	1,479	-43	36
3 - The Rectory, Lake Road	79	1,610	-44	35
4 - 20 Whitepoint Moorings, Point Road	79	1,420	-43 [-10]	26
5 - White Point Road	79	1,368	-43 [-10]	26
6 - Whitepoint Drive House, White Point Rd	79	1,263	-42 [-10]	27
7 - Naval Base	79	678	-37	42
8 - Martime College	79	28	-9	70
9 - Martime College location 2	79	197	-26	53
10 - Ring House	79	261	-28 [-10]	41
11 - 15 Westbourne Place	79	1,636	-44	35
12 - 9 Westbourne Place	79	1,659	-44	35
13 - 1 Westbourne Place	79	1,708	-45	34
14 - 17 Westbourne Place	79	1,723	-45	34
15 - Naval Base - Dockyard Workshop	79	546	-35	44
16 - Naval Base - Dockyard Workshop 2	79	599	-36	43
17 - Naval Base - Dockyard Workshop 3	79	836	-38	41
18 - Naval Base - Recruits Accommodation	79	687	-37 [-10]	32

Table 10.14 illustrates that worst-case predicted noise levels from footpath construction will be significantly lower than that from the main construction works at the East Tip. The footpath construction works will not result in any additional noise impact at the majority of the noise sensitive receptors considered as they are more than 10dB(A) less than the worst-case predicted noise levels from the East Tip construction works. The only instance where the footpath construction works may have a significant effect on the overall noise impact is in the case of one of the National Maritime College buildings which is adjacent to these works. Mitigation measures to address this potential noise impact are included in Section 10.5.

10.4.1.5 Vibration Impacts from Proposed Development

On account of the proximity of the proposed construction works to the Naval Dockyard workshops, there may be potential for some vibration impacts at these workshops. Section 10.2 outlines the key vibration level thresholds whereby structural or nuisance impacts may be experienced.

Standard construction activities are not likely to generate significant levels of vibration, even at close range. The most significant potential source of vibration may be piling. The potential for vibration impacts from construction works and particularly from piling must be considered further at the detailed design stage when more precise details are known about the exact nature and locations of construction activities such as piling are known. The Construction Environmental Management Plan must include a range of mitigation measures based on the detailed design proposals to ensure that there is no significant vibration impacts resulting from the proposed development.

10.4.2 End-use, Aftercare and Maintenance phase Impact

Following the construction phase at the proposed development site, the site will be landscaped to provide a large recreational space including recreational walking areas and a football pitch. There will be 54 car parking spaces servicing the recreational area. On account of the nature of the operational phase activities, the location of the site and the small number of vehicles that will be accessing the site during the operational phase, the proposed development site will not present a significant noise impact on noise sensitive receptors in the study area during the operational phase.

10.4.3 'Do Nothing' Scenario

If the proposed development does not place, there will be no noise and vibration impact and the existing noise environment as surveyed and detailed in Section 10.3 will prevail.

10.4.4 Environmental Noise Regulations (2006)

The proposed development will not have any impact on future action plans as described under the Environmental Noise Regulations, 2006. As outlined in Section 10.4.6, there will be no significant noise impact associated with the end-use, aftercare and maintenance phase of the East Tip.

10.5 MITIGATION MEASURES

10.5.1 Construction Phase

Section 10.4 above outlines the Construction Environmental Management Plan and phasing for the proposed development. Construction activities will operate between the hours of 07:00 and 19:00 on Monday to Fridays, between 09:00 and 16:00 on Saturdays and there will be no activity on Sundays or Bank Holidays. Haul road activities will be limited to 09:30 to 18:00 on Monday to Fridays and 09:00 - 15:00 on Saturdays with no activities on Sundays or Bank Holidays.

As outlined in Section 10.4.1.2, there is potential for significant short-term noise impacts (Ref: short-term as described in the glossary of the EPA Guidelines on the Information to be Contained in Environmental Impact Statements, 2002) at the nearest noise sensitive properties to the proposed development site as a result of worst-case noise levels from the construction phase. Table 10.10 presents worst-case predicted noise levels at a range of the nearest noise sensitive properties to the proposed construction works, clearly highlighting the need for a Noise Management Plan to be in place for the construction phase of the proposed development.

The Noise Management Plan will outline a detailed programme for the construction phase and will include information such as notifications, contact numbers, method of appointing contractor, monitoring, contractual conditions and timescales. The programme of works will be agreed with Cork County Council / Health Services Executive (North Lee Environmental Health) and the successful contractor will be obliged to comply with the information therein.

There may be on limited occasions a requirement to complete some night-time works specifically on the foreshore area to avail of optimum tidal conditions. Such activities will be very limited in number, will be completed in full collaboration with all of the relevant authorities and residents and will have strict noise control measures in place to reduce noise levels from the works to the lowest possible levels.

Vibration

The majority of the nearest sensitive receptors are a sufficient distance from the proposed works for there to be no significant vibration impacts during the construction phase. The Naval Base dockyard workshops are located very close to the proposed site boundary. Any plans to conduct vibration generating activities in the vicinity to these boundary must be outlined in detail in the Construction Environment Management Plan (CEMP) and all potential vibration activities must be completed in full collaboration with representatives from the Naval Base to ensure no sensitive activities potentially taking place within the workshops are detrimentally affected by the proposed works. The CEMP will outline the requirements for all pre- and post construction structural condition and vibration surveys required to protect the most sensitive structural buildings adjacent to the proposed development site. Subject to vibration at sensitive locations not exceeding 5mm/s during general construction works, structural damage to buildings is highly unlikely.

Monitoring

Noise monitoring should take place at the noise monitoring locations outlined in Section 10.2.4 (and Figure 10.1) during the construction works to ensure the nearest noise sensitive properties are not subject to unacceptable noise levels (refer to Figure 10.1). Noise level limits set down by Cork County Council and the Health Services Executive (North Lee Environmental Health) should be adhered to.

Specific Mitigating Measures for Construction Phase

Due to the length of time construction works will be taking place at the East Tip site, there is potential for significant short-term construction noise impacts at the nearest noise sensitive receptors. As the Naval Base is located on Haulbowline Island, this will be the nearest noise sensitive receptor and will also be subject to the greatest noise impact from the proposed construction activities. It is recommended that a robust temporary noise barrier (2-3m in height) is placed along the western boundary of the proposed development site for the duration of the construction works so as to achieve a reduction in noise levels at the Naval Base. Such a barrier will achieve an approximate 10dB(A) reduction in noise levels emitted from the proposed site in the direction of the Naval Base. For the construction of the swale and capping system along the western boundary of the site, the temporary barrier will have to be dismantled. However, these works can be completed in stages so that sections of the temporary noise barrier can remain intact to minimise noise impacts from other construction activites ot the site. Aligned with the measures included in the Noise Management Plan for the proposed construction works (discussed below), noise levels from the proposed development will be reduced to below 55dB(A) for the duration of the works.

Apart from the Naval Base, the worst-case noise predictions indicated that there was potential for noise levels in the high 50s and low 60s dB(A) at some of the other nearest sensitive receptors to the proposed development (See Table 10.10). The landscaping of the proposed development will involve the creation of elevated ridges of land to the north and south of the East Tip site. If these features were created at the start of the earthworks stage, they could act as a large noise barrier providing attenuation of up to 10dB(A) on noise emissions to the noise sensitive receptors not already benefiting from the temporary noise discussed in the paragraph above. If these features are not appropriately placed so as to provide a complete visual screen in the direction of the nearest noise sensitive properties, temporary noise bunds should be created to screen construction activities at the proposed site. With the Noise Management Plan also in place, noise levels from the proposed development site will be well below 55dB(A) at all of the nearest noise sensitive receptors.

A detailed Noise Management Plan should be included in the overall Construction Environmental Management Plan and will include a range of measures aimed at reducing the potential construction noise impact on the nearest receptors to the proposed development site. This plan should address the mode and timing of construction activity in close proximity to the site boundary with the nearest noise sensitive receptors, aiming to reduce the noisiest activities in the vicinity of the boundary of the proposed site. This plan should also address the issues relating to collaboration with the local residents in order to reduce as much as possible the potential impact from construction noise.

The road construction work from the Haulbowline Bridge to the East Tip site may result in additional noise impacts at the Naval Dockyard workshops located adjacent to these works. A robust temporary noise barrier (approximately 2-3m height) should be erected between the proposed works and these workshops to reduce noise levels from the proposed road works by approximately 10dB(A). Likewise, a similar temporary barrier should be placed between the footpath construction works and the National Maritime College building that is adjacent to these works.

A range of measures should be taken to ensure that the quietest machinery is used or that the use of machinery is such as to be sensitive to the residents at the nearest properties. This should be detailed in the Construction Environmental Management Plan mentioned above.

British Standard *BS 5228:2009 – Noise and vibration control on construction and open sites* outlines a range of measures that can be used to reduce the impact of construction phase noise on the nearest noise sensitive receptors. These measures should be applied by the contractor where appropriate during the construction phase of the proposed development. Examples of some of the best practice measures included in BS 5228 are listed below:-

- Ensuring that mechanical plant and equipment used for the purpose of the works are fitted with effective exhaust silencers and are maintained in good working order;
- Careful selection of quiet plant and machinery to undertake the required work where available;
- All major compressors should be 'sound reduced' models fitted with properly lined and sealed acoustic covers which should be kept closed whenever the machines are in use;
- Any ancillary pneumatic percussive tools should be fitted with mufflers or silencers of the type recommended by the manufacturers;
- Machines in intermittent use should be shut down in the intervening periods between work;
- Ancillary plant such as generators, compressors and pumps should be placed behind existing physical barriers, and the direction of noise emissions from plant including exhausts or engines should be placed away from sensitive locations, in order to cause minimum noise disturbance. Where possible, in potentially sensitive areas, acoustic barriers or enclosures should be utilised around noisy plant and equipment.
- Handling of all materials should take place in a manner which minimises noise emissions; and
- Audible warning systems should be switched to the minimum setting required by the health & safety authority.

In order to minimise the likelihood of complaints, the Contractor must keep regular contact with the relevant local authorities and personnel at the nearest sensitive receptors to ensure all are kept informed of the works to be carried out. A complaints procedure should be operated by the Contractor throughout the construction phase.

Specific Mitigating Measures for Traffic and Haul Route

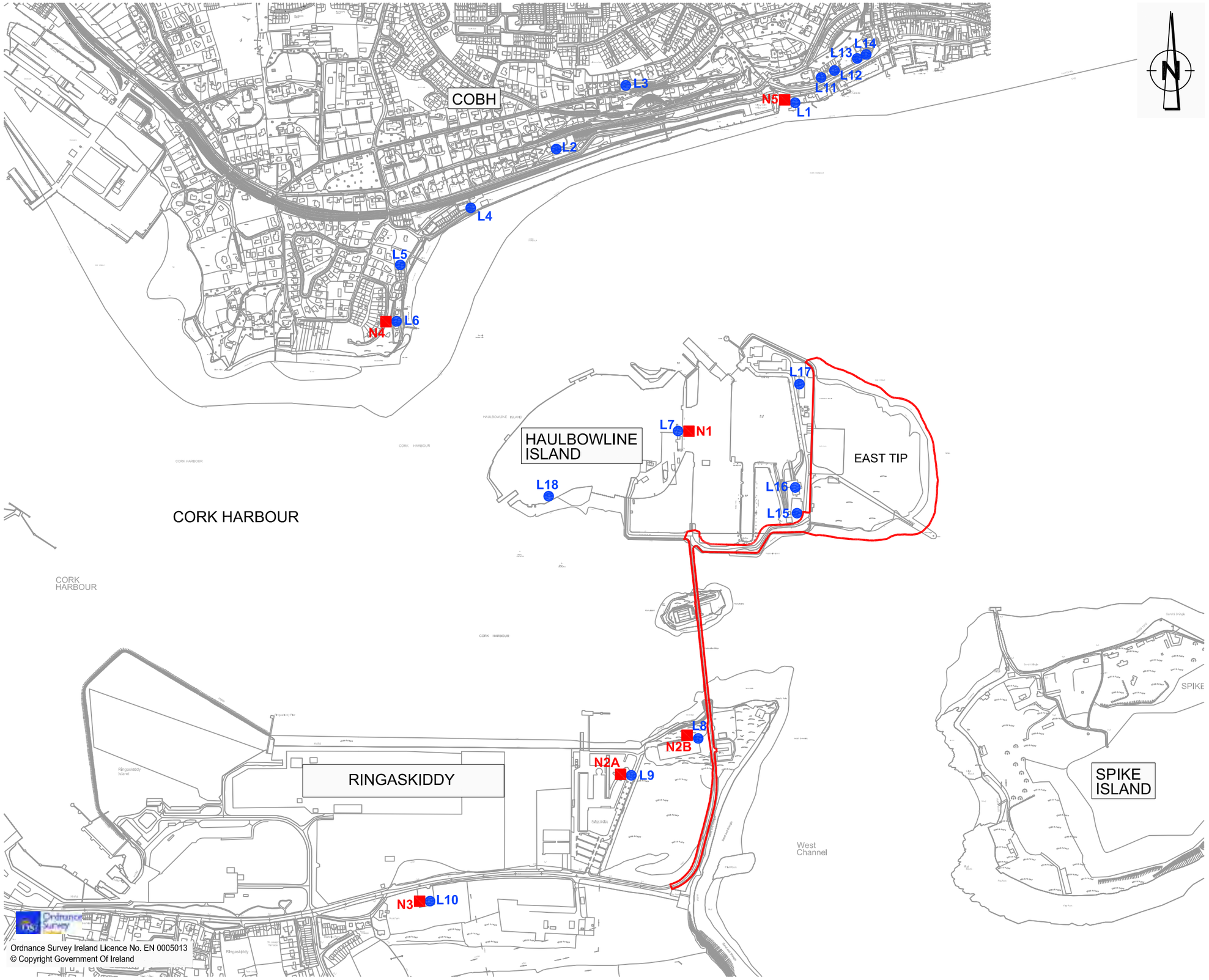
There will be no significant impact from traffic movements from the proposed development on the local road network and therefore there is no requirement for mitigation measures.

10.5.2 End-Use, Aftercare and Maintenance phase

The operational phase of the proposed development will not involve any significant noise generating activities.

10.6 RESIDUAL IMPACT

There will be a temporary noise increase at the nearest noise sensitive properties to the proposed development during the construction phase. With the appropriate mitigation measures in place (as outlined in this section), this noise impact will be slight in significance (see description of slight in EPA *Guidelines on the Information to be Contained in Environmental Impact Statements*, 2002). When construction works are completed, there will be no significant operational phase noise impacts associated with the proposed site.



LEGEND:

- Site Works Boundary
- Noise Prediction Locations
- Noise Monitoring Locations

Title
NOISE MONITORING AND PREDICTION LOCATIONS

Figure 10.1

File Ref : MCE0734 Figure 10.1
Date : April 2013 Rev : F01

East Tip Remediation Project

EAST TIP REMEDIATION PROJECT

RPS

11 LANDSCAPE AND VISUAL

11.1 INTRODUCTION

This chapter examines the potential landscape and visual impact of the proposed development on Haulbowline Island and the wider Cork Harbour area.

This chapter seeks to:-

a) Establish the baseline conditions -

Record and analyse the existing character, quality and sensitivity of the landscape and visual resource. This includes elements of the landscape such as:-

- Landform;
- Land cover including the vegetation, the slopes, drainage, etc;
- Landscape character;
- Current landscape designations and planning policies; and
- Site visibility, comprising short, medium and long distance views.

b) Analyse baseline conditions:-

Comment on the scale, character, condition and the importance of the baseline landscape, its sensitivity to change and the enhancement potential where possible.

A visual analysis (illustrated by photographic material) describing characteristics which may be of relevance to the impact of the design and to the method of mitigation.

c) Describe the development.

d) Identify the Impacts of the Development on the Landscape and Visual Resource:-

Identify the landscape and visual impacts of the development at different stages of its life cycle, including:-

- Direct and indirect *landscape impacts* of the development on the landscape of the site and the surrounding area; and

- *Visual impacts* including: the extent of potential visibility; the view and viewers affected; the degree of visual intrusion; the distance of views; and resultant impacts upon the character and quality of views.

e) Assess the significance of the landscape and visual impacts in terms of the sensitivity of the landscape and visual resource, including the nature and magnitude of the impact.

f) Detail measures proposed to mitigate significant residual detrimental landscape and visual impacts and assess their effectiveness.

g) Assess the ability of the landscape and visual resource to absorb the proposed development.

11.2 METHODOLOGY

11.2.1 Introduction

Methods used in this assessment have been developed by RPS and are derived from the DoEHLG "Landscape and Landscape Assessment" (June 2000) and 'Guidelines for Landscape and Visual Impact Assessment' (GLVIA) by The Landscape Institute and Institute of Environmental Management and Assessment (2002). These documents recommend baseline studies to describe, classify and evaluate the existing landscape and visual resource focusing on its sensitivity and ability to accommodate change. The guidelines are not intended as a prescriptive set of rules but rather offer best practice methods and techniques of Landscape and Visual Impact Assessment (LVIA). The existing landscape and visual context of the study area was established through a process of desktop study, site survey work (October 2012) and photographic surveys. The proposal was then applied to the baseline conditions to allow the identification of potential impacts, prediction of their magnitude and assessment of their significance. Mitigation can then be identified to reduce as far as possible any residual potential landscape and visual impacts.

11.2.2 Landscape Assessment Criteria and Terminology

The following section describes the criteria and terminology used during the landscape assessment.

Landscape Quality

For the purpose of this assessment, landscape quality is categorised as:-

- *Exceptional Quality* - Areas of especially high quality acknowledged through designation as Areas of Outstanding Natural Beauty or other landscape based sensitive areas. A landscape that is significant within the wider region or at a national level;
- *High Quality* - Areas that have a very strong beneficial character with valued and consistent distinctive features that gives the landscape unity, richness and harmony. A landscape that is significant within the district;
- *Medium Quality* - Areas that exhibit beneficial character but which may have evidence of alteration/degradation or erosion of features resulting in a less distinctive landscape. May be of some local landscape significance with some beneficial recognisable structure; and
- *Low Quality* - Areas that are generally negative in character, degraded and in poor condition. No distinctive beneficial characteristics and with little or no structure. Scope for beneficial enhancement.

Landscape Sensitivity

Landscape sensitivity to the type of development proposed is defined as follows:-

- *High Sensitivity*: High visual quality landscape with highly valued or unique characteristics susceptible to relatively small changes.
- *Medium Sensitivity*: Medium visual quality landscape with moderately valued characteristics reasonably tolerant of changes.
- *Low Sensitivity*: Low visual quality landscape with common characteristics capable of absorbing substantial change.

Magnitude of Landscape Resource Change

Direct resource changes on the landscape character of the study area are brought about by the introduction of the proposal and its effects on the key landscape characteristics. The following categories and criteria have been used:-

- *High magnitude*: Total loss or alteration to key elements of the landscape character which result in fundamental and/or permanent long-term change.
- *Medium magnitude*: Partial or noticeable loss of elements of the landscape character and/ or medium-term change.
- *Low magnitude*: Minor alteration to elements of the landscape character and/or short-term/ temporary change.
- *No Change:* No change to landscape character.

Significance of Landscape Impact

The level of significance of effect on landscape is a product of landscape sensitivity and the magnitude of alteration in landscape resource. Where landscape sensitivity has been predicted as high and the magnitude of change as high or medium the resultant impact will be significant in terms of EIA Regulations. This is illustrated in Table 11.1 below.

Table 11.1: Significance of Landscape Impact

Magnitude of Landscape Resource Change	Landscape Sensitivity		
	Low	Medium	High
No Change	No Change	No Change	No Change
Low	Slight	Slight/Moderate	Moderate
Medium	Slight/Moderate	Moderate	Moderate/Substantial
High	Moderate	Moderate/Substantial	Substantial

Landscape Assessment Definitions

- *Landscape Resource*: The combination of elements that contribute to landscape context, character and value.
- *Landscape Value:* The relative value or importance attached to a landscape that expresses national or local consensus because of intrinsic characteristics.
- *Landscape Character*: The distinct and homogenous pattern that occurs in the landscape reflecting geology, landform, soils, vegetation and man's impact.

11.2.3 Visual Assessment Criteria and Terminology

The following text describes the key criteria and terminology used in the visual assessment.

Viewer Sensitivity

Viewer sensitivity is a combination of the sensitivity of the human receptor (i.e. resident; commuter, tourist; walker; recreationist, or worker) and viewpoint type or location (i.e. house, workplace, leisure venue, local beauty spot, scenic viewpoint, commuter route, tourist route or walkers' route). Sensitivity can be defined as follows:-

- *High sensitivity:* e.g., users of an outdoor recreation feature which focuses on the landscape; valued views enjoyed by the community; tourist visitors to scenic viewpoint.
- *Medium sensitivity:* e.g., users of outdoor sport or recreation which does not offer or focus attention on landscape; tourist travellers.
- *Low sensitivity:* e.g., regular commuters, people at place of work (excluding outdoor recreation).

Magnitude of Visual Resource Change

The magnitude of alteration in visual resource or amenity results from the scale of change in the view with respect to the loss or addition of features in the view and changes in the view composition, including proportion of the view occupied by the proposed development. Distance and duration of view must be considered. Other vertical features in the landscape and the backdrop to the development will all influence the magnitude of visual resource change. This can be defined as follows:-

- *High magnitude:* Where changes to the view significantly alter (negative or beneficial) the overall scene or cause some alteration to the view for a significant length of time.
- *Medium magnitude:* Where some changes occur (negative or beneficial) in the view, but not for a substantial part of the view and/or for a substantial length of time.
- *Low magnitude*: Where only a minor alteration to the view occurs (negative or beneficial) and/or not for a significant length of time.
- *No change:* No discernible deterioration or improvement in the existing view.

Significance of Visual Impact

Significance of visual impact is defined on a project by project basis. The principal criteria for determining significance are magnitude and sensitivity of the receptor. A higher level of significance is generally attached to large scale or substantial effects on sensitive receptors.

Where visual sensitivity has been predicted as high or medium, and the magnitude of change as high, the resultant impact will be significant. Where the magnitude of change has been predicted as high and the visual sensitivity has been predicted as high or medium then the resultant impact will be significant in terms of EIA Regulations.

Table 11.2 illustrates significance of visual impact as a correlation between viewer sensitivity and visual resource change magnitude.

Table 11.2: Significance of Visual Impact

Visual Resource Change Magnitude	Visual Sensitivity		
	Low	Medium	High
No Change	No Change	No Change	No Change
Low	Slight	Slight/Moderate	Moderate
Medium	Slight/Moderate	Moderate	Moderate/Substantial
High	Moderate	Moderate/Substantial	Substantial

Beneficial effects upon receptors may also result from a change to the view. These may be through the removal of negative features or visual detractors, or through the addition of well designed elements, which add to the visual experience in a complementary, beneficial and stimulating manner.

Visual Assessment Definitions

Visual Quality: Although the interpretation of viewers' experience can have preferential and subjective components, there is generally clear public agreement that the visual resources of certain landscapes have high visual quality. The visual quality of a landscape will reflect the physical state of the repair of individual features or elements.

Visual Resources: The visual resources of the landscape are the stimuli upon which actual visual experience is based. They are a combination of visual character and visual quality.

Visual Character: When a viewer experiences the visual environment, it is not observed as one aspect at a time, but rather as an integrated whole. The viewer's visual understanding of an area is based on the visual character of elements and aspects and the relationships between them.

Zone of Visual Influence (ZVI)

The ZVI is the area within which views of the site and/or the development can be obtained. The extent of the ZVI is determined primarily by the topography of the area. The ZVI is then refined by field studies to indicate where relevant forestry, woodlands, hedges or other local features obscure visibility from the main roads, local viewpoints/landmarks and/or significant settlements. The ZVI is illustrated in Figure 11.1.

Using terrain-modelling techniques combined with the proposed development specification, a map is created to show areas from where the proposed development would theoretically be seen. A worst case scenario is taken in line with Landscape Institute guidelines.

The actual visual impacts within the ZVI have been described in later sections of this chapter.

Photographs and Photomontages

Photographs and photomontages have been prepared for selected representative viewpoints throughout the study area as indicated in Figure 11.2 and illustrated in Section 11.5.1.5 below. Photomontages are provided in Appendix M: Photomontages.

Viewpoints are chosen to give a typical representative sample of views of the proposal within the landscape using the parameters of distance and direction of view. Viewpoints frequented by members of the public such as public rights of way, car parks and popular viewpoints are usually chosen, along with views from nearby settlements.

Photographs from each viewpoint location are taken covering an arc of view matching that of the visual extent of the development.

11.3 RECEIVING ENVIRONMENT

11.3.1 Scale and Character

Haulbowline Island is located in Cork Harbour broadly between Ringaskiddy and Cobh. The island has historically been used as a Naval Base now focused on the western part of the island. In modern times the East Tip was used for disposal of steelworks waste. The East Tip is effectively now a derelict site with unsightly stockpiles of waste materials that appear black in views from Cobh. The island is connected to the mainland by a bridge that crosses onto Rocky Island and then to Ringaskiddy. Spike Island lies to the southeast of Haulbowline.

The village of Ringaskiddy is located southeast of Cork City, and has a reputation as a hub of industry for County Cork, and as a large ferry port linking Ireland to the UK and France (see Site Location Map Figure 1.1 in Chapter 1 'Introduction' of the EIS). The topography rises gently from the shoreline to the south of Ringaskiddy to form neat rounded hills with a Martello Tower located on one such hill immediately south of Haulbowline. The western side of Ringaskiddy is industrialised with various chemical and pharmaceutical factories.

Cobh is a significantly larger settlement than Ringaskiddy and has an important tourist industry and acts as a satellite town for Cork City. Large cruise liners regularly berth at Cobh from where tourists can explore Cobh and the wider Cork City area. The topography at Cobh rises steeply from the shoreline with stepped terraces of houses that broadly follow the contours.

The topography of the island site is generally flat in the centre with undulations to the western and eastern most edges before reaching sea level at the edge. The naval base buildings offer screening in views from the west but the east side of the island is open to views to the north east and south. Views of the island are available from Cobh to the north, Monkstown to the west and Ringaskiddy to the southwest. In addition Cork Harbour is well used for commercial and leisure craft that will also have views of the island.

Given the coastal location of this proposal it is anticipated that there will be potential views available from:-

- Cobh to the north;
- Spike Island to the southeast; and
- Ringaskiddy and the adjacent coastline to the south and east.

11.3.2 Landscape Character

The landscape character of the study area can be described by use of the following distinctive landscape character areas.

Estuarine Harbour-Based Industrial and Maritime Landscape

This landscape character area is concentrated mainly on low-lying parts of the landscape at the edge of Cork Harbour including the islands. Many of the industrial sites are located at the water's edge for operational purposes. Industrial sites are located at Ringaskiddy (mainly pharmaceutical plants and Port facilities), Haulbowline Island with its naval activities and former steelworks at the East Tip, Rushbrooke (Cork Dockyard), Aghada and Whitegate (electricity generating station, and oil refinery). The value of this landscape is mainly economic, due to its industrial nature. However, some parts have heritage value such as the cranes of Cork Dockyard that are listed as protected structures and as well as on Spike Island, and these areas provide a cultural value to this landscape. This is a generally robust changing landscape. The disturbed industrial landscape at the East Tip on Haulbowline is of poor quality and detracts from the harbour landscape character. This landscape character area has low sensitivity to change.

Harbour Edge Town Centre and Undulating Residential Townscape

Town centres such as Ringaskiddy, Monkstown and Cobh are all located at the waterside of Cork Harbour. The residential areas of these towns have spread outwards along the harbour and upwards on the steep sided river valley topography. Cobh continues to expand on to the higher parts of the hill on which it is located. The towns have a scenic value due to their location on the harbour. Cobh town's character is defined by rows of housing running parallel with the contours of the rising topography and overlooking the harbour. The scenic value of the towns at the coast is expressed by the designations of scenic landscapes and scenic routes. These towns also have recreational value in the form of town parks or walking trails. Monkstown has a high scenic value due to its woodlands. Cobh has many structures recorded for protection. These structures give Cobh a high scenic value. Due to Cobh's history it appears in many travellers guides, giving it a high recreational value. This landscape character area has a medium sensitivity to change.

11.3.3 Planning Designations

County Cork Development Plan 2009- 2015

The Cork County Development Plan 2009 states the following objectives regarding scenic amenity views and prospects.

ENV 2-6 General Visual and Scenic Amenity: It is a general objective to protect the visual and scenic amenities of County Cork's built and natural environment.

ENV 2-7 Scenic Landscape: It is a particular objective to preserve the visual and scenic amenities of those areas of natural beauty identified as 'scenic landscape'.

ENV 2-8 Landscape Conservation Area(s): It is an objective to carry out an appraisal study in order to identify any area(s) or place(s) within the County as a Landscape Conservation Area in accordance with the Planning and Development Acts.

ENV 2-9 General Views and Prospects: It is a general objective to preserve the character of all important views and prospects, particularly sea views, river or lake views, views of unspoilt mountains, upland or coastal landscapes, views of historical or cultural significance (including buildings and townscapes) and views of natural beauty as recognised in the Landscape Strategy.

ENV 2-10 Development on Approach Roads to Towns and Villages: It is an objective to ensure that the approach roads to towns and villages are protected from inappropriate development, which would detract from the setting and historic character of these settlements.

ENV 2-11 Scenic Routes: It is a particular objective to preserve the character of those views and prospects obtainable from scenic routes identified in this plan.

ENV 2-12 Details of Scenic Routes: It is an objective to protect the character and quality of those particular stretches of scenic routes that have very special views and prospects.

ENV 2-13 Development on Scenic Routes:

(a) It is also an objective of the Planning Authority to require those seeking to carry out development in the environs of a scenic route and/or an area with important views and prospects, to demonstrate that there will be no adverse obstruction or degradation of the views towards and from vulnerable landscape features. In such areas, the appropriateness of the design, site layout, and landscaping of the proposed development must be demonstrated along with mitigation measures to prevent significant alterations to the appearance or character of the area.

(b) It is an objective to encourage appropriate landscaping and screen planting of developments along scenic routes. Where scenic routes run through settlements street trees and ornamental landscaping may also be required.

Designated Scenic Routes and Landscapes

As the existing environment is characterised by an estuary, shorelines, waterfront villages, undulating patchwork fields, etc. the County Cork Development Plan 2009 has designated a number of Scenic Landscapes and Scenic Routes in proximity to Ringaskiddy. These are indicated in Maps 9 and 10 in Volume 3 of the Development Plan 2009 and itemised in Table 11.3.

Table 11.3: Designated Scenic Landscapes and Scenic Routes in the Study Area (see Maps 9 and 10 in Volume 3 of the Development Plan 2009)

Designation	Location
Scenic Landscape	Monkstown.
Scenic Landscape	Great Island.
Scenic Route S51	R630 Regional Road & Local Road from Ballynacorra via East Ferry to Whitegate and Roche's Point. Views of the Estuary and Harbour, Roche's Point & the rural coastal environment.
Scenic Route S53	R624 Regional Road, between Cobh and Belvelly. Views of the Upper Harbour and coastal environment.
Scenic Route S54	R610 Regional Road, Local Road & N28 National Primary Route between Passage West and Ringaskiddy. Views of the Harbour.

11.3.4 Project Description

The primary objective of this project is to remediate the East Tip thereby ensuring that potential risks to humans and the wider environment are minimised. Chapter 5 'Project Description' provides an overview of the proposed remediation solution

Once the remediation solution has been constructed, it is proposed that the East Tip will be landscaped for amenity and recreational purposes, which will include the following: tree and shrub planting; paths for walking and running; earth modelling; bird watching; wetland meadows; grass playing field and car parking (Refer to Figure 5.7 for the landscape masterplan and landscape details). A Landscape Management Plan will be developed to address landscaping over 2- 5 years The restored landscape will be carefully regraded in undulating profiles to create new spaces, generate interest and focal points and to provide shelter from harsh winds.

A series of options were considered for the regrading and profiling of the site but it was concluded that the option proposed in the landscape masterplan was the optimum option as it maximises the existing location of stockpiles reducing the volumes that require double handling or transportation around the site. Furthermore, the current plans have located the higher profiles on the north, east and south of the East Tip from where the harshest winds are generated and therefore this affords greatest shelter for future site users.

The path network has been designed to maximise visitors stay at the site by offering points of interest, maximising the length of path network and offering panoramic viewpoints of the Harbour. The path network has been cognisant of the wildlife sensitivities in the area and will encourage observation of wildlife by visitors from the paths and any potential for disturbance has been minimised by use of screen planting and fences.

The biodiversity at the East Tip site will be significantly increased through the use of extensive native woodland and scrub with wildflower meadows and a wetland habitat. Further, measures for bird enhancement have also been considered including a bird roosting ledge, along the eastern boundary, the final location of which will be confirmed with NPWS prior to construction.

11.4 POTENTIAL LANDSCAPE AND VISUAL IMPACTS

Potential impacts for both the construction and end-use, aftercare and maintenance stages are described below in Section 11.5.1 (Construction) and Section 11.5.2 (End-use, Aftercare and Maintenance).

11.4.1 Potential Impacts during the Construction Stage

Potential construction stage impacts are as follows:-

(i) Obstruction of views;
(ii) Change in landscape character;
(iii) Machinery for site preparation/enabling works and operations; and
(iv) Site access and vehicular and plant movements.

11.4.1.1 Landscape Character Area Impacts

An assessment of the significance of the impact of the proposed works during construction on the landscape character area described above has been completed and summarised below. The proposed works are located directly within the Estuarine Harbour-based Industrial and Maritime Landscape Character Area.

Estuarine Harbour-Based Industrial and Maritime Landscape

This landscape character area is concentrated mainly on low-lying parts of the landscape at the edge of Cork Harbour including the islands. This is a generally robust frequently changing landscape. The current East Tip site is a prominent and unsightly part of this landscape. Stockpiles of dark coloured material effectively detract from the character. The existing site has the appearance of an untidy construction site with stockpiles of material and a large shed.

The construction phase of the proposal will be short in duration. Construction phase activities will have a limited landscape resource change due to the condition of the existing site as a disturbed industrial landscape. Temporary stockpiles and earth movements and ground modelling required for remediation will not significantly alter the current landscape character of the site (See Chapter 6 ' Project Construction').

The Estuarine Harbour-based Industrial and Maritime Landscape Character Area has a low sensitivity to change.

When landscape impacts are assessed during the construction phase there will be slight negative impacts due to the low landscape resource change that will result.

Harbour Edge Town Centre and Undulating Residential Townscape

The proposal is not directly located within the landscape character of Harbour Edge Town Centre and Undulating Residential Townscape**.** The only potential direct impact on this landscape is from construction traffic movements through Ringaskiddy. The existing road network at Ringaskiddy supports a busy Port facility and industrial estates. There are frequent large vehicles moving through this landscape on a good network of roads. The increase in construction traffic travelling to and from the Haulbowline site will blend with this existing use without significant change in landscape resource. The landscape impacts are also short in duration.

This landscape character area has a medium sensitivity to change. When landscape impacts are assessed during the construction phase there will be slight negative impacts due to the low levels of landscape resource change that will result.

11.4.1.2 Planning Policy Designation Impacts

Construction stage impacts on relevant designations contained within the Cork County Development Plan are assessed below.

Cork County Development Plan 2009 – 2015

Scenic Route S51: R630 Regional Road and Local Road from Ballynacorra via East Ferry to Whitegate and Roche's Point is designated as a Scenic Route. Views of the Estuary and Harbour, Roche's Point and the rural coastal environment are protected. The R630 is located at its nearest approximately 4km east of the proposed development. Spike Island is located between the R630 and Haulbowline Island in most views from the road. At such distances it is currently impossible to discern detail at the existing site. Construction stage activities will not be noticeable. The viewer sensitivity is high. There is no change in visual resource. The predicted visual impact for the Scenic Route S51 is no change.

Scenic Route S53: The R624 Regional Road, between Cobh and Belvelly is designated as a Scenic Route. Views of the Upper Harbour and coastal environment from the road are protected. The majority of this route is located on the west side of Great Island and therefore visually separated from proposed construction works. On approaching Cobh the road does offer glimpse and direct views across the harbour to the proposed site. The views are from low lying positions. The existing site is currently noticeable in these views with its stockpiles of dark material and disturbed landscape. During construction works there will be low levels of visual resource change due to distance of views and the similar appearance of construction works to the current disturbed landscape. The viewer sensitivity is high. The change in visual resource is low. The predicted significance of visual impact is moderate.

Scenic Route S54: The R610 Regional Road, Local Road and N28 National Primary Route between Passage West and Ringaskiddy are designated as a Scenic Route. Views of the Harbour from these roads are protected. Views from the majority of this road towards the proposed construction works are well screened by topography or built development at Ringaskiddy. Only a short section of the R610 south of Monkstown has a view in the direction of the construction site. However, as exhibited by Viewpoint 5 below due to the location of the construction works on the eastern side of Haulbowline Island with the Naval Base on the western side there are no direct views of the proposed works available from this Scenic Route. Increased traffic will result during the construction stage on the local road network but HGV traffic is a key characteristic of these roads already. The viewer sensitivity is high. There is no change in visual resource. The predicted visual impact for the Scenic Route 54 is no change.

11.4.1.3 Zone of Visual Influence (ZVI)

The ZVI for the construction and end-use, aftercare and maintenance stage of the proposed development is illustrated in Figure 11.1. Due to the nature of the topography around the harbour the ZVI indicated is extensive. The ZVI has been used to identify the locations where potential visual impacts may occur. As viewer distance from the proposed site and existing harbour facility increases, the level of visibility decreases significantly. In reality, views of the site will be entirely obscured from a number of locations within this area such as from within the Ringaskiddy, Monkstown and Cobh urban areas and undulating shoreline.

The ZVI shown on Figure 11.1 is theoretical and the following text describes the actual predicted visual impacts on visual receptors within the ZVI.

11.4.1.4 Visual Impacts on Residential Properties during the Construction Stage

An assessment has occurred within the ZVI to determine the magnitude of visual impact of the proposed development on potential views from sensitive visual receptors including residential properties.

Ringaskiddy Residential Properties: It will not be possible to view the construction works on site from residential properties at Ringaskiddy due to the fact that the East Tip site is low lying and well screened by intervening topography, urban development and trees. Construction traffic will travel through Ringaskiddy on the N28 but no significant visual impacts are predicted as such traffic is a key feature of this road already. Overall no significant visual impacts are predicted for residential properties at Ringaskiddy.

Monkstown Residential Properties: The majority of views from the Monkstown area are well screened due by the Naval Base on the western side of the Island. Even in elevated views as shown in Viewpoint 6 below the built form on the western side of the Island prevents views of the construction works. Overall no significant visual impacts are predicted for residential properties at Monkstown.

Cobh Residential Properties: The fact that the built form of Cobh is located on a steeply inclined southern facing slope results in numerous potential views from residential properties towards Haulbowline Island. The existing East Tip site is a noticeable feature in views from properties (mostly at elevated locations) as illustrated by Viewpoint 1 (and Photomontage). As exhibited, the existing disturbed landscape is a noticeable feature in views from Cobh appearing as a black and unattractive landscape east of the Naval Base. While construction activities within the site (i.e., construction vehicles and plant) will be just about discernible in views from Cobh there will be little difference in the view to that currently found with stockpiles of materials (albeit with remodelling in progress). Works to the foreshore area will also be distant in views and mobile machinery at these locations will be transitory in views reducing their potential for impact. As a result there will be a low change in visual resource. The viewer sensitivity is medium. The predicted significance of visual impact will be slight/moderate.

Harbour Users: The Harbour is well used by commercial and leisure craft. Visitors to Spike Island travel in boats from Cobh currently. All such vessels will have potential for views of the proposed construction works. However, such views are not from single fixed points, predominantly at sea level, not focused on a single point or vista and always moving. The construction activities will be difficult to discern from most locations and particularly from distance. All these factors combine to result in low changes in visual resource. The viewer sensitivity is high. The predicted significance of visual impact will be moderate.

11.4.1.5 Viewpoint Assessment

A series of representative viewpoints have been selected from locations throughout the study area and subjected to specific assessment below. The location of all viewpoints can be found on Figure 11.2. Please refer to Appendix M: Photomontages to view the accompanying photomontages for Views 1-4.

Viewpoint 1: View from Lake Road Cobh (See Photomontage Appendix M: Photomontages)

Viewer sensitivity: this view is from a local road called Lake Road in Cobh and is predominantly used by the local community and occasional tourists visiting the amenity park as a viewing point. The viewer sensitivity is high.

Existing visual resource: the existing view is elevated and offers a panoramic view across the harbour. The disturbed landscape at the East Tip is a noticeable feature with black stockpiles of material providing a visual poor appearance. The existing playing field is an exception to this disturbed industrial character and is visible to the immediate right of the slag heaps on the East Tip. To the right of the East Tip site is the Naval Base which is a prominent visual feature with tall buildings, gantries and lights. Spike Island is located in the background of the view with the fortifications just discernible on the hill top. Beyond Spike Island the Harbour extends further until it reaches the open sea.

Predicted view: the construction works will be directly visible from this location. However, the change in visual resource from the existing view will be very low as the existing view already consists of stockpiles of materials and is disturbed in character. The remodelling works required will not be that dissimilar to the existing view. Movements of construction vehicles will be hard to discern at this distance (>1km). The works in the foreshore area will also be difficult to discern and transitory in nature. Any works will be short in duration.

Magnitude of change: the magnitude of change in visual resource is low.

Significance of Visual Impact: the predicted significance of visual impact will be short in duration.

Viewpoint 2: View from Rocky Island (See Photomontage Appendix M: Photomontages)

Viewer sensitivity: this view is available from a small amenity area at Rocky Island. The viewer sensitivity is high.

Existing visual resource: the existing view is slightly elevated on a rocky promontory in the Harbour. The view is directed towards Haulbowline Island with the existing disturbed industrial landscape a very noticeable and prominent detractor from the quality of the view. There are visible gantries, steelwork and stockpiles located on the Island. Car parking associated with the Naval Base is also prominent on the shoreline. Views to Cobh are screened with distance views towards the rest of Great Island coastline visible to the centre right.

Predicted view: the proposed construction works will be directly visible from this viewpoint. The visible stockpiles will be regraded and existing steel structures and buildings will be removed (See Appendix G for the Inventory of Structures to be Demolished). There will be visible construction vehicles entering and leaving the site. Such features are already visual components of the existing view and there will be low levels of visual resource change. Any visual impacts will be short in duration.

Magnitude of change: the magnitude of change in visual resource is low.

Significance of Visual Impact: the predicted significance of visual impact will be short in duration.

Viewpoint 3: View from Ringaskiddy Shoreline (See Photomontage Appendix M: Photomontages)

Viewer sensitivity: this view is from the shoreline at Ringaskiddy where a small public amenity area is located. The viewer sensitivity is high.

Existing visual resource: the existing view from a low level at the shoreline that offers a view across open water to Haulbowline Island. The disturbed industrial landscape at the East Tip site is very noticeable with stockpiles, equipment and steel structures all visually prominent. The stockpiles etc partly screen the built form of Cobh to the rear of the Island.

Predicted view: the proposed construction stage of the development will be directly visible from this location. The existing stockpiles will be regraded and existing structures removed. Construction traffic will be visible entering and leaving the site but not overly prominent at this distance. Overall the change in visual resource will be low as the site remains as a disturbed industrial landscape during the construction stage.

Magnitude of change: the magnitude of change in visual resource is low.

Significance of Visual Impact: the predicted significance of visual impact will be short in duration.

Viewpoint 4: View from Martello Tower Ringaskiddy (See Photomontage Appendix M: Photomontages)

Viewer sensitivity: this view is available from the Martello Tower located east of Ringaskiddy which is accessed by a sign posted footpath and will be available to the local community and tourists. The viewer sensitivity is high.

Existing visual resource: the existing view is elevated and offers a panoramic view across the hill side to Cork Harbour. The foreground is dominated by electricity infrastructure. Haulbowline Island is visible in the centre of the view including the East Tip and the Naval Base facilities. Beyond Haulbowline Island Cobh is visible extending up the hillsides north of the Harbour.

Predicted view: the proposed construction stage of the development will be directly visible from this viewpoint.. The regrading of the stockpiles will be visible but at this distance it will be difficult to discern from the existing situation.

Magnitude of change: the magnitude of change in visual resource is no change.

Significance of Visual Impact: the predicted significance of visual impact will be no change.

Viewpoint 5: View from Amenity area at Whitepoint Cobh

Viewer sensitivity: this view is from an amenity area at Whitepoint in Cobh. This view is available to the local community and tourists. The viewer sensitivity is high.

Existing visual resource: the existing view is low lying and across parkland to Haulbowline Island. The western side of the Island is dominated by the Naval Base buildings which significantly restrict views towards the East Tip site. Only a very small strip of the shoreline on the northern shore of the East Tip is partly visible in the centre of the view.

Predicted view: the proposed construction stage of the development will be well screened from this viewpoint by existing buildings at the Naval Base. Only a very small part of the works will be potentially visible and at this distance (>1km) the works will not be discernible.

Magnitude of change: the magnitude of change in visual resource is no change.

Significance of Visual Impact: the predicted significance of visual impact will be no change.

Viewpoint 6: View from Diamond Hill Monkstown

Viewer sensitivity: this view is from an elevated location at Diamond Hill in Monkstown. This view is predominantly available to the local community. The viewer sensitivity is high.

Existing visual resource: the existing view is elevated and offers a panoramic view above rooftops to Cork Harbour. To the right of the view the Port facilities at Ringaskiddy are noticeable. The access from Ringaskiddy to Haulbowline Island is visible in the centre of the view. The well treed promontory at Whitepoint is visible to the centre left with the tall cranes at Rushbrooke breaking the skyline. Haulbowline is just discernible to the rear of the trees at Whitepoint but very well screened.

Predicted view: due to the distance of this view (approx 4km) from the proposed construction works and intervening vegetation and topography there will be no direct or indirect views of the construction stage works.

Magnitude of change: the magnitude of change in visual resource is no change.

Significance of Visual Impact: the predicted significance of visual impact will be no change.

Viewpoint 7: View from Cobh Cathedral

Viewer sensitivity: this view is from a local road directly in front of Cobh Cathedral in Cobh and is predominantly used by the local community and occasional tourists visiting the Cathedral as a viewing point. The viewer sensitivity is high.

Existing visual resource: the existing view is elevated and offers a panoramic view across the Harbour from Ringaskiddy to the right and Spike Island to the left. The disturbed landscape at the East Tip site is a noticeable feature with black stockpiles of material providing a visually poor appearance. The existing playing field is an exception to this disturbed industrial character and is visible to the immediate right of the East Tip. The Naval Base is a feature with tall buildings, gantries and lights. Beyond Haulbowline Island the view extends towards Crosshaven Harbour.

Predicted view: the construction works will be directly visible from this location. However, the change in visual resource from the existing view will be very low as the existing view already consists of disturbed industrial landscape. The remodelling works required will not be that dissimilar to the existing view. Movements of construction vehicles will be hard to discern at this distance (>1km). Any works will be short in duration.

Magnitude of change: the magnitude of change in visual resource is low.

Significance of Visual Impact: the predicted significance of visual impact will be short in duration.

Viewpoint 8: View from High Road Cobh R624

Viewer sensitivity: this view is from the R624 road in Cobh and is predominantly used by the local community and occasional tourists visiting the town centre. The viewer sensitivity is high.

Existing visual resource: the existing view is slightly elevated and offers a panoramic view across the Harbour from Ringaskiddy to the right and to Spike island and beyond to the left. The disturbed industrial landscape at the East Tip site is visible providing a visually poor appearance. To the right of East Tip site is the Naval Base which is a prominent visual feature with tall buildings, gantries and lights. Spike Island is located in the background of the view with the fortifications just discernible on the hill top. Beyond Spike Island the Harbour extends towards Crosshaven and beyond.

Predicted view: the construction works will be directly visible from this location. However, the change in visual resource from the existing view will be low as the existing view already consists of stockpiles of materials and is disturbed in character. The remodelling works required will not be that dissimilar to the existing view. Movements of construction vehicles will be hard to discern at this distance (>1km). Any works will be short in duration.

Magnitude of change: the magnitude of change in visual resource is low.

Significance of Visual Impact: the predicted significance of visual impact will be short in duration.

11.4.2 End-Use, Aftercare and Maintenance Phase Impacts

During the end-use, aftercare and maintenance phase potential impacts result from the use of the site as an urban parkland.

11.4.2.1 Landscape Character Area Impacts

The proposed development is located directly within the Estuarine Harbour-based Industrial and Maritime Landscape.

Estuarine Harbour-Based Industrial and Maritime Landscape

This landscape character area is concentrated mainly on low-lying parts of the landscape at the edge of Cork Harbour including the islands. This is a generally robust frequently changing landscape. The current East Tip site is a prominent and unsightly part of this landscape.

The end-use phase of the proposal will consist of the new parkland created on the remediated site. The greening of the eastern side of Haulbowline Island and removal of the disturbed industrial landscape will have a beneficial landscape impact on the Harbour landscape.

The Estuarine Harbour-based Industrial and Maritime Landscape Character Area has a low sensitivity to change.

The predicted change in landscape resource is medium beneficial.

When landscape impacts are assessed during the end-use, aftercare and maintenance phase there will be slight/moderate beneficial impact due to removal of unsightly industrial features and the creation of an attractive parkland.

Harbour Edge Town Centre and Undulating Residential Townscape

The proposal is not directly located within this landscape character. The new parkland will however provide a much more attractive backdrop to Cobh and have an indirect beneficial impact on this landscape.

This landscape character area has a medium sensitivity to change.

When landscape impacts are assessed during the end-use, aftercare and maintenance phase there will be slight beneficial impacts due to the removal of unsightly industrial features and creation of a new parkland setting.

11.4.2.2 Planning Policy Designation Impacts

End-use, aftercare and maintenance stage impacts on relevant designations contained within the Cork County Development Plan are assessed below.

Cork County Development Plan 2009 – 2015

Scenic Route S51: The R630 is located at its nearest approximately 4km east of the proposed development and at such distances it is currently impossible to discern detail at the existing site. End-use, aftercare and maintenance stage activities will not be noticeable. The predicted visual impact for the Scenic Route 51 is no change.

Scenic Route S53: The majority of this route is located on the west side of Great Island and therefore visually separated from proposed construction works. On approaching Cobh the road does offer glimpse and direct views across the harbour to the proposed site. The views are from low lying positions. The existing site is currently noticeable in these views with its stockpiles of dark material and disturbed landscape. During the end-use, aftercare and maintenance phase the green parkland setting will make a beneficial visual impact when compared to the current disturbed industrial landscape. The viewer sensitivity is high. The change in visual resource is low. The predicted significance of visual impact is moderate beneficial.

Scenic Route S54: Views from the majority of this road towards the proposed construction works are well screened by topography or built development at Ringaskiddy. The predicted visual impact for the Scenic Route 54 is no change.

11.4.2.3 Visual Impacts on Residential Properties

An assessment has occurred within the ZVI to determine the magnitude of visual impact of the proposed development during the end-use, aftercare and maintenance phase on potential views from sensitive visual receptors including residential properties.

Ringaskiddy Residential Properties: It will not be possible to view the end-use proposal for the site from residential properties at Ringaskiddy due to the fact that the East Tip site is low lying and well screened by intervening topography, urban development and trees. Overall no significant visual impacts are predicted for residential properties at Ringaskiddy.

Monkstown Residential Properties: The majority of views from the Monkstown area are well screened by the Naval Base on the western side of the Island. Even in elevated views as shown in Viewpoint 6 below the built form on the western side of the Island prevents views of the construction works. Overall no significant visual impacts are predicted for residential properties at Monkstown.

Cobh Residential Properties: The existing East Tip site is a noticeable feature in views from properties (mostly at elevated locations) as illustrated by Viewpoint 1 (and Photomontage). The existing disturbed industrial landscape is a noticeable feature in views. The removal of the visually poor landscape and creation of a green parkland landscape will have a beneficial impact on the views from properties in Cobh. The predicted significance of visual impact will be slight/moderate beneficial.

Harbour Users: The Harbour is well used by commercial and leisure craft. Visitors to Spike Island currently travel in boats from Cobh. All such vessels will have potential for views of the proposed end-use for the site. The completed parkland will provide an attractive feature in the waters of the harbour and results in removal of unsightly stockpiles and features that currently detract from views resulting in low beneficial changes in visual resource. The viewer sensitivity is high. The predicted significance of visual impact will be moderate beneficial.

11.4.2.4 Viewpoint Assessment

A series of representative viewpoints have been selected from locations throughout the study area and subjected to specific assessment below. The location of all viewpoints can be found on Figure 11.2.

Viewpoint 1: View from Lake Road Cobh (See Photomontage Appendix M: Photomontages)

Viewer sensitivity: this view is from a local road called Lake Road in Cobh and is predominantly used by the local community and occasional tourists visiting the amenity park as a viewing point. The viewer sensitivity is high.

Existing visual resource: the existing view is elevated and offers a panoramic view across the Harbour. The disturbed landscape at the East Tip site is a noticeable feature with black stockpiles of material providing a visual poor appearance. The existing playing field is an exception to this disturbed industrial character and is visible to the immediate right of the stockpiles within the East Tip site. Also to the right of the East Tip site is the Naval Base which is a prominent visual feature with tall buildings, gantries and lights. Spike Island is located in the background of the view with the fortifications just discernible on the hill top. Beyond Spike Island the Harbour extends further until it reaches the open sea.

Predicted view: the new parkland will be directly visible from this viewpoint. The parkland will have a beneficial visual impact when compared to the existing disturbed industrial landscape. The parkland will be visible in the form of grassland and trees. It will not be possible to discern much of the finer grain details on the site.

Magnitude of change: the magnitude of change in visual resource is low.

Significance of Visual Impact: the predicted significance of visual impact will be moderate beneficial.

Viewpoint 2: View from Rocky Island (See Photomontage Appendix M: Photomontages)

Viewer sensitivity: this view is available from a small amenity area at Rocky Island. The viewer sensitivity is high.

Existing visual resource: the existing view is slightly elevated on a rocky promontory in the Harbour. The view is directed towards Haulbowline Island with the existing disturbed industrial landscape a very noticeable and prominent detractor from the quality of the view. There are visible gantries, steelwork and stockpiles located on the Island. Car parking associated with the Naval Base is also prominent on the shoreline. Views to Cobh are screened with distance views towards the rest of Great Island coastline visible to the centre right.

Predicted view: the propsed end-use for the stie will result in a green parkland setting visible to the centre right of the view. Overall there is a beneficial visual impact with the removal of unsightly industrial features.

Magnitude of change: the magnitude of change in visual resource is low.

Significance of Visual Impact: the predicted significance of visual impact will be moderate beneficial.

Viewpoint 3: View from Ringaskiddy Shoreline (See Photomontage Appendix M: Photomontages)

Viewer sensitivity: this view is from the shoreline at Ringaskiddy where a small public amenity area is located. The viewer sensitivity is high.

Existing visual resource: the existing view is from a low level at the shoreline that offers a view across open water to Haulbowline Island. The disturbed industrial landscape at the East Tip site is very noticeable with stockpiles, equipment and steel structures all visually prominent. The stockpiles etc partly screen the built form of Cobh to the rear of the Island.

Predicted view: the proposed end-use for the site will result in a new green parkland setting created on the East Tip site. This new parkland will have a beneficial visual impact.

Magnitude of change: the magnitude of change in visual resource is low.

Significance of Visual Impact: the predicted significance of visual impact will be moderate beneficial.

Viewpoint 4: View from Martello Tower Ringaskiddy (See Photomontage Appendix M: Photomontages)

Viewer sensitivity: this view is available from the Martello Tower located east of Ringaskiddy which is accessed by a signposted footpath and will be available to the local community and tourists. The viewer sensitivity is high.

Existing visual resource: the existing view is elevated and offers a panoramic view across the hill side to Cork Harbour. The foreground is dominated by electricity infrastructure. Haulbowline Island is visible in the centre of the view including the East Tip and the Naval Base facilities. Beyond Haulbowline Island Cobh is visible extending up the hillsides north of the Harbour.

Predicted view: the proposed end-use for the site will be directly visible from this viewpoint. The existing stockpiles of materials in the existing disturbed industrial landscape at the East Tip site will be replaced by a green parkland setting with visible grass and trees. It will not be possible to discern any other features of the parkland from this distance. Overall there is a beneficial visual impact.

Magnitude of change: the magnitude of change in visual resource is low.

Significance of Visual Impact: the predicted significance of visual impact will be moderate beneficial.

Viewpoint 5: View from Amenity Area at Whitepoint Cobh

Viewer sensitivity: this view is from an amenity area at Whitepoint in Cobh. This view is available to the local community and tourists. The viewer sensitivity is high.

Existing visual resource: the existing view is low lying and across parkland to Haulbowline Island. The western side of the Island is dominated by the Naval Base buildings which significantly restrict views towards the East Tip site. Only a very small strip of the shoreline on the northern shore of the East Tip is partly visible in the centre of the view.

Predicted view: the proposed end-use for the site will be well screened from this viewpoint by the adjacent Naval Base.

Magnitude of change: the magnitude of change in visual resource is no change.

Significance of Visual Impact: the predicted significance of visual impact will be no change.

Viewpoint 6: View from Diamond Hill Monkstown

Viewer sensitivity: this view is from an elevated location at Diamond Hill in Monkstown. This view is predominantly available to the local community. The viewer sensitivity is high.

Existing visual resource: the existing view is elevated and offers a panoramic view above rooftops to Cork Harbour. To the right of the view the Port facilities at Ringaskiddy are noticeable. The access from Ringaskiddy to Haulbowline Island is visible in the centre of the view. The well treed promontory at Whitepoint is visible to the centre left with the tall cranes at Rushbrooke breaking the skyline. Haulbowline, just discernible to the rear of the trees at Whitepoint, is very well screened.

Predicted view: due to the distance of this view (approx 4km) from the proposed parkland and intervening vegetation and topography, there will be no direct or indirect views of the end-use proposal for the site .

Magnitude of change: the magnitude of change in visual resource is no change.

Significance of Visual Impact: the predicted significance of visual impact will be no change.

Viewpoint 7: View from Cobh Cathedral

Viewer sensitivity: this view is from a local road directly in front of Cobh Cathedral in Cobh and is predominantly used by the local community and occasional tourists visiting the Cathedral as a viewing point. The viewer sensitivity is high.

Existing visual resource: the existing view is elevated and offers a panoramic view across the Harbour from Ringaskiddy to the right and Spike Island to the left. The disturbed landscape at the East Tip site is a noticeable feature with black stockpiles of material providing a visually poor appearance. The existing playing field is an exception to this disturbed industrial character and is visible to the immediate right of the East Tip. The Naval Base is a feature with tall buildings, gantries and lights. Beyond Haulbowline Island the view extends towards Crosshaven Harbour.

Predicted view: the end-use for the site will be directly visible from this location. The removal of unsightly disturbed industrial features and replacement with an attractive parkland will have a beneficial impact on views from Cobh. It will be difficult to discern any details of the parkland other than grassland and trees.

Magnitude of change: the magnitude of change in visual resource is low.

Significance of Visual Impact: the predicted significance of visual impact will be moderate beneficial.

Viewpoint 8: View from High Road Cobh R624

Viewer sensitivity: this view is from the R624 road in Cobh and is predominantly used by the local community and occasional tourists visiting the town centre. The viewer sensitivity is high.

Existing visual resource: the existing view is slightly elevated and offers a panoramic view across the Harbour from Ringaskiddy to the right to Spike island and beyond to the left. The disturbed industrial landscape at the East Tip site is visible providing a visually poor appearance. To the right of the East Tip site is the Naval Base which is a prominent visual feature with tall buildings, gantries and lights. Spike Island is located in the background of the view with the fortifications just discernible on the hill top. Beyond Spike Island the Harbour extends towards Crosshaven and beyond.

Predicted view: as with Viewpoint 7 above the proposed end-use for the site will be directly visible from this location. The removal of unsightly disturbed industrial features and replacement with an attractive parkland will have a beneficial impact on views from Cobh. It will be difficult to discern any details of the parkland other than grassland and trees.

Magnitude of change: the magnitude of change in visual resource is low.

Significance of Visual Impact: the predicted significance of visual impact will be moderate beneficial.

11.5 MITIGATION MEASURES

11.5.1 Construction Stage Mitigation Measures

Temporary site compounds and fencing used during the construction phase will be carefully located to avoid unnecessary visual impacts. All construction phase impacts will be short in duration.

Construction areas will be kept tidy at all times. A detailed Construction Environmental Management Plan will be prepared by the Contractor at the construction stage . This CEMP will take in to account the requirements to prepare a Landscape Management Plan and various other plans (dust, invasive species, waste etc) to ensure works are carried out in a environmentally sustainable manner (refer to Chapter 6 'Project Construction').

11.5.2 End-Use, Aftercare and Maintenance Phase Mitigation Measures

For the purposes of the EIS it has been assumed that the end-use, aftercare and maintenance stage of the site consists of the completed parkland as set out in the landscape masterplan. For full details of the landscape masterplan proposals please refer to Chapter 5 'Project Description'.

Management and Maintenance

The key mitigation measure during the end-use stage will be ensuring the landscape planting and grassed areas are properly established and maintained to achieve the desired effect of an attractive parkland. Maintenance of the landscape works will be required to be an integral part of the on-going operational site management. This will include a defects liability period during which any defective plant material is to be replaced. Litter picking and weed control shall be carefully monitored during the early growing seasons of the landscape maintenance contract. Contractors will comply with all health and safety standards, in particular with regard to maintenance works during the end-use and aftercare phase of the scheme. New planting will require temporary protection from strong winds and suitable staking.

11.6 RESIDUAL IMPACT

RPS was commissioned to complete a Landscape and Visual Impact Assessment (LVIA) of the proposed development at the East Tip, Haulbowline Island, Co. Cork during construction and end-use, aftercare and maintenance stages.

The proposed East Tip Remediation Project is located within a landscape character area identified as Estuarine Harbour-based Industrial and Maritime Landscape Character Area. This landscape character area has been identified as having a low sensitivity to change. During construction the predicted magnitude of landscape resource change will be low and the significance of landscape impact will be slight negative due to limited change in landscape resource as the existing site already consists of a disturbed industrial landscape. All construction phase impacts will be of short duration. On completion of the proposed landscape masterplan for the site as part of the after use strategy the development will have a slight/moderate beneficial impact on the local landscape character due to the creation of a new attractive parkland.

The Zone of Visual Influence (ZVI) has been established for the proposed project to allow any potential areas of significant visual impact to be identified. Actual visual impacts from within the ZVI have been predicted by site survey and assessment.

A total of 8 viewpoints have been assessed and no viewpoints have been predicted to have significant visual impacts. During the end-use, aftercare and maintenance stage moderate beneficial visual impacts have been predicted for views from both Ringaskiddy and Cobh from where the new parkland will benefit views when compared to the existing disturbed landscape prominent in views.

In conclusion, the broader landscape character area and visual context around Haulbowline Island area has the capacity to absorb a development of this scale and the proposal is acceptable in landscape and visual terms and will result in beneficial landscape and visual impacts.

Legend

- Study Area Boundary / Extent of works
- Predicted Extent of Permanent Works
- PES Boundary
- Intermediate Horizon
- Zone of Visual Influence

Title

ZONE OF VISUAL INFLUENCE

Figure .11.1

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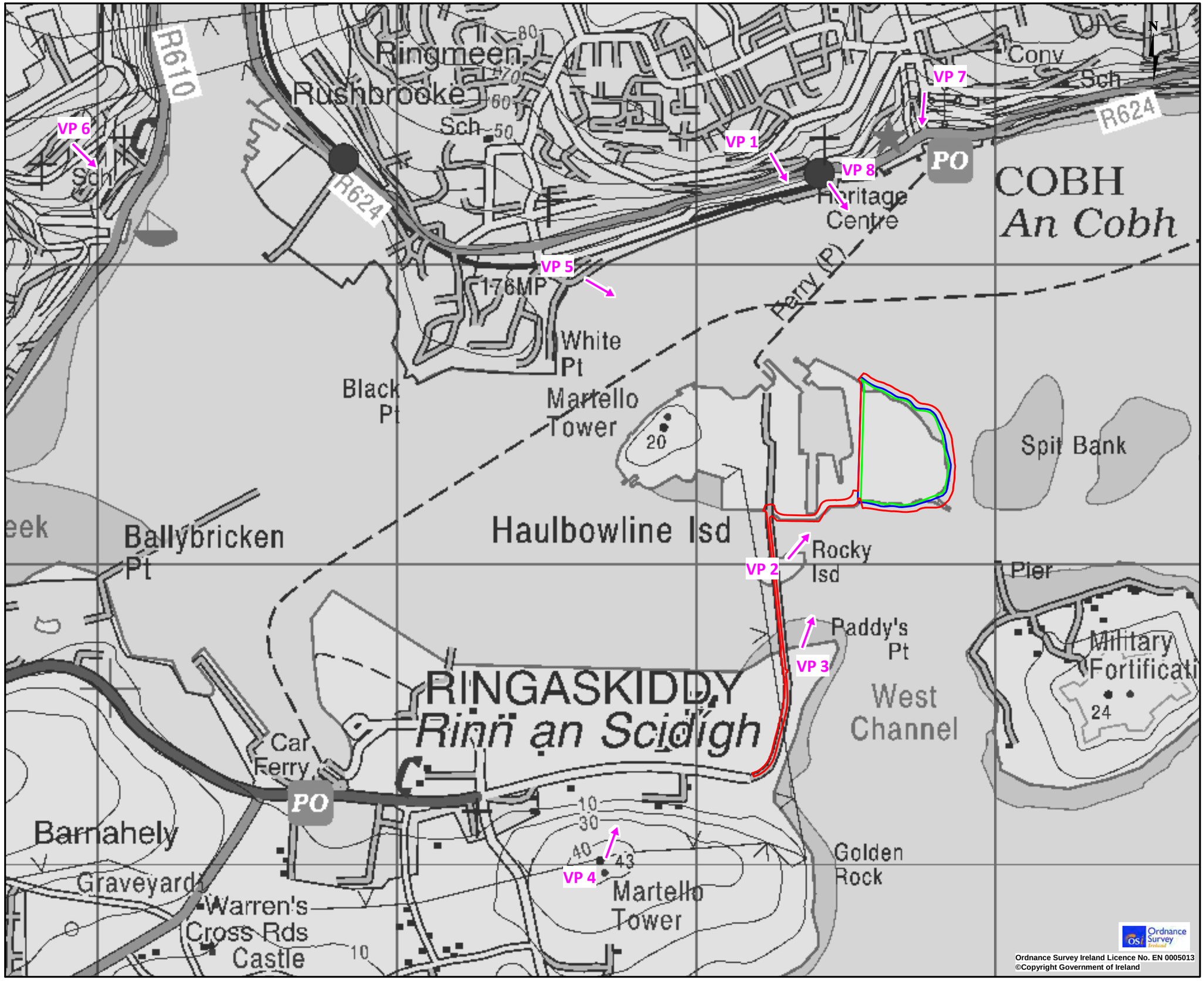
Date: April 2013
Rev : F01

East Tip Remediation Project

EAST TIP REMEDIATION PROJECT

RPS



Legend

- Study Area Boundary / Extent of works
- Predicted Extent of Permanent Works
- PES Boundary
- Viewpoint Locations

Title
VIEWPOINT LOCATIONS

Figure .11.2

File Ref: MCE0734MI0026F01
Date: April 2013
Rev : F01

East Tip Remediation Project

EAST TIP REMEDIATION PROJECT

RPS

12 MATERIAL ASSETS

12.1 INTRODUCTION

'Material Assets' may be described as resources that are valued and that are intrinsic to specific places. They may be of either human or natural origin and the value may arise for either economic or cultural reasons.

By definition, 'material assets' can include items which are of architectural, archaeological and cultural importance. However, these particular cultural assets are specifically considered in detail in Chapter 15 'Archaeology and Cultural Heritage'. This chapter therefore concentrates largely on assets of an economic value but also considers some assets of a social and cultural value.

The chapter describes the potential impacts on material assets as a result of the construction and end-use, atefercare and maintenance phases of the proposed remediation solution and end-use for the site. This Chapter also identifies the mitigation measures to ameliorate any impacts identified.

12.2 METHODOLOGY

The assessment was undertaken in accordance with the Planning and Development Regulations, 2001 (as amended) and in consultation with the appropriate Environmental Protection Agency Guidelines and Advice Notes. Given the proposal is for the remediation of an existing waste site it is considered that the project falls most closely within the Project Type 32 as referred to in the EPA's 'Advice Notes on Current Practice in the Preparation of Environmental Impact Statements', (September 2003). A 'Type 32' project comprises a 'Waste disposal installations for the incineration, chemical treatment or landfill of hazardous and non-hazardous waste'. It is acknowledged that this Project Type 32 does not specifically apply to the remediation works at the East Tip and therefore the advice notes are used only as guidance for the purposes of the assessment of the project on material assets.

For such projects the Advice Notes suggest considering the following matters when assessing impact of such projects on Material Assets:-

- Power Supply;
- Road Network;
- Potential for such projects affecting groundwater development in the area in the future, especially down gradient of the site; and
- Attraction of feeding birds and impact on aircraft operations.

Given the specific island nature of the site and the proposal, there is little potential for impacts on groundwater affecting development in the wider area. However this is considered in greater detail in Chapter 13 'Soils, Geology and Hydrogeology' of this EIS. In terms of birds presumably the Advice notes envisages a municipal waste facility with biodegradable waste that would attract substantial levels of bird activity. That is not the case in this instance having regard to the fact that this project seeks to remediate a site which does not offer a food source for birds. However, the proposed parkland end-use will enhance the environment for bird life which is discussed in Chapter 14 'Ecology'.

The existing utilities and resources in the area and potential impacts to material assets were assessed by conducting a desk top study, undertaking site visits within the vicinity of the East Tip site and through consultation with the site foreman and the major utility and service providers in the area.

12.3 EXISTING ENVIRONMENT

12.3.1 Property and Infrastructure

The East Tip site is a property asset in State ownership. There is a wayleave in place to the entrance of the crematorium from the end of the L2545 local road.

Haulbowline Bridge is an important physical asset as it provides the only physical link to the mainland at Ringaskiddy. It is essential to the operation of the Irish Naval Service, and also provides access to The Island crematorium on Rocky Island. The bridge comprises of two sections – from the mainland to Rocky Island and from Rocky Island to Haulbowline. The bridge was commissioned and constructed by Irish Steel Holdings and opened in 1966. It was designed by O'Connell and Harley Consulting Engineers of Cork and constructed by Ascon Ltd. of Dublin. It is currently owned by the Department of Finance and the bridge is currently in need of some structural remedial works. Until such remediation works take place there is a 25 tonne weight restriction currently in place on the bridge.

12.3.2 Cultural/Social Associations

While not a cultural, social or community association per se, the Irish Naval Service (INS) has long historical and social linkages with the areas of Ringaskiddy and Cobh and their local communities. In this regard the INS can be considered to have a value as a cultural/social asset.

The historical buildings and layout of the Naval Base are a physical component of the Navy's cultural asset. The buildings and dockyard at the Naval Base are important physical representations of the Navy's presence at Haulbowline and are visible from the main shipping routes through the harbour and from the historical town of Cobh.

12.3.3 Cork Harbour

Cork Harbour itself is an economic asset with local, regional and national importance due to both it's natural characteristics as well as its man-made interventions. The harbour is home to a significant level of industry, in particular at Ringaskiddy, Little Island, Tivoli, Cobh and the City. There are port related activities found at a number of locations around the harbour. It's natural attributes also make it an import location for fishing, tourism and leisure sectors.

12.3.4 Utilities

Electricity Supply

There is an existing electricity supply serving the island of Haulbowline. This comprises one electricity line running from Ringaskiddy onto Haulbowline Island to the west of the bridge, and a second line running along the bridge itself. Both of these lines are currently live.

Once on the island a supply line runs from Haulbowline Bridge along the main access road to the East Tip site. An ESB substation is located at the entrance to the East Tip site (it's south-western corner). From the substation, the electricity line veers to the north west towards the Naval Base. The foreman's building on the East Tip site is connected to the Naval Base power supply via an underground cable.

There are two submarine electricity cables which previously served the island but which are no longer in use. These two cables run from the mainland to the north west of the site. A single submarine cable historically provided a link to Spike from Haulbowline.

Figure 12.1 provides an overview of the existing electricity network within the vicinity of the East Tip. Figure 12.2 identifies disused services, including submarine electricity cables in the vicinity of the East Tip site.

Telecommunications

A telecommunications line links to Haulbowline island via the bridge. A further onward link is provided from Haulbowline to Spike Island via a submarine cable from to the south east corner of the East Tip site.

Once on the island the telecommunications line runs from the Haulbowline Bridge along the main site access road passing the East Tip site entrance and enters the Naval Base. A telecommunications line runs along the perimeter of the eastern site boundary serving the Naval Base. The telecommunications network in the vicinity of the site predominantly consists of underground cables. The network runs underground at certain locations when entering buildings on the Naval Base.

Figure 12.3 provides an overview of the existing telecommunications network within the vicinity of the East Tip.

Gas Supply

Haulbowline Island is not currently connected to the gas network. There is however a gas supply running as far as the Crematorium on Rocky Island channelled from Ringaskiddy to the south (Figure 12.4). It is understood that a disused gas pipeline is positioned under Haulbowline Bridge and extends the full length, as identified on Figure 12.2, which identifies disused services within the vicinity of the site.

Water Supply

Water supply is fed into Haulbowline Island via three routes. It is fed in via 2 no. pipes to the north west of the site and via the Haulbowline Bridge to the site. From the bridge, an underground watermain follows the western access road (on its southern side) and veers north next to the Naval Dock Mooring inlet into the Naval Base.

The only water supply running as far as the East Tip site itself serves the existing site foreman's building. Any other water supply pipework on the East Tip site is no longer in use.

Figure 12.5 provides an overview of the existing water supply infrastructure within the vicinity of the East Tip.

Sanitary Services

There are currently no operational wastewater treatment systems on the East Tip site. There is however a treatment plant serving the Naval Base to the west of the site, to which the existing site foreman's office at the East Tip is connected. A sewer runs along the western boundary of the site which connects to the Naval Base treatment plant.

Figure 12.6 provides an overview of the local services within the Naval Base including the sewer network within the vicinity of the East Tip.

Lighting

Street lighting exists along the Haulbowline Bridge and access road to the south of the Naval Base and the East Tip site. No lighting exists on the East Tip site itself where the remediation works are proposed.

12.4 POTENTIAL IMPACTS

This section details the potential impacts to utilities and property during the construction and end-use, aftercare and maintenance phases of the project.

12.4.1 Construction Phase

12.4.1.1 Property and Infrastructure

No potential impact on the asset value of the East Tip site is identified until such time as the remediation works are complete.

Irish Naval Services operations are a distinct use and will be affected by the proposed development on a temporary basis given the nature of the access arrangements, the requirement for some works to Navy property and generally the contiguous location of the East Tip to the Naval dockyard. Accordingly a letter of consent to the making of this application has been included with the planning application.

Any works at the East Tip that require individual gross vehicle loads greater than 25 tonnes will not be permitted until the structural integrity remedial works to the bridge have been completed. The use of the bridge for delivery vehicles with gross vehicle loads less than 25 tonnes will be undertaken in agreement with the Bridge Engineer to ensure the integrity of the existing bridge is maintained.

There is no proposed land take or severance of third party lands associated with the construction phase. There are potential temporary negative impacts on third party land uses during the construction phase however, and such issues are dealt with in the appropriate section of this EIS, i.e. Chapter 7 'Community and Socio-Economic', Chapter 8 'Traffic and Transport', Chapter 9 'Air Quality and Climate', Chapter 10 'Noise and Vibration' and Chapter 11 'Landscape and Visual'.

The wayleave in place for the operators of the Crematorium will not be interfered with during the course of the proposed works.

12.4.1.2 Cultural/Social Associations

The construction activities at the site have potential to conflict with Naval operations on a temporary basis and/or cause inconvenience, due to dust emissions, noise generation and traffic impact in particular.

12.4.1.3 Cork Harbour

Given the current status of the East Tip site, the presence of construction activity on the site will have little potential for impact on tourism or leisure sectors (See Chapter 7 'Community and Socio-Economic'). Potential impacts on harbour users such as sea fisheries and port operations are also discussed in Chapter 7 'Community and Socio-Economic'.

Works may be required within the sea for the purposes of the PES construction and possible sea going delivery vessels. However any works will be close to shore, any delivery vessels will be subject to normal seafaring rules and the Contractor will liaise with the Navy and other harbour users to ensure any conflicts in boat movements are avoided. Accordingly, there is a potential for temporary negative impacts to harbour users.

12.4.1.4 Utilities

Electricity lines, telephone lines, broadband lines and water supply piping are all channelled into Haulbowline via Haulbowline Bridge and along the proposed access road to the south west of the site from where they connect into the Naval Base. Some existing utilities which service the Department of Defence site to the West of the East Tip also cross over into the remediation area.

There is therefore potential for utility supply to be temporarily disrupted during the construction stage of development due to road widening and improvement works proposed to the access road between the bridge and the East Tip site to the east of the island. In addition there is also potential for disruption to services adjacent to the western site boundary (in the Department of Defence site) where some relocation of services within the remediation area will be required to facilitate the proposed development (details are set out in Chapter 6 'Project Construction').

Electricity Supply

The electricity supply for the construction works will be from the existing electricity supply serving the site. Given the nature of the works being undertaken at the site however, most plant and machinery will be powered by diesel with little relative draw on the electricity supply. The development therefore has no potential for impact in terms of electricity supply.

Telecommunications

The construction compound can be connected to the existing telecoms supplies to Haulbowline Island. There is no potential for impact in this regard.

Gas Supply

The construction of the proposed works will not require a gas supply and therefore has no potential for impact on same.

Water Supply

Water is required during the construction stage to serve the on-site welfare facilities as well as for the purposes of dust suppression, washing, cleaning and the decontamination showers. Haulbowline Island is currently served by a 200mm cast iron water supply. There is an existing water supply to the East Tip site. It is assumed that this is a standard domestic supply, which will have sufficient capacity to serve the welfare facilities. It shall be the Contractor's responsibility to ensure that there is adequate water on site to service the welfare facilities.

Dust suppression measures required in the course of construction however will require much greater volumes of water, which will subsequently require the use of bowsers on site which can be filled from a hydrant on the island. A hydrant is available on the former steelworks site. The potential volume of water used for the purposes of dust suppression could be quite high during periods of dry weather, which is considered a potentially slight negative effect.

Dust suppression measures are outlined in Chapter 9 'Air Quality and Climate' of this EIS and will be carried out so as to ensure that the surface water management system is not compromised by excess volumes.

Sanitary Services

The Contractor will be required to manage the wastewater generated from the site welfare facilities during the construction works. It will be a requirement that all wastewater generated on site is disposed of appropriately in a waste water treatment facility. The waste water treatment plant at the Irish Navy Service (INS) is currently operating at capacity and at time of preparing this EIS the Navy had plans of installing a new wastewater plant. If this new waste treatment plant is in place when the works commence and suitable capacity is available, the option of disposing of wastewater to this plant for the duration of the construction period may be explored at the detailed design stage. The increased loading on the treatment plant from the welfare facilities would be relatively low and is not expected to have any potential impact. If the treatment plant is not in place or this option is not deemed suitable, wastewater be taken to the mainland for disposal as per Contractor responsibility. Wastewater arising intermittently from the proposed wheelwash facility will be disposed of appropriately to a wastewater facility as required.

Lighting

Locallised lighting of the construction site at night maybe required on a temporary basis to optimise the tidal cycle for works required in the foreshore area. The lighting could potentially be perceived as a form of light pollution within the harbour and is therefore considered as a slight temporary negative impact.

In addition existing lighting will remain in situ and be maintained, and it is not considered necessary to upgrade lighting at this location for the purposes of construction.

12.4.2 End-Use, Aftercare and Maintenance Phase

12.4.2.1 Property and Infrastructure

Given that the East Tip currently comprises a waste site, it currently has little economic, natural or cultural intrinsic value. However, the site is strategically located within Cork Harbour and has an important historical linkage with Spike Island. With the remediation of the site and the delivery of a new recreation amenity park to serve the public at this important coastal site, the site will become an asset of considerable value for the local and regional population.

The wayleave held by the owners of the crematorium on Rocky Island will remain in place and will be unaffected during this phase.

In addition, there will be improvements to the access road and footpath networks which will benefit the Navy and the crematorium as well as the proposed public amenity area.

A new football pitch will be provided for use by the Irish Naval Service. The standard of the current pitch on site is so poor that it has been unplayable in recent times. A new pitch therefore is a moderate positive impact.

12.4.2.2 Cultural/Social Associations

The remediation of the site and the provision of a public park will have a positive impact for members of the neighbouring Naval Service. The park will serve as an amenity feature for Naval recruits based on the island as well as permanent staff based at Haulbowline where it can be used for running and leisure walking, etc. However, it will not have any particular impact on the Naval Service facility itself or how it operates.

12.4.2.3 Cork Harbour

The East Tip of Haulbowline Island is currently a landmark within Cork Harbour for negative reasons. While the remediation of the site will not have any economic impacts on Harbour activity, the improvements in the quality of the landscape which will result in noticeable positive impacts on tourism and leisure activities.

12.4.2.4 Utilities

Electricity Supply

There is no potential for impact on electricity supply as any plant and machinery required for maintenance (i.e., grass cutting) will be powered by diesel.

Telecommunications

There is no potential for impact to telecommunications as connection to the telecommunications is not required during the enduse, aftercare and maintenance phase of the project.

Gas Supply

There is no potential for impact to the gas supply as a connection to the gas supply is not required.

Water Supply

No welfare facilities, toilet blocks or cafes are proposed for the end use of the site therefore water supply will not be required for these purposes. Any water required for maintenance of the proposed park can be tanked in. There is therefore no potential for impact.

Sanitary Services

No welfare facilities, toilet blocks or cafes are proposed for the end use of the site therefore no waste water treatment or disposal requirements arise. There is therefore no potential for impact**.**

Lighting

There will be no permanently installed lighting within the East Tip site and existing lighting on the access road and the bridge will be maintained. Playing pitches will be primarily used during the daytime therefore no lighting is required in this regard. Accordingly, there are no potential impacts identified.

12.5 MITIGATION MEASURES

12.5.1 Construction Phase

12.5.1.1 Property and Infrastructure

While there is potential for temporary impact to the Irish Naval Service during the construction phase A letter of consent to the making of this application has been included with the planning application and every effort will be made to liaise with the Irish Naval Service to avoid impacts during the construction phase.

12.5.1.2 Cultural/Social Associations

Close consultation with the Irish Naval Service and the Island Crematorium will be maintained throughout the construction stage to minimise potential for inconvenience.

12.5.1.3 Cork Harbour

The majority of the works will occur in the dry and from the landward side, however where works are required in the foreshore, any vessels or machines will generally remain close to shore, any delivery vessels will be subject to normal seafaring rules and the Contractor will liaise with the Navy, the Port of Cork and other harbour users to ensure any conflicts in boat movements are avoided.

12.5.1.4 Utilities

The following mitigation measures will be implemented to prevent or minimise impact on utility supplies:-

- Identify exact location of utilities prior to construction through liaison with the relevant authorities and utility companies.
- Utility locating devices will be used where necessary and safe digging practices will be used when working around underground utilities.
- Maintain utility supply to Haulbowline Island during construction with use of temporary arrangements where necessary.
- If short term disruptions to supply are unavoidable in order to bring new arrangements on line, prior notice will be given to the Irish Naval Service and appropriate times agreed.
- Suitable precautions will be taken in the vicinity of overhead cables, i.e. warning signs and installation of 'goal posts' where necessary.
- A 24 hour emergency contact number for the relevant authority or utility company will be readily available on site.

Electricity Supply

No adverse potential impacts are identified. Accordingly no mitigation measures are necessary. Chapter 9 'Air Quality and Climate' requires that the Contractor prepares an Energy Management Plan to include measuressuch as the use of solar/thermal power to heat water for the on-site welfare facilities and contamination unit (sinks and showers).

Telecommunications

No adverse potential impacts are identified. Accordingly no mitigation measures are necessary.

Gas Supply

No adverse potential impacts are identified. Accordingly no mitigation measures are necessary.

Water Supply

The use of water during construction should be controlled and minimised where possible. Chapter 9 'Air Quality and Climate' requires that the Contractor prepares an Energy Management Plan to include measures such as the use of low flow showers and tap fittings to reduce water consumption during the construction phase.

Sanitary Services

No adverse potential impacts are identified. Accordingly no mitigation measures are necessary.

Lighting

Night time lighting will only be used where necessary for security and safety purposes for works required to optimise the tidal cycle. The lighting will be locallised to the area of works and minimised where possible.

12.5.2 End-Use, Aftercare and Maintenance

No adverse impacts negative impacts to utilities are identified once the site is remediated and the recreational end-use is established. Therefore, no mitigation measures are proposed. Overall the proposal will provide a positive impact to harbour users, property and infrastructure and cultural/social associations.

12.6 RESIDUAL IMPACT

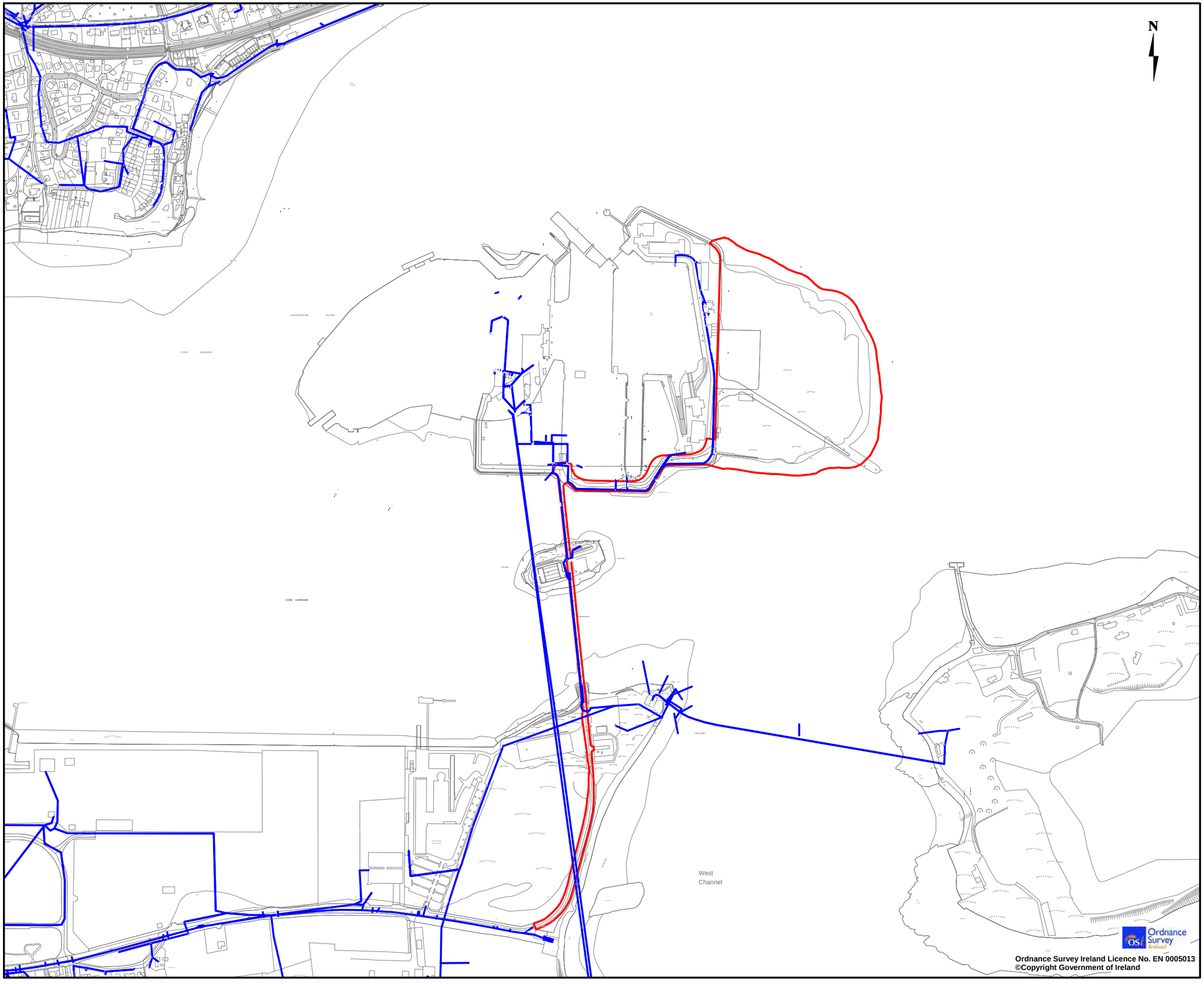
12.6.1 Construction Phase

No residual impacts are expected in respect of material assets during construction.

12.6.2 End-Use, Aftercare and Maintenance Phase

The remediation of the site from a waste site to a recreational facility open to the public at this strategic coastal site will result in a significant in the asset value of this site for the State, Cork County Council and residents of Ringaskiddy and Cork. This is a significant positive impact.

The delivery of a new football pitch for use by the Navy is considered a moderate positive impact.



Legend

- Electrical Services
- Study Area Boundary / Extent of works

Title

HAULBOWLINE ISLAND
STUDY AREA
ELECTRICAL SERVICES

(DATASETS PROVIDED BY ESB NETWORKS)

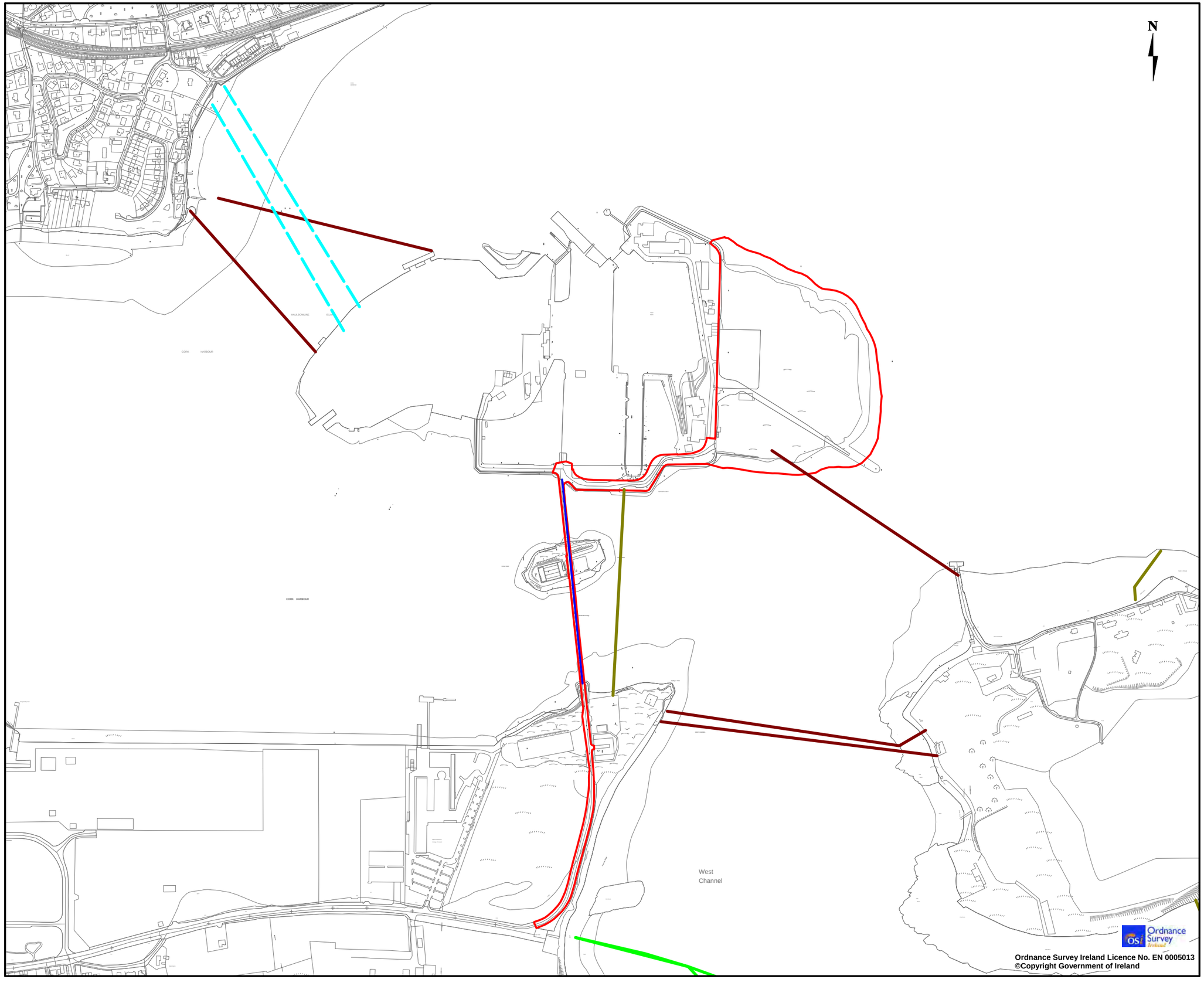
Figure 12.1

File Ref: MCE0734MI0010F01
Date: April 2013
Rev : F01

East Tip Remediation Project

EAST TIP REMEDIATION PROJECT

RPS



Legend

- Water Main
- Submarine Electricity Cables
- Submarine Cables
- Unverified
- Gas Pipeline Disused
- Study Area Boundary / Extent of works

Title

HAULBOWLINE ISLAND
STUDY AREA
DISUSED SERVICES

(DATASETS PROVIDED BY VARIOUS SOURCES INCLUDING : THE SPIKE ISLAND MASTERPLAN, CORK COUNTYCOUNCIL, PORT OF CORK COMPANY)

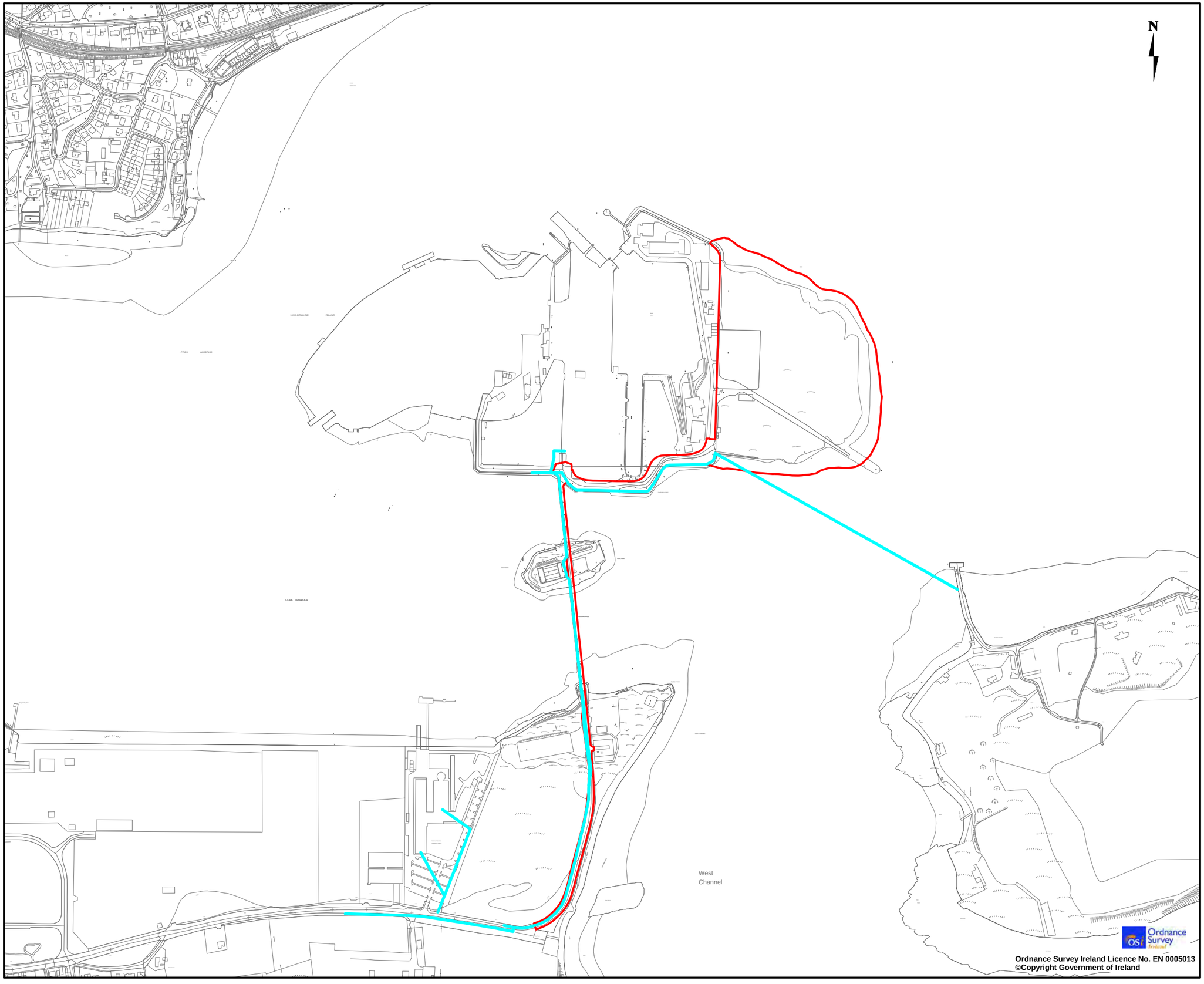
Figure 12.2

File Ref: MCE0734MI0015F01
Date: April 2013
Rev : F01

East Tip Remediation Project

EAST TIP REMEDIATION PROJECT

RPS



Legend

- Eircom Services
- Study Area Boundary / Extent of works

Title

HAULBOWLINE ISLAND STUDY AREA TELECOMMUNICATION SERVICES

(DATASETS PROVIDED BY EIRCOM)

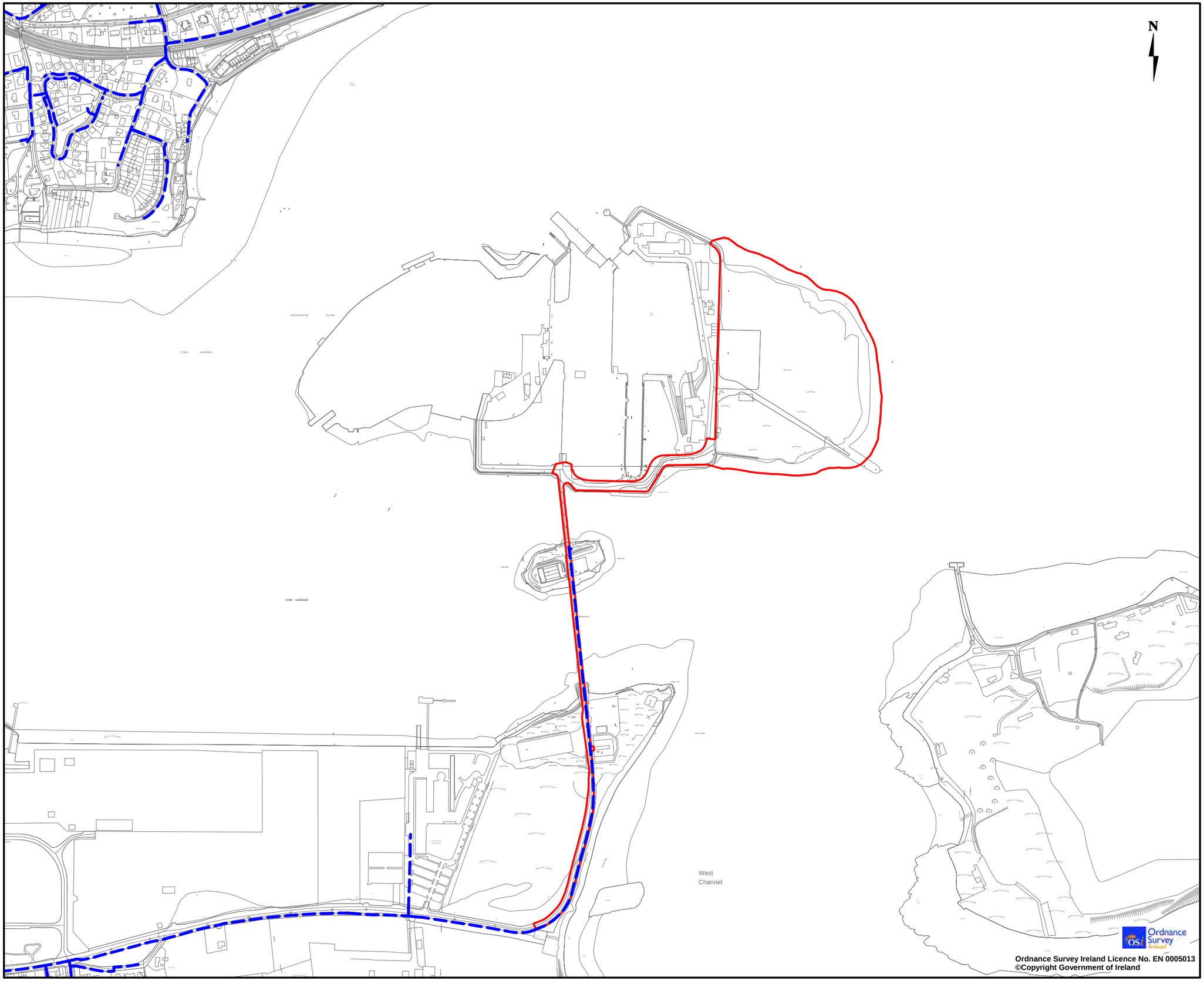
Figure 12.3

File Ref: MCE0734MI0016F01
Date: April 2013
Rev : F01

East Tip Remediation Project

EAST TIP REMEDIATION PROJECT

RPS



Legend

Distribution Medium Pressure Gas Mains

Study Area Boundary / Extent of works

Title

HAULBOWLINE ISLAND
STUDY AREA
GAS SERVICES

(DATASETS PROVIDED BY BORD GÁIS NETWORKS)

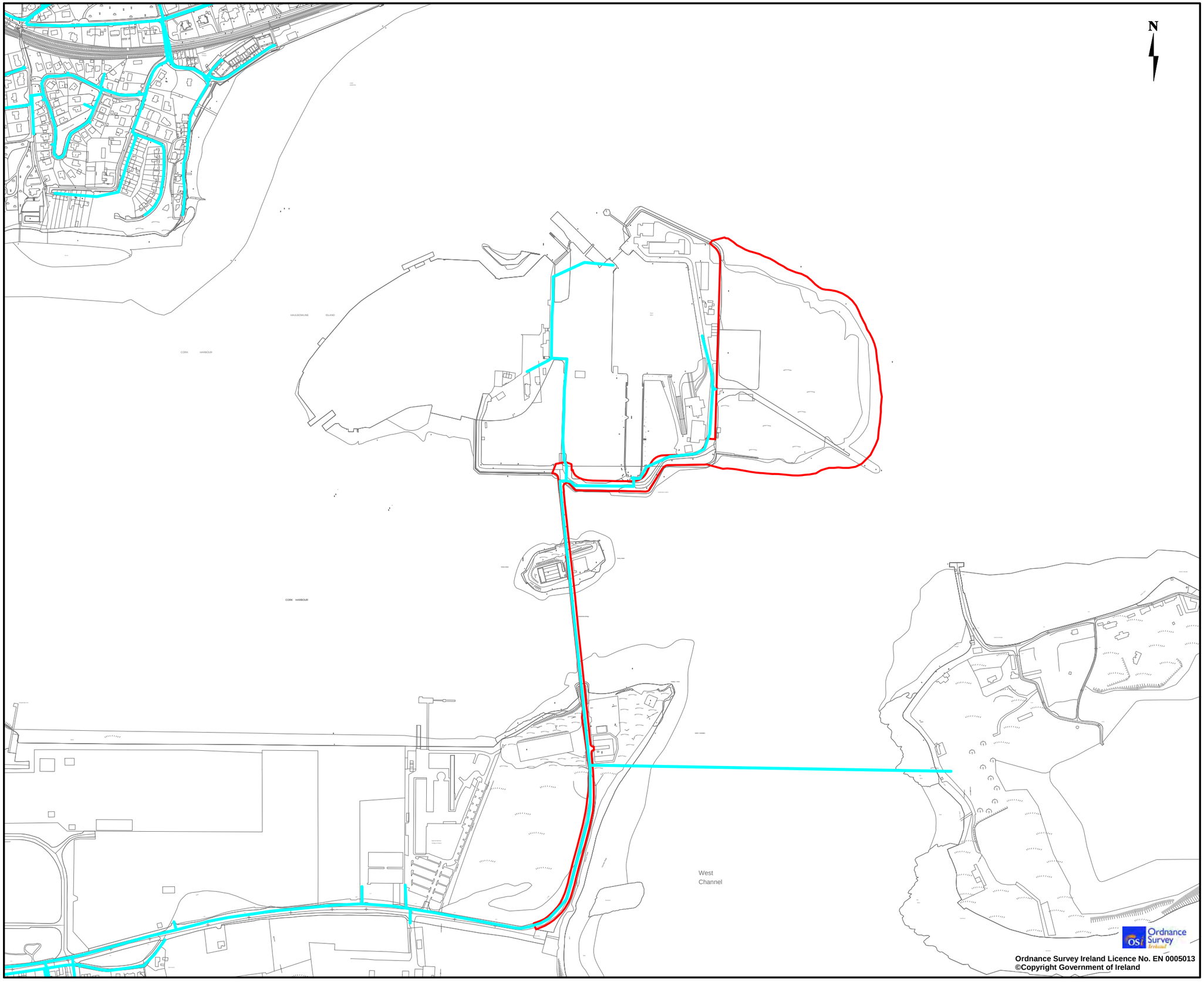
Figure 12.4

File Ref: MCE0734MI0011F01
Date: April 2013
Rev : F01

East Tip Remediation Project

EAST TIP REMEDIATION PROJECT

RPS



Legend

- Water Network
- Study Area Boundary / Extent of works

Title

HAULBOWLINE ISLAND
STUDY AREA
WATER SERVICES

(DATASETS PROVIDED BY CORK COUNTY COUNCIL)

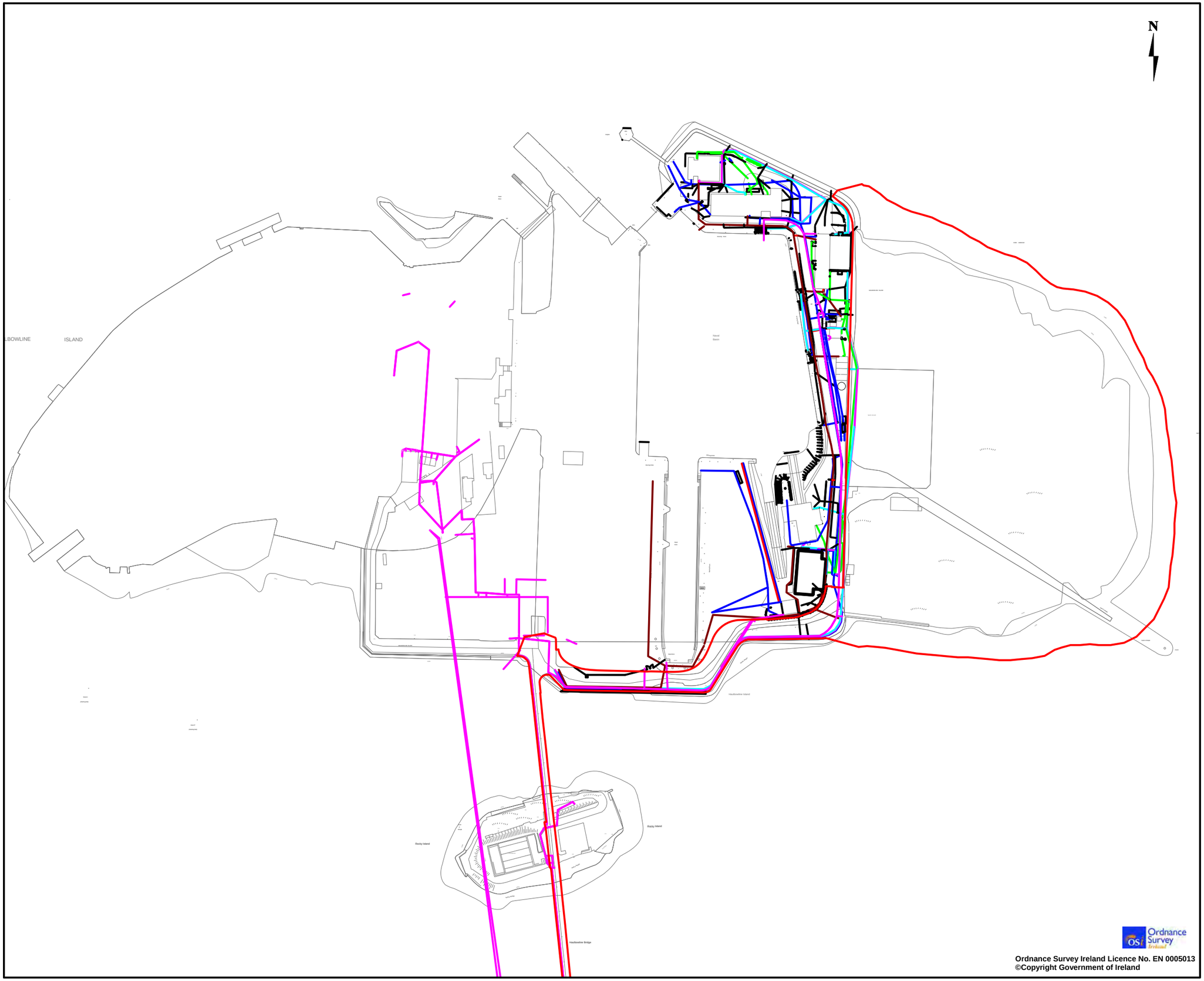
Figure 12.5

File Ref: MCE0734MI0013F01
Date: April 2013
Rev : F01

East Tip Remediation Project

EAST TIP REMEDIATION PROJECT

RPS



Legend

E ELECTRICAL

C COMPUTER

T TELEPHONE

S SEWER

D DRAIN

W WATER

G GAS/OIL

CC/TV

Study Area Boundary / Extent of works

Title

HAULBOWLINE ISLAND
LOCAL SERVICES

(DATASETS PROVIDED BY DEPARTMENT OF DEFENCE NAVAL DOCKYARD HAULBOWLINE)

Figure 12.6

File Ref: MCE0734MI0014F01
Date: April 2013
Rev : F01

East Tip Remediation Project

EAST TIP REMEDIATION PROJECT

RPS

13 SOIL, GEOLOGY & HYDROGEOLOGY

13.1 INTRODUCTION

This chapter describes the current baseline soil, geology and hydrogeology of the East Tip and surrounding area and assesses the impacts from the proposed design solution with respect to:-

- The do-nothing scenario,
- The construction stage; and
- The end-use, aftercare and maintenance stage.

Reference has been made to the extensive body of information collected at the East Tip and surrounding area over several years of independent investigation by several organisations on behalf of the Department of the Environment Heritage & Local Government, Cork County Council and the Irish Defence Forces in compiling the baseline and review of the proposed outline design to assess potential impacts from the remediation project. The most recent information includes the site investigation, environmental monitoring and risk assessment which is contained in the Detailed Quantitative Risk Assessment (DQRA) for the East Tip (WYG, 2013a, b & c). Two Addenda to the DQRA have been prepared by WYG. One addendum (WYG, 2013b) assesses the geochemical effects that would occur within groundwater within the East Tip if the rate of marine water infiltration and leaching of contaminants in the waste was restricted and the second Addendum (WYG, 2013c) addresses the risk associated with waste in the area of the foreshore outside the PES. All three documents are contained within Appendix A of the EIS. These documents should be read in conjunction with the EIS as the basis for the impacts to soil, geology and hydrogeology draw extensively upon these reports, and are collectively referred to as the "DQRA" within the EIS. Where specific reference is made within the EIS to tables, figures, conclusions or appendices of the individual DQRA documents, these are cross-referenced to the specific report.

13.2 METHODOLOGY

13.2.1 Impact Assessment

This chapter of the EIS has been produced in accordance with the Environmental Impact Assessment Regulations, relevant guidance published by the EPA (2002 & 2003) and the Institute of Geologists of Ireland (IGI) *Guidance for the preparation of Soil Geology and Hydrogeology Chapters of Environmental Impact Statements* (2013).

The IGI's Guidelines (2013) have recently been updated and the proposed new methodology of assessment has been incorporated within this chapter of the EIS. These guidelines draw upon that produced by the EPA (2002 & 2003) and the National Roads Authority (2009).

The impact assessment methodology developed by NRA (2009) that considers both the sensitivity (importance) of the receiving environment and the predicted change (impact significance) in the environment to describe the overall significance of the environmental impact is a useful framework to adopt for this assessment and is reproduced below. This sequential process takes three steps:-

- **Step 1:** Quantify the Importance of an environmental feature (Table 13.11 - Hydrogeology).
- **Step 2:** Estimate the Scale of the impact on the feature from the proposed development (Table 13.2 - Hydrogeology).
- **Step 3:** Determine the Significance of the impact on the feature from the matrix (Table 13.3) based on the Importance of the feature and the scale of the impact.

Table 13.1: Criteria for Rating Site Importance of Hydrogeological Features (NRA, 2009)

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale.	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status.
Very High	Attribute has a high quality or value on a regional or national scale.	Regionally Important Aquifer with multiple wellfields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – e.g. NHA status. Regionally important potable water source supplying >2500 homes. Inner source protection area for regionally important water source.
High	Attribute has a high quality or value on a local scale.	Regionally Important Aquifer. Groundwater provides large proportion of baseflow to local rivers. Locally important potable water source supplying >1000 homes. Outer source protection area for regionally important water source. Inner source protection area for locally important water source.
Medium	Attribute has a medium quality or value on a local scale.	Locally Important Aquifer Potable water source supplying >50 homes. Outer source protection area for locally important water source.
Low	Attribute has a low quality or value on a local scale.	Poor Bedrock Aquifer. Potable water source supplying <50 homes.

Table 13.2: Criteria for Rating Impact Significance at EIA Stage – Estimation of Magnitude of Impact on Hydrogeology & Geology Attribute (NRA, 2009)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute.	Removal of large proportion of aquifer. Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >2% annually.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute.	Removal of moderate proportion of aquifer. Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >1% annually.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute.	Removal of small proportion of aquifer. Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >0.5% annually.
Negligible	Results in an impact on an attribute but of insufficient magnitude to affect either use or integrity.	Calculated risk of serious pollution incident <0.5% annually
Minor Beneficial	Results in minor improvement of attribute quality.	Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality.	Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality.	Major enhancement of geological heritage feature

Table 13.3: Rating of Significant Environmental Impacts at EIA Stage (NRA, 2009)

Importance of Attribute	Magnitude of Impact*			
	Negligible	Small Adverse	Moderate Adverse	Large Adverse
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant/ Moderate	Profound/ Significant	Profound
High	Imperceptible	Moderate/Slight	Significant/ Moderate	Profound/ Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/ Moderate

* It should be noted that as the East Tip is to be remediated, there will also be **Positive** impacts to be considered.

13.2.2 Available Information

A considerable body of soil, geological and hydrogeological information has been collected at the Haulbowline site over several years. The most recent site investigation conducted in 2012 was developed to fill existing data gaps at the site and the information has been drawn together in a Detailed Quantitative Risk Assessment (DQRA) for the site (WYG 2013a). This section of the EIS has been prepared based on the previous information and risk assessment (DQRA) prepared for the site combined with a site walkover of the site and review of the proposed remedial solution and alternatives.

There were no significant limitations in the methodology employed or significant gaps in the data available for the final assessment of the baseline condition and predicted potential impacts. There is a substantial volume of technical information available and the EIS has informed the DQRA. For example, during initial assessment, it was recognised that there was a potential limitation in the water quality monitoring data that forced the DQRA assessment to be extremely conservative with respect to chromium (VI) in groundwater due to a relatively high laboratory method detection limit (MDL) of 30ug/l, which is significantly above the respective screening level of 0.6ug/l used in the assessment. Upon further research, it was possible to achieve a lower MDL using a different laboratory and retesting of all water sample locations was conducted in November 2012 in order to provide further measurement of chromium (VI) baseline conditions and potential impacts.

At the time of publication of the EIS, additional leachate analysis of waste samples using a bespoke method with sea water rather than fresh water (which is the standard NRA method) was awaited. Although it is anticipated that there may be some variation between the two test methods, these differences are not expected to significantly change the results of the DQRA and EIS due to the considerable body of groundwater quality data available and used for both assessments.

It should be noted at the outset that site conditions differ hydrogeologically at the East Tip from the majority of terrestrial development projects due to a number of factors, which impact the risk assessment (DQRA) and EIS:-

- The East Tip is located on Haulbowline Island within Cork Harbour;
- The East Tip itself has been reclaimed land from the sea by the gradual infill of the waste material during the former steel plant's operation; and
- The majority of the waste material on the East Tip is located below mean tide water level.

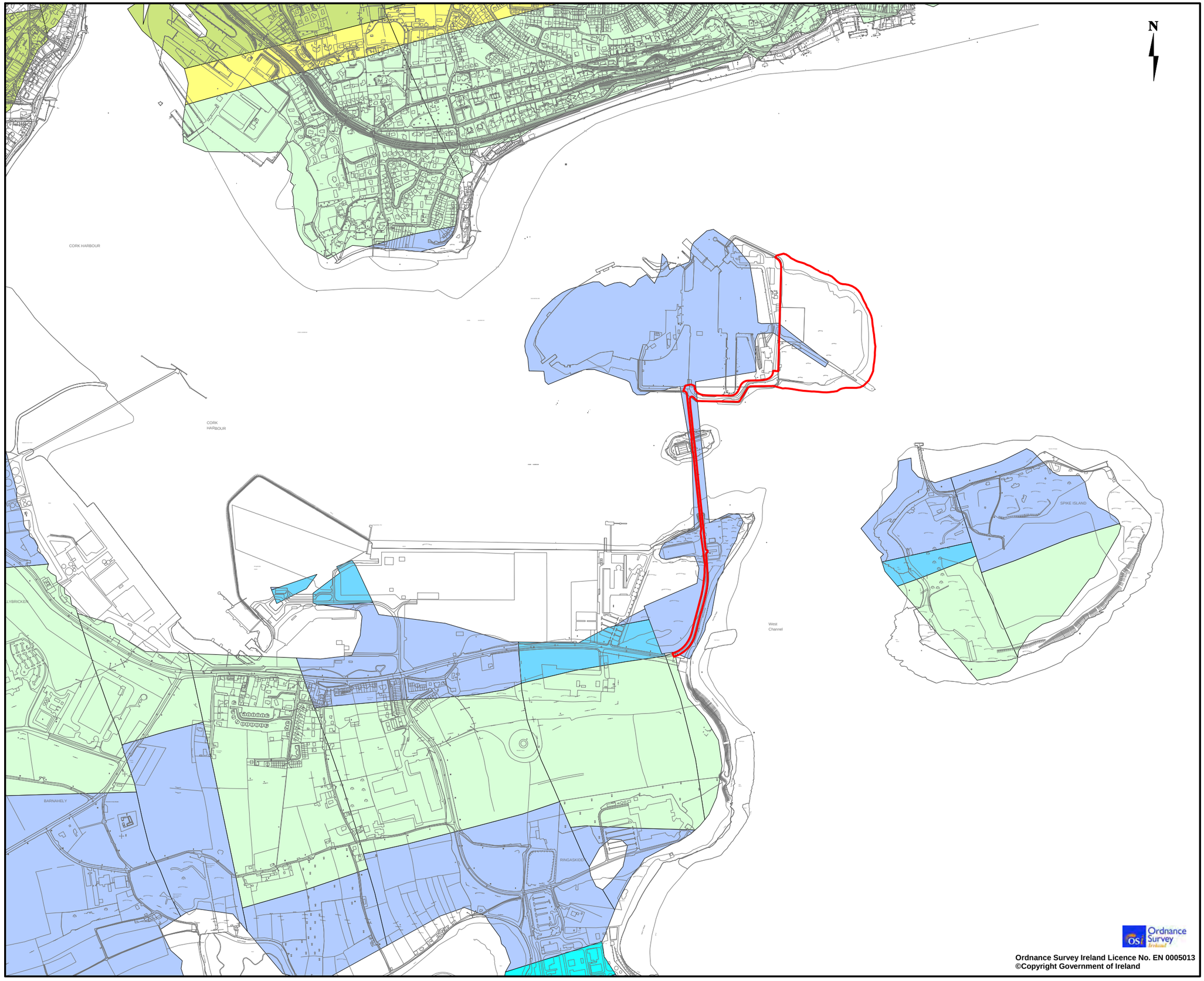
As a result, groundwater within the waste material and underlying hydrogeological units is saline and more representative of sea water than fresh potable groundwater. This is significant for the EIS in that, traditional concepts of groundwater quality, groundwater flow and potential impacts are different to other development projects. For example, groundwater itself within the underlying limestone bedrock aquifer is not considered to be a potential resource as it is not potable due to its saline condition. Groundwater is effectively seawater and is a pathway for potential contaminants to impact the adjacent seawater of Cork Harbour. In addition, the site itself is deposited waste that has been developed over several decades and which has been potentially causing impacts to the receiving environment for decades. The aims and objectives of this project are to improve the current condition so that the site can be returned to a beneficial use and protect the environment into the future.

13.3 EXISTING ENVIRONMENT

13.3.1 Regional Setting

Waulsortian Limestone (Lower Carboniferous age) has been mapped by the Geological Survey of Ireland (GSI) below Haulbowline Island and outcrops of the limestone bedrock are visible on the western part of the island beneath the Naval Base and immediately to the South at the “The Island” Crematorium site. The Waulsortian Limestone is massive and pale grey in colour and is prone to karst (limestone solution weathering). As a result it is classified as a Locally Important Karst Aquifer (Lk) by the GSI. The Waulsortian Limestone extends to the east below Cork Harbour to Oldtown and Cloyne and to the west below Ringaskiddy and Shanbally. Older Lower Carboniferous rocks (Tournasian) comprising sandstone, mudstone and limestone (the Cuskinny Member, Old Head Sandstone Formation and Gyleen Formation) and Upper Devonian old red sandstone, conglomerate and siltstones extend to the north beneath Cobh. The Cuskinny Member of sandstone and mudstone is mapped to the south of the site occupying the general higher ground associated with a structural fold before the Waulsortian Limestone outcrops to the south at Loughbeg (refer to Figure 13.1 Bedrock Geology). The geological terrain has been extensively faulted with north – south and east – west trending faults that displace bedrock units that are clearly visible on the bedrock geological map of the area.

Although the Waulsortian Limestone has been classified as a Locally Important Karst Aquifer (Lk) in the area, the aquifer will be of limited value on Haulbowline Island due to the saline water quality observed in the aquifer beneath the East Tip. Given its island location, groundwater within the limestone aquifer at this location will be down gradient of all the terrestrial land groundwater which will be discharging to Cork Harbour. This is an important aspect with respect to the risk posed from potentially contaminated groundwater within the limestone aquifer.



Legend

Study Area Boundary / Extent of works

Bedrock Geology

- Old Head Sandstone Formation
- Cuskinny Member
- Waulsortian Limestones
- Loughbeg Formation
- Ballysteen Formation
- Gyleen Formation

Title

HAULBOWLINE ISLAND
STUDY AREA
BEDROCK GEOLOGY

Figure 13.1

File Ref: MCE0734MI0023F01
Date: April 2013
Rev : F01

East Tip Remediation Project

EAST TIP REMEDIATION PROJECT

RPS

13.3.2 East Tip, Haulbowline

Extensive characterisation of the waste has been conducted at the East Tip as described in the DQRA (WYG 2013a). The DQRA is an extensive document and should be read in parallel with the EIS. The relevance of the waste body in relation to the Soil, Geology and Hydrogeology section of the EIS is:-

- The presence of the East Tip on an island location with a substantial portion of the waste body located beneath sea water level in the surrounding harbour. The majority of the waste body is therefore saturated with saline water of similar chemistry to sea water.
- The distribution of contaminants of concern (COC), their mobility, fate and transport in groundwater and the environment. Although significant solid concentrations of metal contaminants are present within the waste, the vast majority of these are relatively immobile in the groundwater environmental conditions present within the waste and the underlying natural geological units.
- The heterogeneity of the waste which has been deposited on the East Tip due to successive phases of emplacement without any apparent subdivision and the reworking that has occurred during earlier remediation attempts.

The baseline existing environment section of the EIS for the East Tip relies extensively upon the work previously conducted on the site and captured within the DQRA (WYG 2013a&c). This subsection of the EIS presents summary information on the baseline condition and the reader is referred to the DQRA for more detailed descriptions of the baseline environment with respect to:-

- Waste and natural subsoil description, delineation and chemical (solid and leachability) data.
- Permeability and hydraulic characteristics of the waste and natural strata (subsoils).
- Groundwater flow and interaction with the surrounding marine tidal regime of Cork Harbour.
- Groundwater and marine water quality.
- Estimated contaminant transport loading (flux) in groundwater discharging to the marine environment from the East Tip
- Risks posed to human health from direct pathway exposure to contaminants on the East Tip and risks posed to surrounding water in Cork Harbour.

13.3.2.1 Waste Types

Chapter 1 ‘Introduction’ of the EIS provides an overview of the waste types present on East Tip and foreshore area and Section 2 of the DQRA (WYG 2013a) provides further information on the contaminants of concern (COC) and their mobility in the environment.

13.3.2.2 Natural Soils

The sequence of natural geological subsoil beneath the waste on the East Tip varies across the site and comprises a sequence of silt, clay and sand & gravel, which overlies the limestone bedrock. A summary of the subsoil thickness and how it varies across the site is provided in Table 13.4.

Table 13.4: Summary of Geological Units Present Beneath the East Tip

Material	Occurrence	Thickness in metres (Approx. Range Beneath East Tip)	Features of Note
Waste	Uniformly present across the East Tip.	3 - 11	Comprised predominantly processed & non-processed slag (granular) and to a lesser extent refractory, millscale, sludge and construction and demolition type waste.
Silt/Marine Alluvium	Uniformly present across the site beneath the waste material. Thickness varies with thickest areas below the centre of the site (BH316 area) and the north of the site (BH306 area). The alluvium appears to thin locally in the southwest corner of the site (BH118A area), which also corresponds with the rise in the top of the limestone bedrock in this area.	6.2 - 15	The silt/alluvium is the first natural subsoil beneath the waste and will therefore receive the greatest potential loading of dissolved phase contamination from the overlying waste. The fine grain size within the silt and presence of organic material will provide important attenuating mechanisms for dissolved phase contaminants in groundwater that vertically infiltrates the material. Permeability within the waste will also be low due to the fine grain size of the material.
Clay	Not uniformly present beneath the silt / alluvium with detection in the southern and central part of the site between the silt and the sand & gravel. Clay not present between these two units in the north of the site (BH306 area). Occasional detections of light brown clay between the sand & gravel and the underlying limestone bedrock (BH309 area).	-	Where present, the clay will provide another naturally attenuating layer between the silt and the underlying sand & gravel and limestone bedrock. The CSM used in the DQRA has grouped the clay with the marine alluvium for the purposes of assessment.
Sand & Gravel	Uniformly present beneath the East Tip and appears to pinch out to the southeast as the limestone bedrock rises off site beneath the Spit Bank (Marine BH135 area).	1.9 – 19.5 (base not proven at thickest location BH117R)	The sand & gravel will have higher permeability than the overlying finer grained alluvial materials and is expected to be hydraulically connected to the underlying limestone bedrock.
Limestone Bedrock	Uniformly present beneath the East Tip.	Top of bedrock encountered between 23.8 – 43.1mbgl. Base not proven	Varying degrees of karst weathering observed in the limestone bedrock.

13.3.3 Bedrock

The bedrock mapped by the Geological Survey of Ireland (GSI) under the site is the Carboniferous aged Waulsortian Limestone that is known to form karst features due to solutional weathering of the carbonate minerals within the limestone. Karst formation within the Waulsortian can develop at depth within preferential fractures where groundwater flow over geological time scales has created preferentially enlarged solution features. In other places, the karst will only develop on the upper weathered surface forming an epikarst (thin 1-2m thick zone of preferential weathering of the limestone). In the limestone matrix blocks not affected by karst weathering, the limestone will remain strong and competent. At its most extreme, karst weathering can develop extensive open cavities and cave systems that can become filled with sediment washed into the cavities.

The recent drilling programme into the bedrock at Haulbowline illustrates limestone that is typical of all of these features and observed at varying depths as noted below:-

- BH312C in the southern part of the site progressed directly into competent and hard grey limestone at 26.2 m depth directly beneath the sand and gravel. Only slight weathering of individual fractures was observed with clay smearing also being observed (refer to the Photographic Records of BH312C for illustration) in Photographs 13.1-13.2.

- BH310C in the eastern part of the site progressed into an 8m thick weathered zone of karst limestone at 36.7 m depth that continued until to 44.6m. Core recovery was relatively poor at this location due to the fractured and broken nature of the limestone as can be seen in the core photographs (Photograph 13.3).

- BH306C in the northeast part of the site progressed into a thick (over 15m) very karstified formation of limestone from 33.5m depth whose base was not proven at 49.2 m depth. The karst at this location included weak broken limestone, sand, gravel and clay infilling the karst solutional cavities within the limestone as can be seen in the core photographs (refer to Photographs 13.4 – 13.5).

Photograph 13.1: Bedrock Core from BH312C – Competent Hard Limestone with Minor Solution Weathering Along Fractures

Photograph 13.2: Bedrock Core from BH312C – Competent Hard Limestone with Minor Solution Weathering Along Fractures

Photograph 13.3: Bedrock Core from BH310C – Karstified Limestone with Poor Core Recovery

Photograph 13.4: Bedrock Core from BH306C – Significant Karst Solution of Limestone with Sand, Gravel and Clay Infilling

Photograph 13.5: Bedrock Core from BH306C – Significant Karst Solution of Limestone with Sand, Gravel and Clay Infilling

Field observations of the Waulsortian Limestone outcrop on "The Island" bridge crossing to Haulbowline also indicate karst surface weathering of the limestone (refer to Photograph 13.6).

Photograph 13.6: Exposed Limestone Bedrock on "The Island" Bridge Crossing to Haulbowline Illustrating Small Scale Karst Formation on the Surface of the Limestone

13.3.3.1 Geological Cross Sections

A series of geological cross sections have been developed for the site utilising the 2012 site investigation data and also boreholes logs from the 2005 investigation (WYG, 2005). These are presented in DQRA Appendix W (WYG 2013a), and can be summarised as follows.

North to South Cross Section

Cross Section A-A' cuts the site in an east to west direction along the centre of the site from BH302 in the north, through BH303, BH116A, BH305, BH309 and BH312C. The waste depth varies in this cross section from approximately 11m thick at BH302 in the north, decreasing to approximately 7m at BH116, located centrally in the north and approximately 7m thickness in the south at BH312C. Underlying the waste is approximately 11m thickness of alluvial silt from approximately -4mAOD to approximately -15mAOD, underlain by between 4m and 8m (approx) thickness of gravels, underlain by limestone the top of which was recorded at between -20mAOD and -23mAOD.

East to West Cross Sections

Cross Sections B-B' and C-C' intersect the site in an east to west direction with B-B' in the north of the site and C-C' in the south of the site. Both cross sections show shallower depths of waste in the western most part of the site at BH304 and BH308, with depths of waste typically increasing towards the eastern part of the site. Underlying the waste material is alluvial silt, varying from approximately 6m thick to approximately 15m thick, with the greater depths observed in the centre of the site. A continuous thin layer of clay is shown in the cross section B-B', however this is not present in the southern cross-section C-C'. Gravels are shown to underlie alluvium and clays at thicknesses ranging from 7m to 15m extending to a maximum of -36mAOD. This is underlain by limestone at an approximate depth of approximately -30mAOD.

13.3.4 Hydrogeology

13.3.4.1 Permeability

Permeability assessment of the waste and natural geological materials has been undertaken at the East Tip using a combination of in-situ rising and falling head tests and particle size distribution (PSD) and correlation with estimates of permeability (WYG 2013). The in-situ tests have been conducted on all of the hydrogeological units with the PSD analysis only being conducted on the waste. Overall, a sufficiently large number of analyses have been undertaken in order to support the risk assessment.

These results are summarised in Table 13.5 from the DQRA (WYG 2013a). It should be noted that the in-situ tests are considered to be more reflective of hydraulic conductivity of the material as the PSD data represents estimates based on disturbed samples which are likely to have increased the estimated values (through the disturbance and breaking of fused slag materials) and then assuming that PSD correlations based on natural well sorted geological materials are valid. The PSDs are therefore considered to overestimate the hydraulic conductivity of the waste. Nonetheless, they also illustrate the inherent heterogeneity of the waste through the large range in hydraulic conductivities measured (by several orders of magnitude) and provide a conservative basis for use in the DQRA.

Table 13.5: Summary Permeability Measurements within Hydrogeological Units (Based on WYG 2013a)

Waste/Geological Unit	Maximum Permeability (m/d)	Average Permeability (m/d)	Minimum Permeability (m/d)
Waste (In-situ)	641	66.3	0.0181
Waste (PSD)	2,572	381	6.16
Waste (In-situ and PSD Combined)	2572	184	0.0181
Alluvium	0.59	0.15	0.003
Sand and Gravel	9.98	3.9	0.04
Limestone Bedrock	5.44	2.26	0.17

As can be seen, the PSD permeability ranges in the waste are up to an order of magnitude higher than those measured in-situ through rising and falling head tests. The permeability data for the limestone is interesting to note that, although BH306C was significantly karstified (refer to Section 14.3.3), its permeability was the lowest measured. This can be explained by the presence of fine sediment (clay) infilling that was observed within the limestone cavities in the borehole logs, which illustrates an important principle. It is not just the presence of karst but the infill present in the cavities that will impact the permeability of the limestone.

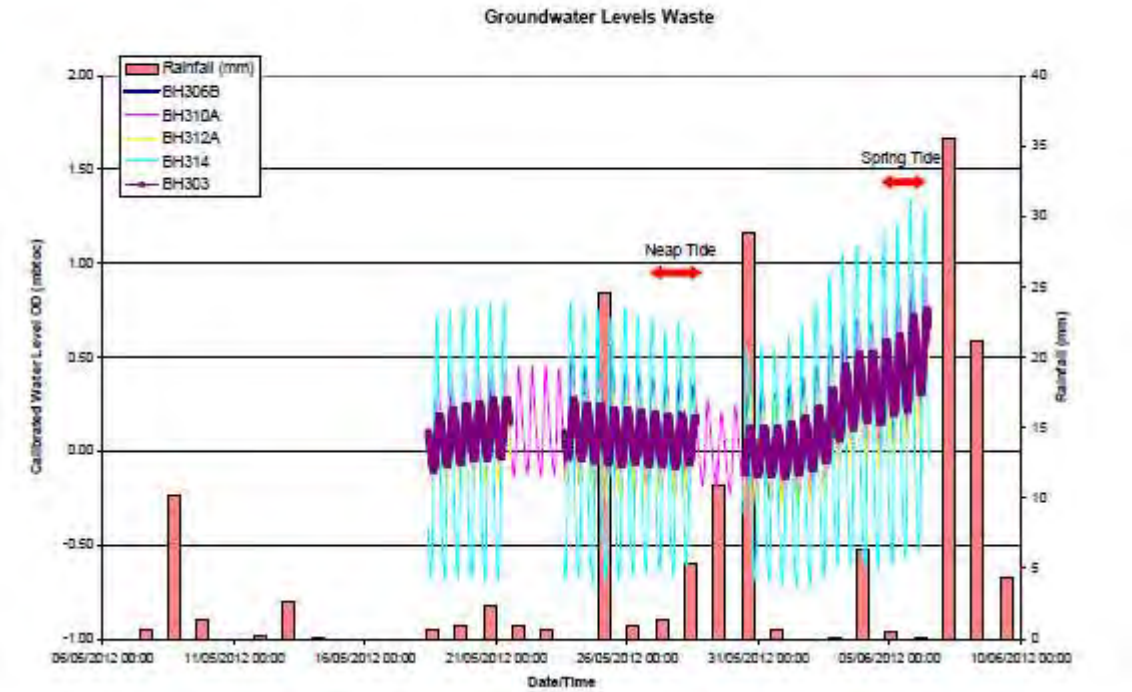
13.3.4.2 Groundwater Flow & Interaction with Tidal Regime

In situ groundwater data level loggers were strategically deployed in monitoring installations across the site to determine the variability in groundwater levels over time. Full factual records are presented in the site investigation Factual Report (PGL, 2012) together with data plots and the key data statistics are summarised in Table 13.6 for each of the key strata types.

All of the data collected during the monitoring period (July – August 2012) was within the tidal range (i.e. between MHWS 1.53mAOD and MLWS -2.17mOD) and the average sea level is close to zero mAOD. Moreover, a consistent twice-daily 'tidal' pressure signal was recorded within all strata types (including saturated waste material) monitored beneath the site.

Rainfall data for the monitoring period was also procured and overlaid on the in-situ data logger plots and show that the effects of precipitation on hydraulic head levels were absent or negligible by comparison to the tidally driven fluctuations. (Figure 13.2), which shows the neap tide on the 28th May 2012, followed by a spring tide around the 5th of June 2012.

Figure 13.2: Groundwater Levels in Waste Boreholes



(Source:WYG (2013a)DQRA, Appendix A).

Table 13.6: Groundwater Level Data Summary

Strata	Borehole	Max (mAOD)	Min (mAOD)	Avg (mAOD)
Waste	BH303	0.75	-0.13	0.14
	BH310A	0.95	-0.23	0.12
	BH312A	0.59	-0.31	0.08
	BH314	1.34	-0.72	0.01
Alluvium (Silt/ Clay)	BH304	0.41	0.07	0.18
	BH308	1.15	-0.72	0.16
	BH309	0.45	0.01	0.16
	BH316	0.51	0.01	0.22
	BH306D	0.70	-0.43	-0.01
	BH312B	1.03	-1.38	-0.05
Sand and Gravel (Fluvio-Glacial Deposits)	BH117R	**1.43**	-1.35	0.00
	BH125R	1.25	-1.16	-0.04
	BH313	1.31	-1.34	-0.04
Bedrock (Limestone)	BH306C	1.49	**-1.83**	-0.41
	BH310C	1.18	-1.47	-0.07
	BH312C	1.38	-1.45	-0.07

Note 1: Levels referenced against topographic benchmark (mAOD) and not corrected for local mean sea level, which is -0.3 to -0.4m below Ordnance Datum in this area.

Note 2: Maximums, minimums and therefore averages weren't necessarily recorded over same time periods.

Collectively these observations indicate that there is no 'perched' groundwater table on the site (as previously thought), or a 'water table' in the traditional sense of land based assessments. Instead, the data demonstrates that there is a saturated mass of waste material which is in a perpetual state hydraulic interaction with the surrounding tidal waters of the estuary (i.e. direct hydraulic continuity with the sea). On this basis, any apparent hydraulic gradient observed across the site is considered to be a short-lived function of the tidal regime and will be reversed and balanced within a normal 6-12 hour tidal cycle. The net effect, as evidenced by the overall average head level of -0.02mOD in Table 13.6, is a flat hydraulic gradient approximating to mean local sea level and no definitive (or continuous) direction of groundwater flow can be inferred.

It is important to note that a tidal signal, as evidenced by twice-daily variations in hydraulic head level in monitoring wells, is clear evidence of hydraulic connection to the sea. Again, the hydraulic head fluctuations observed in saturated natural strata below the normal tidal range are considered to be a pressure signal related to tidal loading rather than as direct evidence of the flow of water either vertically or laterally within these units. This is represented in a cross section with tidal graphs presented in Appendix Y of the DQRA (WYG 2013a).

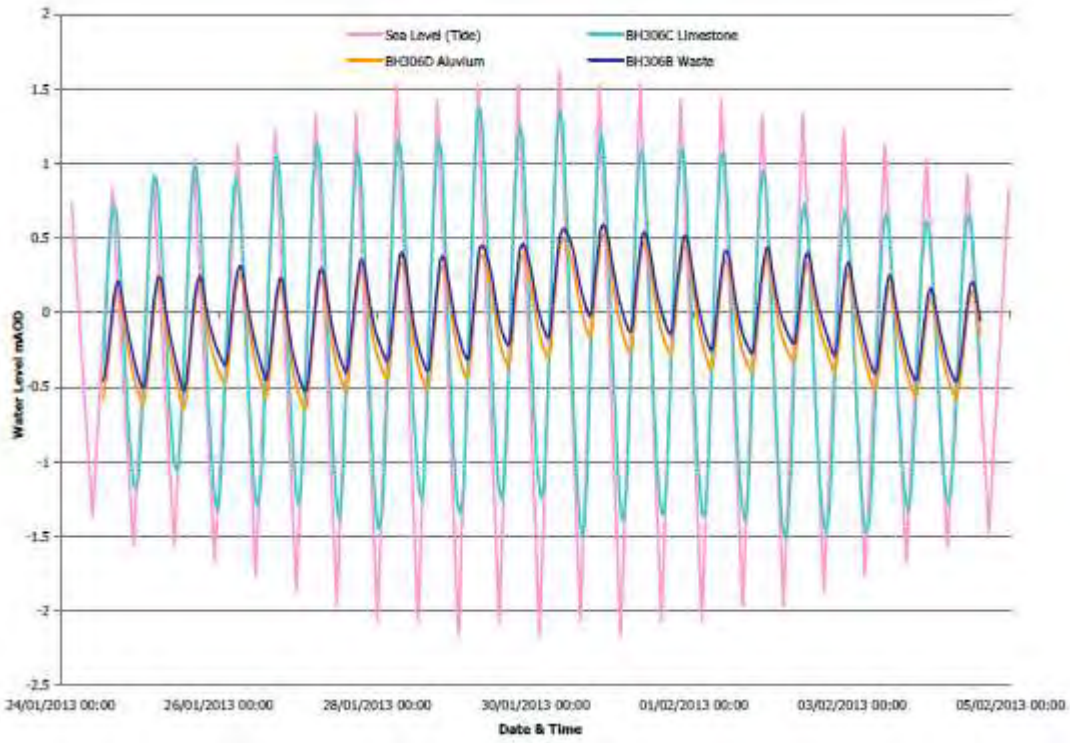
Additional to the above, Figures 13.3-13.5 below provide hydrographs for groundwater in the waste, alluvium and limestone for 3 sets of 3 No. boreholes clustered together (BH306, BH310 and BH312). The data was collected using data loggers installed into each of these boreholes from 21st January 2012 until 4th February 2012. The sea water level has also been plotted on the graphs from published tidal charts for nearby Cobh. All boreholes show a tidal signal with it being most pronounced in the limestone boreholes. It is clear that there is no persistent downward head. During a rising tide the limestone does appear to have an upward head, however this appears to be confined by the low permeability alluvium.

The hydrographs also show a lag between the high tide water levels in the alluvium and waste when compared with the limestone and seawater. The alluvium's hydraulic conductivity as outlined in Section 13.3.4.1 is an order of magnitude lower than that of the limestone, retarding water movement, resulting in a dampening of the tidal signal and lag of about ¼ of the tidal cycle.

The lag and less pronounced tidal signal in the waste is also evidence of a lower hydraulic conductivity. In Figure 13.3 the tidal response appears to be the same for groundwater in waste and groundwater in alluvium East Tip, Haulbowline Island, Cork. Detailed Quantitative Risk Assessment East Tip, Haulbowline Island, Waste Licensing Project, which suggests that these both have a similar hydraulic conductivity. There is a more pronounced lag time associated with the waste which also appears to drain at a slower rate into the harbour, i.e. no or little groundwater flow component. It is considered likely that the reduced conductivity of the waste is preventing it being influenced by the full tidal range such that the full high tide water level cannot permeate into the waste before the tide falls again.

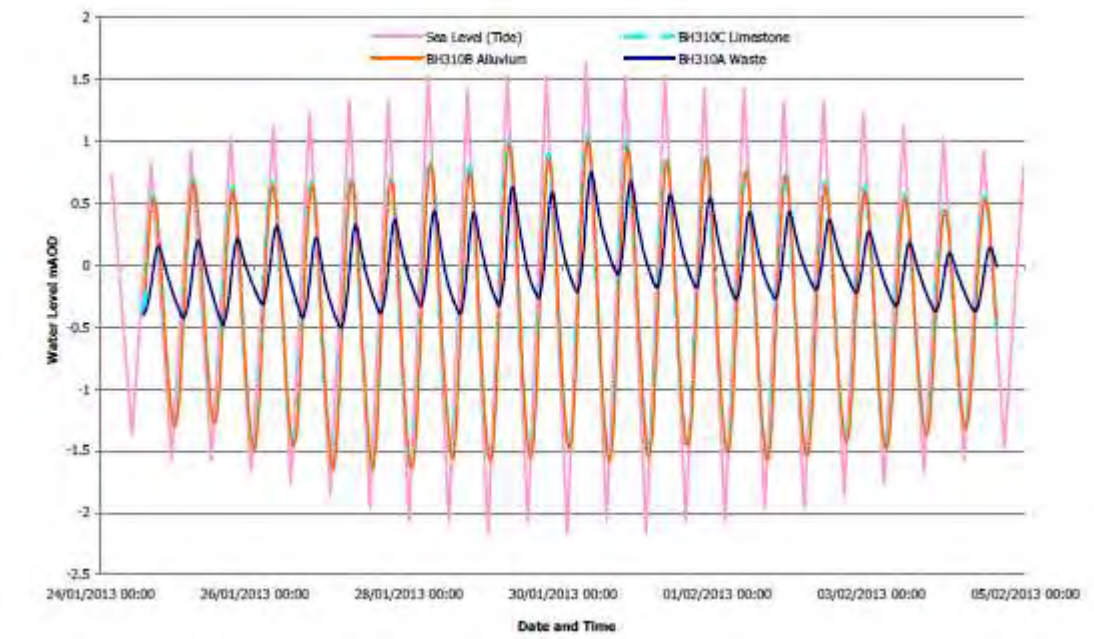
Similarly the waste does not drain to the minimum low tidal level as it is essentially contained within a confining low permeable alluvium basin (Cross Section BB Appendix W of the DQRA, WYG 2013a).In Figure 13.4, the hydrograph shows a very similar tidal signal and response for groundwater in both the alluvium and limestone. However this response is different from that observed for the groundwater in the waste and as a result these are considered to be confined.

Figure 13.3: Hydrograph Showing Groundwater Levels Monitored at BH306B, BH306C and BH306D



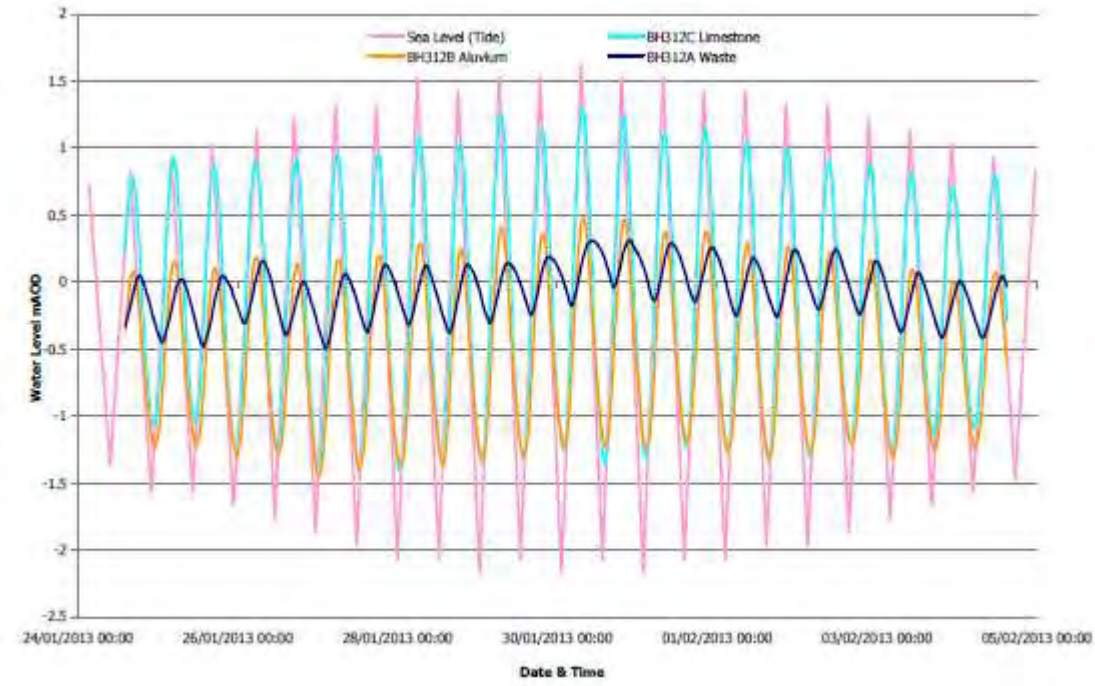
(Source: WYG (2013a)DQRA, Appendix A).

Figure 13.4: Hydrograph Showing Groundwater Levels Monitored at BH310A, BH310B and BH310C



(Source: WYG (2013a) DQRA, Appendix A).

Figure 13.5: Hydrograph Showing Groundwater Levels Monitored at BH312A, BH312B and BH312C



(Source: WYG (2013a) DQRA, Appendix A).

13.3.5 Baseline Soil/Waste Contamination

13.3.5.1 Introduction

Extensive soil and water chemical testing has been conducted at the East Tip, particularly during 2005 and 2012 for solid dry chemical results and leachate contamination from the waste materials and natural geological strata. This included:-

- A detailed review of all previous site investigations at the site;
- A review of the industry profile to assess whether all potential contaminants of concern (COC) had been assessed;
- Use of best practice to statistically determine an appropriate and robust sample density for the site;
- Trial pitting and borehole drilling to improve the characterisation of the site;
- Targeted soil sampling of all individual waste types present on the site;
- Targeted soil sampling of all unconsolidated natural geological strata;
- Leachate analysis of the waste and natural strata soil samples;
- Groundwater quality monitoring at both low and high tides;
- Surface water and seepage water sampling;
- Marine water sampling; and
- Tidal range hydraulic monitoring in key groundwater monitoring wells across the site.

The Detailed Quantitative Risk Assessment (DQRA) prepared by WYG (2013a&c) and included in Appendix A: DQRA of the EIS provides a comprehensive description of the soil quality present on the site and this EIS chapter summarises general aspects of the chemical results.

Table 13.7 summarises the overall distribution of contaminants observed across the different media (e.g. solid waste, waste leachate laboratory analysis, groundwater and marine water) at the East Tip. The summary table provides the number of samples in which individual contaminants (e.g. chromium, copper, and mercury) exceed the respective screening/assessment criteria used in the DQRA. The screening/assessment criteria used in the DQRA were chosen to be protective of human health and the environment relevant to the East Tip and its future use and are listed in Table 13.8 and described further within the DQRA.

Table 13.7 Haulbowline Remediation Project - Number of Samples Above Relevant CriteriaBased upon DQRA (October, 2013)

Contaminant of Concern	Solid Waste	Solid Natural Strata (Alluvium)	Leachate (NRA test)	Groundwater (Waste)	Groundwater (Alluvium)	Groundwater (Sand & Gravel)	Groundwater (Bedrock)	Surface Water, Excavations & Seepage	DQRA Flux (10m)	DQRA Flux (15m)	DQRA Flux (25m)	DQRA Flux (50m)	Marine Water
Number of Samples	145	34	28	42	23	9	12	5	Calculated	Calculated	Calculated	Calculated	12
EIS Reference & Relevant Criteria	DQRA (WYG 2013a)- Table 5 (Parkland Use), DQRA (WYG 2013c) - Table 5 (Commercial Use)	DQRA (WYG 2013a) - Table 6 (Parkland Use)	DQRA (WYG 2013a) - Table 8 (Water Quality Standard), DQRA (WYG 2013c) - Table 6 (Water Quality Standard)	DQRA (WYG 2013a) - Table 19 & 20 (Water Quality Standard)	DQRA (WYG 2013a) - Table 21 & 22 (Water Quality Standard)	DQRA (WYG 2013a) - Table 23 & 24 (Water Quality Standard)	DQRA (WYG 2013a) - Table 25 & 26 (Water Quality Standard)	DQRA (WYG 2013a) - Table 27 (Water Quality Standard)	DQRA (WYG 2013a) - Table 39 (Water Quality Standard)	DQRA (WYG 2013a) - Table 39 (Water Quality Standard)	DQRA (WYG 2013a) - Table 39 (Water Quality Standard)	DQRA (WYG 2013a) - Table 39 (Water Quality Standard)	DQRA (WYG 2013a) - Section 3.6 (Water Quality Standard)
Arsenic	29	1			3	1							
Cadmium	2		1		1	2	11						
Lead	34		2	1									
Nickel	2			1			1						
Vanadium	12												
Zinc	1		1	2			2						
Benzo(a)pyrene	1 *			1									
Aluminium			11										
Chromium (total)			10	28	8	4	3	3					
Chromium (VI)			14	4					X	X	X		
Copper			7	6	2	1	1	1					
Mercury			3	19 **	7	2	2	4					
Anthracene			4										
Fluoranthene			10	1									
pH			16	20	1								
Manganese			1	7	23	9	8		X				
Benzo(k)fluoranthene				1				1					
Ammoniacal Nitrogen						1							

Notes:
Blank = No samples exceeding the relevant criteria for the contaminant of concern
X = Calculated exceedence based upon dilution of contaminant flux in marine water (refer to DQRA Sections 6.6-6.7)
* = 62 samples tested for PAH's
** = 48 samples tested for mercury

Table 13.8: Environmental Screening and Assessment Criteria Referred to in DQRA (WYG 2013a)

Receptor	Screening/Assessment Criteria used in DQRA	Rationale
Human Health (Park Land End Use)	At Risk Generic Assessment Criteria (GAC) for Park Land Use Full list provided in Appendix B of the DQRA (WYG 2013a) in Appendix A of this EIS.	Park land use Atrisk GACs are considered appropriate for screening soils based upon the possible future recreational use of the East Tip. The CSM for this land use and derivation of GACs assumes that the site in question has large grassed areas that are used for a range of recreational activities including picnicking, sunbathing and casual sports uses e.g. a football 'kick around'. There is also often a small children's play area, which may have tarmac or other hard cover. Parks are also assumed to have areas such as flower beds and paddling pools or duck ponds. However, pathways relating to contact with surface water are not included within the GACs.
Human Health (Commercial End Use)	Commercial and industrial land use GACs derived by CIEH and LQM (CIEH 2009) Full list provided in Appendix B of the DQRA (WYG 2013a) in Appendix A of this EIS.	Commercial and industrial land use GACs, have been recently derived in the UK by the Chartered Institute of Environmental Health and the Land Quality Management Team at the University of Nottingham. These were developed through collaboration of a number of UK contaminated land specialist practitioners and published jointly by CLAIRE and CIEH, (CIEH, 2009). These screening criteria can be considered to be appropriate in assessing risks to the health of current users of the site. They assume that buildings are present, normally for office use on site and that indoor pathways are therefore applicable. Outdoor contact pathways are restricted to lunchtimes or break times. There is currently a building on site which, on occasion, is utilised as an office. It should be noted that these GACs are typically less than the above park land use GACs and therefore generally the use of park land use GACs provides for a more conservative assessment.
Waste Leachate Groundwater Surface Water and Seepages from Site Marine Water	Water Quality Standards (WQS) drawn from surface water quality standards considered appropriate for the site and the main receptor of marine water in Cork Harbour. Table 4 of the DQRA (WYG 2013a) outlines the individual water quality concentrations adopted.	The analytical data from solid leachability tests, groundwater and surface water samples has been assessed by direct comparison with water quality standards (WQS) as presented in Table 4. Where a specific Irish Surface Water Standard is not available, then other standards such as drinking water standards (Irish standards if available) were utilised or environmental quality standards (EQS) from the UK. These are mainly national statutory standards sourced from, in order of preference, European Communities Environmental Objectives (Surface Waters) Regulations 2009 (Annual Average) for surface waters other than inland waters e.g. coastal and transitional waters; European Communities Environmental Objectives (Surface Waters)

Receptor	Screening/Assessment Criteria used in DQRA	Rationale
		Regulations 2009 (Annual Average) for inland surface waters; and other international water quality standards namely UK Environmental Quality Standards (EQS) and UK Drinking Water Standards (DWS). These are used as screening standards in the first instance to determine which of the potential contaminants of concern (COC) should be further assessed for significance of the risk posed. In order to assess PCOCs, compliance point standards are required which should be appropriate for the receptor being considered. For the East Tip site, the Cork Harbour waters are considered to be the primary receptor. As a result the preferred quality standards adopted are those as in Table 4 and are EQS values for "other surface waters".

As can be seen in Table 13.7 although a relatively large number of potential contaminants of concern (COC) are identified within the solid waste, waste leachate and groundwater, it is only a relatively small number of contaminants that emerge from the site as current seepages along the foreshore (total chromium, mercury and benzo(k)fluoranthene) that occasionally exceed the screening / assessment criteria before mixing and dilution with sea water. It should be noted that these compounds are not observed in all seepages and none were observed above the screening criteria in the most recent sampling round of November 2012. The DQRA (WYG 2013a) which has modelled groundwater and contaminant discharge from the site on a conservative basis predicts theoretical chromium (VI) and manganese concentrations in sea water which have not been detected in the marine water sampling conducted to date. Chromium (VI) was not detected above the laboratory's method detection limit from any seepage sampled in November 2012.

The following sub-sections of the EIS summarise the results of the DQRA in relation to the distribution of contaminants in the different media across the East Tip.

13.3.5.2 Solid Waste Results

The site investigation found that the East Tip is comprised of waste which was deposited on shallow harbour sediments and built up to form a land mass. The waste is composed of several different waste types which originated from the steel works and summarised in Table 13.9. The waste types are described in detail within Chapter 1 Introduction of the EIS and in the DQRA (WYG 2013a).

Table 13.9: Summary of Waste Chemical Results – East Tip (based on WYG 2013a)

Waste Type	Exceedance above GAC	Distribution Across Site
Slag Waste	Slag wastes exceeded the GACs for arsenic, lead and vanadium for a parkland use with between 5% and 32% of the 22 no. slag samples tested.	Wide distribution
Refractory Waste	Exceeded the GACs for arsenic, lead and vanadium for a park landuse with between 8 and 54% of the 13 no. Refractory Waste samples tested having elevated concentrations of these metals.	Mixed with varying quantities of slag material and other waste types
Millscale Waste	Arsenic and lead were measured at concentrations in excess of the park landuse GACs in 71% (5 no. out 7 no.samples)of samples analysed and one sample had a measured cadmium concentration in excess of the commercial GAC.	Rarely encountered during the investigation, resulting in only 2 No.of the samples analysed in 2012 being comprised of 100% millscale
Sludge	Arsenic in 3 no. samples, lead in 4 no. samples and cadmium, nickel and zinc in one sample were measured above the parkland use GACs with one cadmium concentration exceeding the commercial land use GAC.	Rarely encountered during The investigation and as a result only 4 no. samples from suspected sludge material were analysed as part of the 2012 investigation
Flue Dust	One sample (OP102mbgl), had cadmium and lead concentrations that exceeded both the park and commercial landuse GACs. Zinc and arsenic concentrations exceeded the parkland use GACs.	Rarely encountered during the investigation with only 1 no. sample being identified and analysed.
Demolition and Construct-ion Waste	Arsenic, lead and vanadium exceeded the parkland use GAC in approximately 50% of the 9 No. samples analysed.	Low volumes of demolition waste were encountered, typically observed as occasional construction and demolition type waste mixed with slag. It was also observed on the surface in the southeast corner of the site originating from the factory's demolition.

13.3.5.3 Natural Strata Results

The DQRA (WYG 2013a) provides considerable detail on the distribution of contaminants in the natural strata beneath the East Tip. Chemical concentrations were generally found to decrease with sample depth within the natural strata and were significantly lower than those observed in the overlying waste, as illustrated in Table 13.10.

Table 13.10: Summary of Waste and Geological Concentrations (mg/kg) (based on WYG 2013a)

Contaminant	Waste			Geological Strata		
	Minimum	Maximum	Average	Minimum	Maximum	Average
Arsenic	3.5	126	31	<1 (LOD)	92.4	9.5
Total Chromium	23	6480	2081	<4.5 (LOD)	1593	84
Chromium VI	<0.6 (LOD)	14.7	1.6	<0.3 (LOD)	<3 (LOD)	NC
Copper	<1 (LOD)	4020	780	<1 (LOD)	210	27
Zinc	95	189000	4435	15.6	789	142
Lead	21	41700	900	7.75	184	35
Nickel	8.1	2860	228	2.6	209	29
Cadmium	<0.2 (LOD)	553	12	<0.1 (LOD)	1.4	0.4
Water Soluble Boron	<1 (LOD)	17.3	100	1.4	10.4	5.8
Vanadium	3.1	581	219	2.69	238	33
pH	6.5	12.7	8.38	6.5	10	7.8

As can be seen there is a consistent decrease in contaminant concentrations between the waste and the geological strata, such as:-

- Arsenic in natural soils ranged from less than laboratory detection limits to 92.4mg/kg (BH30416.5-17mbgl), with an average of 9.5mg/kg. These data are considerably less than the maximum and average concentrations for the overlying waste with respective maximum and average concentrations of 126mg/kg and 31mg/kg.

- Total chromium in natural soils ranged from less than laboratory detection limits to a maximum of 1593mg/kg(BH13115mbgl[1]) with an average of 84mg/kg. Typically the measured concentrations were less than 100mg/kg for most samples analysed. These data were lower than those observed for the overlying waste material with a maximum concentration of 6480mg/kg and average of 2081mg/kg.

- Chromium VI in natural soils were less than laboratory detection limits in all samples analysed, however in the waste material the maximum observed concentration was 14.7mg/kg with an average of1.6mg/kg.

- Copper, zinc, lead, nickel, cadmium, water soluble boron, vanadium and pH all had maximum and average concentrations lower than that observed in the waste material.

Figures 13.6, 13.7, and 13.8 present the results for chromium, arsenic and zinc metals plotted against depth, which indicates that there has been limited vertical downward migration of contamination.

[1] mbgl – metres below ground level

Figure 13.6: Distribution of Chromium in Soils Across the East Tip as a Function of Depth

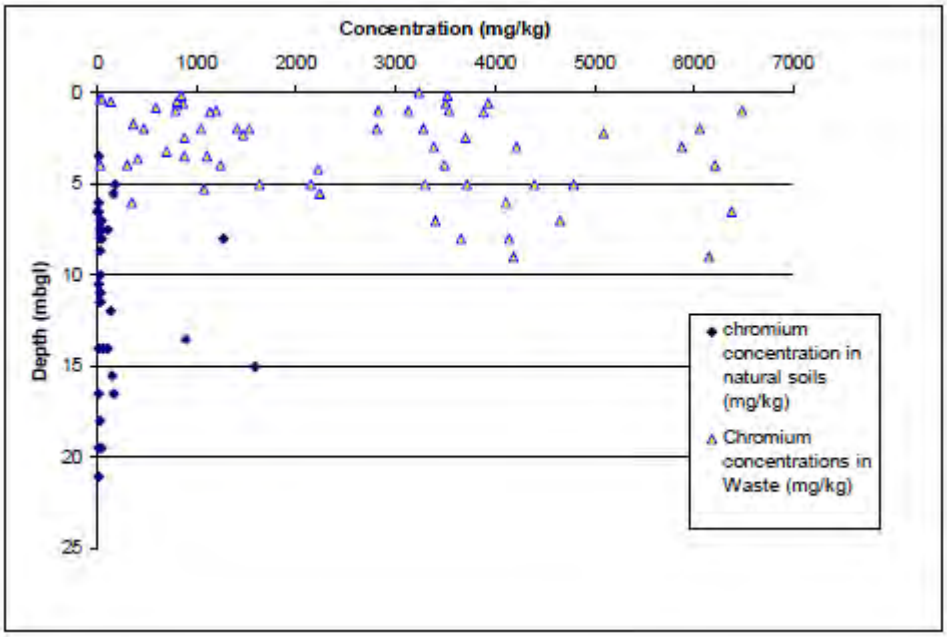


Figure 13.7: Distribution of Arsenic in Soils Across the East Tip as a Function of Depth

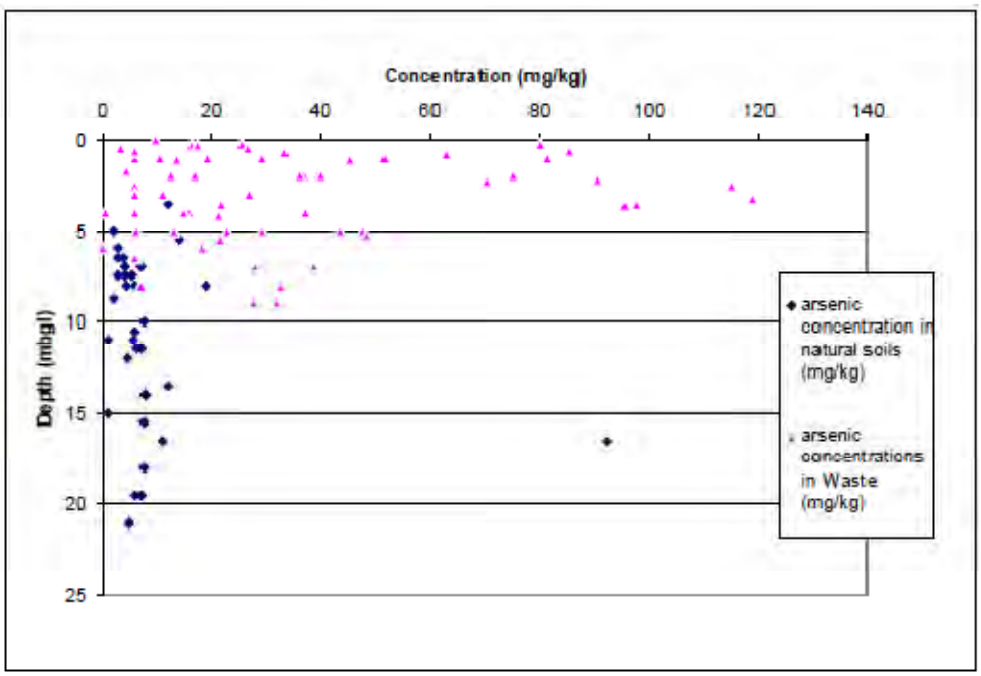
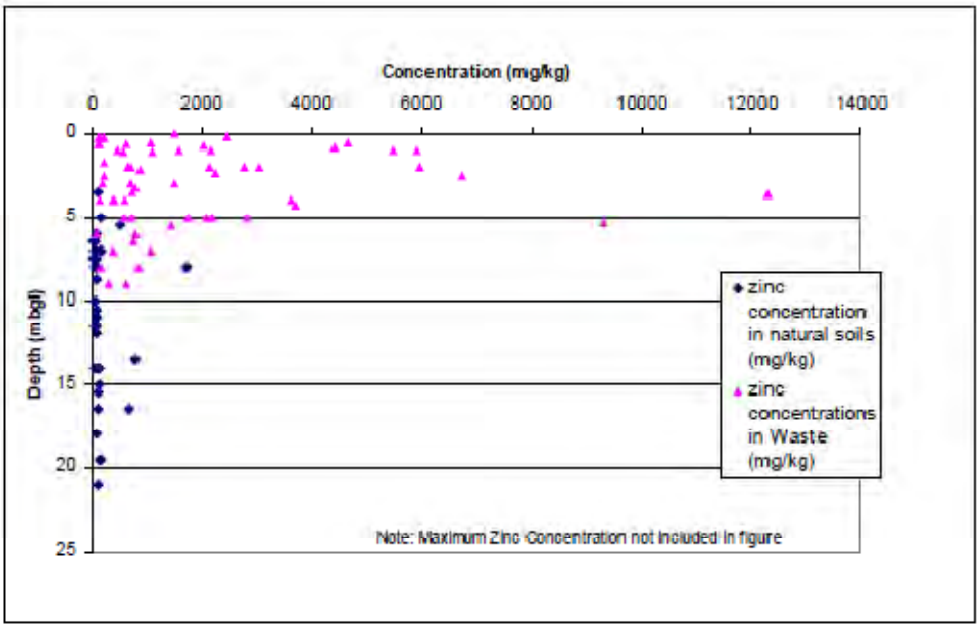


Figure 13.8: Distribution of Zinc in Soils Across the East Tip as a Function of Depth



13.3.5.4 Leachate Results

The DQRA (WYG 2013a) includes a detailed description of the leachate test results conducted on waste samples across the East Tip and WYG (2013c) includes leachate results from the foreshore area. Additional leachate analysis using a bespoke method with sea water rather than fresh water (which is the standard NRA method) was awaited at the time of publication this EIS. Although it is anticipated that there will be variation between the two test methods with the sea water test being more representative of leaching effects due to the tidal interaction on the site, these differences are not expected to significantly change the results of the DQRA and EIS due to the considerable body of groundwater quality data available and used for both assessments.

13.3.6 Baseline Groundwater & Surface Water Quality

13.3.6.1 Introduction

Several rounds of groundwater quality data have been collected from the East Tip during the most recent investigations in 2012, including:-

- High and low tide sampling in June –July 2012.
- Repeat sampling in November 2012 (majority at low tide).

The first round of data collected in (June-July) had relatively high laboratory method detection limits (MDL) for some of the contaminants (e.g. mercury and chromium VI), which prompted the need for additional data with lower MDL's to complete the risk assessment. All sets of data have been used in the DQRA and are presented in detail within Section 3 of the DQRA (WYG 2013a). The November 2012 data are summarised in the subsections below (Tables 13.11 – 13.14) and the reader is referred again to the DQRA for a comprehensive description of contaminants in groundwater.

13.3.6.2 Groundwater Results November 2012

Table 13.11: Summary Groundwater Concentrations for Boreholes Screened into Waste (November 2012)

Contaminant	WQS (µg/l)	Total No. of Samples	Range (µg/l)	No. Samples Exceeding WQS	Boreholes that Exceed WQS Standard
Chromium	4.6	16	<0.2-18.3	6	BH130, BH306B, BH310A (high and low tide), BH311, BH315
Chromium VI*	0.6	16	<2- 33	3	BH310A (low and high tide only)
Copper	5	16	<3-21	2	BH312A (low and high tide)
Zinc	40	16	1.8-45.4	1	BH314 (high tide only)
Manganese	30	16	<0.3-1784	3	BH301A, BH302, BH305
Mercury**	0.05	22	<0.003-0.23	3	BH312A (high and low tide) and BH314

Note 1: Table does not include results of duplicate samples.

Table 13.12: Summary Groundwater Concentrations for Boreholes Screened into Alluvium (November 2012)

Contaminant	WQS (µg/l)	Total No. of Samples	Range (µg/l)	No. Samples Exceeding WQS	Borehole Exceedance of Standard
Arsenic	20	9	<0.9-31.1	1	BH310B
Cadmium	0.2	9	<0.03-0.36	1	BH310B
Manganese	30	9	75.9-4908	9	BH304 (high and low tide), BH306D, BH308, BH309, BH310B, BH312B, BH316 (low and high tide)

Table 13.13: Summary Groundwater Concentrations for Boreholes Screened into Sands and Gravels (November 2012)

Contaminant	WQS (µg/l)	Total No. of Samples	Range (µg/l)	No. Samples Exceeding WQS	Borehole Exceedance of Standard
Arsenic	20	3	3.4 - 25	1	BH313
Cadmium	0.2	3	<0.03-0.65	2	BH313, BH117R
Manganese	30	3	76.2 - 2126	3	BH313, BH117R, BH125R

Table 13.14: Summary Groundwater Concentrations for Boreholes Screened into Limestone (November 2012)

Contaminant	WQS (µg/l)	Total No. of Samples	Range (µg/l)	No. Samples Exceeding WQS	Borehole Exceedance of Standard
Cadmium	0.2	4	0.37-1.78	4	BH122, BH306C, BH310C, BH312C
Manganese	30	4	7-790.5	2	BH306C, BH310C
Zinc	40	4	16.7-95	1	BH310C
Mercury	0.05	4	<0.01-0.07	1	BH306C

13.3.6.3 Seepages and Surface Water Results November 2012

Samples were also collected from the seepages during low tide during the sampling in November 2012. The analysis results did not identify concentrations in excess of the WQS. In particular, chromium VI concentrations were less than the laboratory detection limit of 2µg/l. Laboratory analysis results compared to WQS are presented in Appendix L of the DQRA (WYG 2013a).

13.3.6.4 Marine Water Results

Samples of seawater were collected from 6 No, locations from around Cork Harbour during low tide in June 2012 and again in November 2012 and analysed for the Contaminants of Concern (COC). Laboratory analysis results compared to WQS are presented in Appendix L of the DQRA(WYG 2013a). The sample locations are presented on Figure 12 of the DQRA. One sample is from south of Haulbowline to the west of the East Tip (HW01), three are in close proximity to the East Tip (HW02, HW03 and HW04) and two are from the outer harbour (HW05, HW06) down river of the East Tip.

For all samples tested, none of the COC concentrations (including chromium VI) exceeded relevant WQS, including those taken in close proximity to the East Tip.

13.3.7 Conceptual Site Model

13.3.7.1 Overview of Methodology

The Conceptual Site Model (CSM) that has been developed in the DQRA and the EIS has been developed based on the following documents:

- EPA (2012) Framework Approach for the Management of Contaminated Land and Groundwater at EPA Licensed Facilities;
- EPA (2007) Code of Practice: Environmental Risk Assessment for Unregulated Disposal Sites; and
- Environment Agency (UK) (2004) Model Procedures for the Management of Land Contamination.

The fundamental starting point for contaminated land risk assessment is the **Source – Pathway – Receptor** framework, in which:-

- **A Source –** is an entity or action, which releases contaminants to the environment.
- **A Pathway –** is a mechanism by which receptors can become exposed to contaminants.
- **A Receptor –** is the component at risk of experiencing an adverse response following exposure to a contaminant.

The conceptual site model (CSM) represents the characteristics of the site and shows the relationship between sources, pathways and receptors. These relationships are termed pollutant linkages and in order for a risk to be realised all three components must be present.

Defining the conceptual model requires identification of all potential sources, pathways and receptors of contamination and identifying plausible combinations of these three components. These potentially significant pollutant linkages can then be qualitatively or quantitatively assessed to identify potential risks.

In the case of the East Tip, an example of a potential Source – Pathway – Receptor Linkage includes metal contamination in the waste (Source) that poses a potential risk to human health (Receptor) of future users of the site through direct (dermal) contact and inhalation of dusts (Pathways).

The DQRA (WYG 2013a) prepared for the site has been conducted in a staged/iterative approach with all potential pollutant linkages identified and described in the Initial Conceptual Site Model (refer to Section 1.5 of the DQRA), which considers risks to:-

- Water – further assessed through Detailed Quantitative Risk Assessment in Section 6 of the DQRA (WYG 2013a).
- Human Health - further assessed through Generic Quantitative Risk Assessment in Section 3 of the DQRA (WYG 2013a).

Risk assessment was also conducted for the waste in the foreshore area (WYG 2013c) and added to the predicted discharge to marine water in order to assess cumulative impact.

13.3.7.2 Human Health

The DQRA has updated the Conceptual Site Model for the site pre-remediation (i.e. the baseline condition) with reference to screening / assessment criteria for future parkland use. A full description of the contaminants and relevance within a Source – Pathway – Receptor framework is presented within Section 4 (WYG 2013a) of the DQRA and the outcomes are summarised in Table 13.15 (and illustrated in Figure 13 of the DQRA) (reproduced as Figure 13.9).

Table 13.15: Updated Conceptual Site Model - Human Health (based on DQRA)(WYG 2013a)

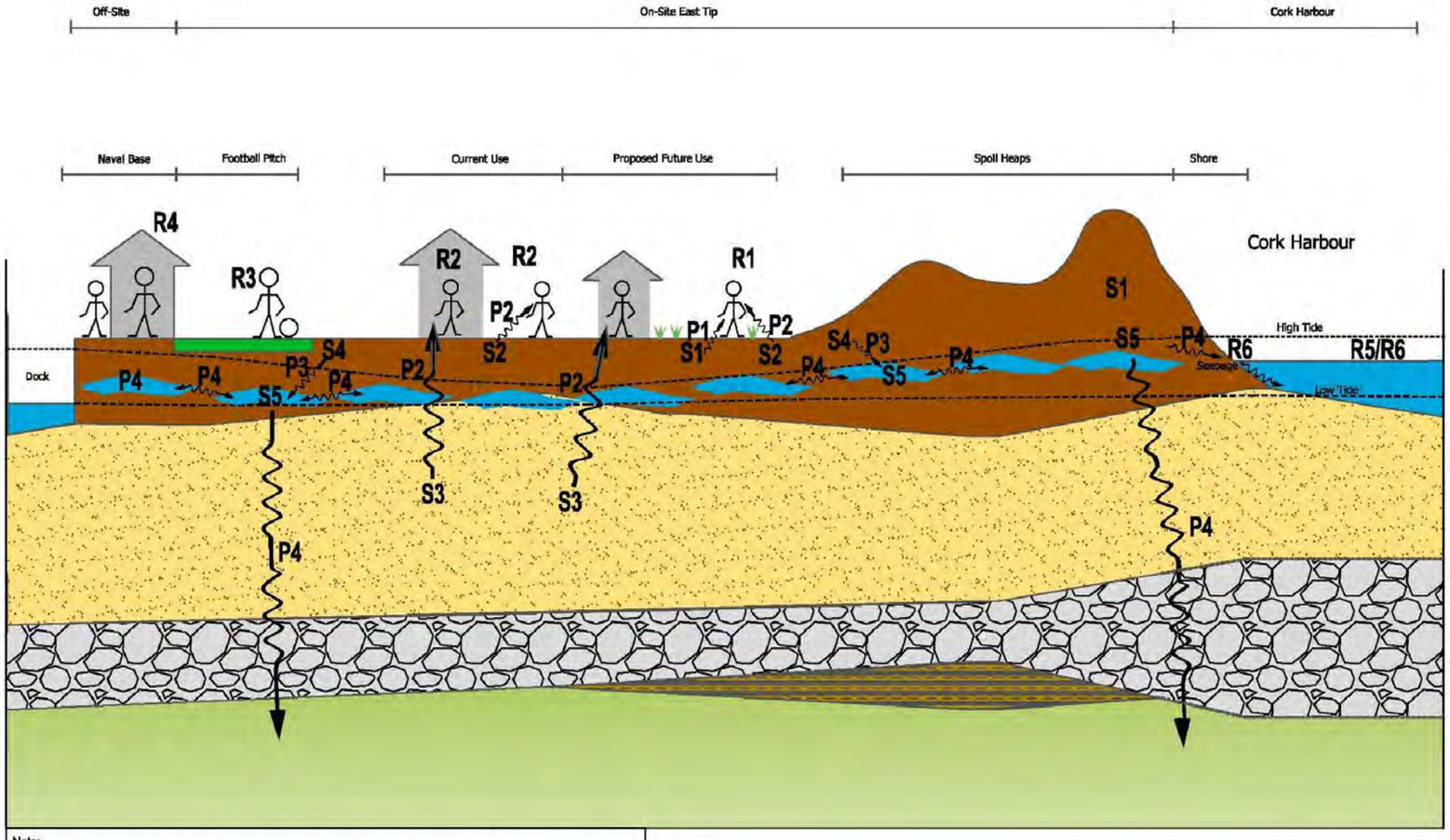
Source	Pathway	Receptor
Shallow arsenic and lead contamination associated with waste material including surface stock piles across the site.	Direct dermal contact Ingestion dust and soil Inhalation of dust	Future park land users
Asbestos in waste material.	Inhalation of fibres	Current commercial users, future park users and construction workers
Hotspots of contamination, BH312m BH314, OP10 Millscale, sludge and flue dust.	Direct dermal contact Ingestion dust and soil Inhalation of dust	Future park land users
Groundwater Contamination associated with waste material, arsenic, chromium, copper, zinc, minor lead, nickel, cadmium, aluminum, manganese.	Direct dermal contact Ingestion	Construction workers (unlikely unless excavating below water table)
Ground Gas – methane.	Lateral and vertical migration	Current and future site users

13.3.7.3 Controlled Waters

The DQRA (WYG 2013a) has updated the Conceptual Site Model for the site pre-remediation (i.e. the baseline condition) with reference to screening / assessment criteria for marine water. A full description of the contaminants and relevance within a Source – Pathway – Receptor framework is presented within Section 6 of the DQRA (WYG 2013a) and the outcomes are summarised in Table 13.16 (and illustrated in Figure 13 of the DQRA, reproduced as Figure 13.9).

Table 13.16: Updated Conceptual Site Model – Water & Ecology (Based on DQRA)(WYG 2013a)

Source	Pathway	Receptor
Leachable chromium, chromium VI, copper, lead, limited cadmium, zinc and PAHs. Waste types – slag, sludge, refractory, millscale, flue dust, construction and demolition materials.	Leaching from unsaturated zone	Shallow groundwater in slag material
	Leaching within tidal zone through wetting and drying	Shallow groundwater in slag material
	Lateral and vertical groundwater migration, preferentially through waste	Cork Harbour waters
	Uptake by flora and fauna	Flora and fauna in Cork Harbour particularly on foreshore
	Erosion and leaching	Cork Harbour waters and flora and fauna in Cork Harbour particularly on foreshore
Groundwater contamination associated with waste material, arsenic, chromium, chromium VI, copper, zinc, lead, manganese, nickel and mercury.	Lateral and vertical groundwater migration, preferentially through waste	Cork Harbour waters
	Uptake by flora and fauna	Flora and fauna in Cork Harbour particularly on foreshore



SOURCES:

S1	Arsenic & lead contamination (waste) Hotspots of contamination BH312B, BH314 & OP10
S2	Asbestos (Waste)
S3	Ground Gas (methane) in alluvium
S4	Leachable chromium, chromium VI, copper, lead, cadmium, zinc & PAHs
S5	Groundwater contaminants in waste:- Arsenic, chromium VI, chromium, copper, zinc, lead, manganese, nickel, mercury, benzo(a)pyrene, benzo(k)fluoranthene, fluoranthene

PATHWAYS:

P1	Dermal contact ingestion & inhalation
P2	Inhalation of dusts & vapours
P3	Solid phase leaching to groundwater
P4	Contaminant migration in groundwater

RECEPTORS:

R1	Future park users
R2	Commercial site users / construction workers
R3	Current navy football pitch users
R4	Adjacent navy base
R5	Cork Harbour
R6	Ecology - flora & fauna

Note:
Drawing not to scale and is for illustrative purposes only to provide pictorial presentation of a conceptual site model. The significance of various contamination sources, pathways and receptors, as shown, are yet to be fully quantified and as a result this diagram should not be used to conclude that actual significant risks due to the presence of contamination in the East Tip are present.
Note1:
The conceptual model presented is pre-remediation and does not include future proposed remediation.

KEY:

WASTE
CLAY
MARINE ALLUVIUM
LIMESTONE
SANDS & GRAVELS
GROUNDWATER
PATHWAYS

Title
CONCEPTUAL SITE MODEL
(Reproduced from DQRA)

Figure 13.9

File Ref : MCE0734 Figure 13.9
Date : October 2013 Rev: F02

East Tip Remediation Project

EAST TIP REMEDIATION PROJECT

RPS

13.3.8 Risk Assessment

13.3.8.1 Human Health – GQRA

The Human Health Risk Assessment was completed using statistical analysis of the contaminant concentrations within the waste and comparison against two potential end uses for the East Tip where Generic Assessment Criteria (GAC) have been developed for the purposes of assessing risks to human health under different end uses of the site **prior to remediation**:-

- Park Land Use.
- Commercial Land Use.

Section 3 of the DQRA (WYG 2013a) provides a full description of the results of the analysis and in summary the following contaminants under the different end uses were identified in Table 13.17.

Table 13.17: Summary of the GQRA Human Health Risk Assessment (WYG 2013a)

East Tip – End Use	Risk Assessment Findings
Park Land	Arsenic: Site wide impact Lead: Site wide impact & outlier at one location at depth (2m) and on the Navy football pitch at one location (0.9m depth)
Commercial Land	Lead: Outlier at one location at depth (2m)

In the foreshore waste DQRA (WYG 2013c), only one sample exceeded the GAC for commercial land use (for Nickel at 2.2-2.5m depth), which is not considered to pose a risk to human health due to its location at the depth where direct human health contact pathways are not considered viable.

Waste samples were screened for the presence of asbestos and approximately 50% of these were identified as containing trace quantities of asbestos fibres, typically 0.003%-0.006% comprising mainly of the lower risk chrysotile. Further examination identified that the asbestos fibres had not been subjected to a heat treatment and as a result are not considered to originate from the slag or raw scrap metal that was used by the steelworks. Detailed results are presented in Appendix M of the DQRA(WYG 2013a). Asbestos is considered to have the potential to cause risks (pre-remediation) to the health of current and future site users through inhalation pathways and has been dealt with in detail within Chapter 9, 'Air Quality and Climate' and Appendix K of the EIS. Similar trace levels of asbestos were identified in four samples collected from the foreshore waste (WYG 2013c) at concentrations of 0.003% to 0.01%.

13.3.8.2 Controlled Waters

The DQRA (WYG 2013a) recognises that a substantial proportion of the waste material beneath the site is in direct hydraulic continuity with the estuarine waters of Cork Harbour, and therefore assesses the risk posed to the receiving water quality of Cork harbour by considering the following:-

- The quantity (mass) of dissolved phase contamination that is generated through tidal inflow and discharge from the site on a daily basis - the contaminant flux (in units of mass/time).

- The dilution of the contaminant flux once it enters the marine water in Cork Harbour surrounding the site and assessing how far this extends with reference to surface water quality (concentration) standards (in units of mass/volume).

A bespoke analytical model was developed to improve the understanding of the likely scale of impact represented by the site by considering the effects of dilution of contaminants in the estuarine waters of Cork Harbour, through what is referred to in the DQRA as a "Tier 4 Assessment" and is described in detail within Section 6 of the DQRA (WYG 2013a).

The Tier 4 modelling exercise presented within the DQRA seeks to establish a conservative estimate of the mass of dissolved phase contaminant flux potentially leaving the site, and to understand this mass within the context of the daily flux of water passing the site as part of the local tidal regime.

The Tier 4 modelling comprises three distinct steps summarised in Table 13.18.

Table 13.18: Summary of the DQRA Tier 4 Risk Assessment(WYG 2013a)

Step	Methodology / Description	Key Findings/Risk Assessment
1. Contaminant Flux Assessment	1. Quantification of groundwater discharge from the site using Darcy's Law ($Q=KIA$)[2] 2. Calculation of contaminant mass transport in groundwater flow (based on average contaminant concentrations in groundwater within the waste across the site).	Conservative input parameters for groundwater flow calculation and assumption that average groundwater concentrations discharge from the entire site.
2. Dilution of Contaminant Flux within Cork Harbour	Radial zones surrounding the East Tip have been used to dilute the calculated flux from the site within sequential zones up to 100m from the site.	Majority of contaminants were below the screening/assessment criteria with the exception of:- - Chromium (VI) predicted above surface water quality standard up to and including 25m from shoreline. - Manganese predicted above surface water quality standard up to and including 10m from shoreline.
3. Sensitivity Analysis	The model was run with higher inputs to assess sensitivity of results:- - Maximum contaminant concentrations vs. average values - Increasing the contaminant flux by 50% - Varying the hydraulic conductivity values used within the model - Using a maximum theoretical contaminant flux.	Variation of the hydraulic conductivity was found to be the most sensitive parameter in the model:- - A decrease in the average hydraulic conductivity of the waste by a factor of 10 reduced the predicted impacts below screening/assessment criteria within 10m of the site (under Darcy's Law flux). - A decrease in the average hydraulic conductivity of the waste by a factor of 100 reduced the predicted impacts below screening/assessment criteria within 10m of the site (under maximum theoretical contaminant flux).

It should be noted, that although the Tier 4 Risk Assessment has predicted a potential impact for chromium (VI) and manganese insofar as it predicts concentrations of both of these contaminants in

[2]Where 'Q' is Flow (m3/day) 'K' is Hydraulic conductivity (m/day) 'I' is hydraulic gradient, expressed by hydraulic head over distance of travel (h/l) and 'A' is the cross sectional area through which flow occurs.

excess of respective screening criteria in harbour waters. However, neither of these contaminants has been observed in marine water quality above the surface water quality standard used in the assessment. The input assumptions and parameters used in the model are therefore considered to be conservative and robust for the purposes of developing the remedial solution for the site. A relevant example of this conservatism includes the use of an average hydraulic conductivity for the waste incorporating disturbed particle size distribution (PSD) correlations, which are significantly higher than those obtained from in-situ measurements (refer to Table 13.5). The groundwater level hydrographs for the permeable natural strata beneath the site (e.g. sand & gravel and limestone bedrock) confirms that these units are under confined pressure by the overlying alluvium at the East Tip. Therefore potential vertical downward migration of contaminants from the waste by advective transport will be limited.

In order to assess the environmental risk of a small proportion of waste (predominantly slag with refractory brick and metal) in the foreshore area, WYG (2013c) prepared a Foreshore Waste Assessment Addendum to the DQRA (refer to Appendix A). This assessment used leachate results from waste sampled in the foreshore and conservatively assessed the impacts to surface water quality in the receiving waters through tidal flux calculations and dilutions within marine water. This risk assessment concluded that tidal interaction and leaching within residual waste in the foreshore area does not cause surface water concentrations to exceed water quality standards (refer to Table 10 of WYG 2013c).

13.4 POTENTIAL IMPACTS

13.4.1 Impact Assessment Criteria

Following the NRA (2009) and IGI (to be published 2013) EIA assessment methodology, the sensitivity and importance of the environmental soil, geology, hydrogeology and by extension human health environment are classified in Table 13.19.

Table 13.19: Sensitivity and Importance of Relevant Soil, Geology and Hydrogeology Features

Environmental Attribute	Sensitivity and Importance	Comments
Human Health – Through Exposure to Contaminated Materials	Extremely High	Potential Impacts to Human Health identified and assessed through DQRA and Chapter 9 'Air Quality & Climate'.
Marine Water	Low	Although there are sensitive marine waters in the wider bay area, those in the vicinity of the site are not designated nor of significant sensitivity. The area is adjacent to WFD HMBW.
Groundwater in Locally Important Aquifer	Low	Although the limestone aquifer is Locally Important, the groundwater quality within the aquifer beneath the site is saline and therefore not of potable quality.

The criteria for rating the significance of potential impacts will be as outlined in the Methodology section (Table 13.2) in relation to the magnitude of impacts and Table 13.3 in relation to the rating of significant impacts when combining the sensitivity of the attribute and the magnitude of impact.

13.4.2 Do-Nothing Scenario

Under a "Do-nothing" scenario, the site would remain in its current condition with contaminant concentrations in the groundwater and surrounding environment remaining generally stable with the

current baseline condition. Natural variation in groundwater chemistry would continue as is evidenced in the variation recorded in the DQRA (WYG 2013a) due to tidal effects.

The DQRA (WYG 2013a) has predicted that there is a theoretical minor measurable impact from contaminated groundwater flux from the site in the near shore marine waters (refer to Table 13.18 and WYG 2013a DQRA Table 39). However, as previously stated, this is considered to be conservative due to several factors previously discussed in the DQRA, and in particular the use of high permeability values from PSD correlations which may over-estimate the intrinsic and undisturbed permeability of the waste when calculating an average value for use in estimating groundwater flow and contaminant transport flux from the waste.

The baseline marine water analysis suggests that the site is having a negligible impact on dissolved concentrations of the water environment in its current condition. Therefore under a "Do-nothing" scenario, it is predicted that there would be no significant change to this and dissolved concentration impacts in the marine receiving water environment would remain imperceptible. Erosive effects on the East Tip would however continue causing localised impacts as additional solid waste is eroded from the shoreline.

Under a "Do-nothing" scenario, the site would remain in its current condition with contaminant concentrations in the waste material exposed at surface and shallow depth being exposed to potential end users of the site. As potential risks have been identified to human health in the DQRA (WYG 2013a) from direct contact exposure Pathways, the site would remain sterilised from potential future use for public amenity.

Therefore, the significance of leaving the site in its current state without remedial action can be classified according to the NRA (2009) criteria as outlined in Table 13.20.

Table 13.20: Magnitude of Impacts – Do Nothing

Potential Impact	Magnitude of Impact	Comments
Impacts to Human Health through direct contact with exposed contamination on the East Tip.	Negligible - based on restricted access and use of Personal Protective Equipment (PPE) by employees/ contractors that come into contact with the waste.	Access to the East Tip in its current state prevents direct contact with contamination by third parties. Health & Safety procedures minimises exposure to contamination by personnel who need to access the site (e.g. employees, contractors). However, this prevents the site being used for beneficial purposes.
Impacts to Human Health through windblown dust containing contamination from the East Tip.	Refer to EIS Section 9 (Air Quality and Climate)	The East Tip acts as a current source of air pollution in the area through windblown dust. The impacts on human receptors are presented in summary format in Section 9.3.4. While general dust and fine particulates are low, there are some elevated levels of pollutants over short timeframes (Arsenic, Barium, Calcium Lead, Nickel) identified in the area.
Impacts to receiving water quality in surrounding Marine Environment.	Moderate adverse based on the restriction to shellfish collection in the area.	Although low levels of a small number of dissolved phase contaminants have been detected in low tide seepages from the site in the foreshore area and the DQRA (WYG 2013a) has predicted a potential discharge of dissolved phase contaminants, measured water quality in the marine water surrounding the site has not measured contaminants above the wider background concentrations of marine water in Cork Harbour. However, the site is currently a source of contaminated sediment material as a result of

Potential Impact	Magnitude of Impact	Comments
		erosion and a potential source of dissolved contamination due to inundation. The area currently has a shellfish collection ban in force.
Impacts to water quality in the Limestone Aquifer.	Negligible	No significant impacts to water quality in the limestone aquifer have been detected below the site due to the lack of constant vertical head gradients to drive contamination through the underlying alluvium and the natural attenuating capacity of the alluvium (silt) in absorbing dissolved phase metal contaminants.

The significance of the potential impacts is therefore presented in Table 13.21 following NRA (2009).

Table 13.21: Significance of Impacts – Do Nothing

Environmental Attribute	Sensitivity & Importance	Magnitude of Impact	Significance of Impact	Comments
Human Health – through direct contact exposure to contaminated materials.	Extremely High	Negligible	Imperceptible	However, the site will remain in a sterilised condition and will not be of beneficial use to the community.
Human Health through windblown dust containing contamination from the East Tip.	Extremely High	Refer to EIS Section 9 (Air Quality and Climate)	Refer to EIS Section 9 (Air Quality and Climate)	Current site acts as an air pollution source which does pose a low risk.
Marine Water.	Low	Moderate Adverse	Slight	Current site is a source of contaminated sediment material as a result of erosion and a potential source of dissolved contamination due to inundation. Although the area currently has a shellfish collection ban in force, dissolved phase sampling of marine water does not indicate impacts to water quality above the screening / assessment criteria and sediment transport modelling suggests limited transport from the island.
Groundwater in Locally Important Aquifer.	Low	Negligible	Imperceptible	Groundwater quality is saline and not potable.

13.4.3 Preferred Solution - Construction Stage

Section 5 ('Project Description') and Section 6 ('Project Construction') of the EIS outlines the proposed remedial solution and the construction techniques that will be employed to achieve the remediation.

The relevant aspects of the construction stage in relation to the soil geology and hydrogeology environment are:-

- Excavation and scrape back of waste material along the foreshore to install the Perimeter Engineered Structure with a maximum permeability of $1x10^{-5}$ m/s. During the construction work, temporary disturbance of the sediments may cause an increase in suspended sediments in marine waters local to the work zone.

- Excavation of a 1m wide trench along the western boundary of the site with the former sea wall bordering the Navy site and creation of a Perimeter Engineered Structure with a maximum permeability of $1x10^{-5}$ m/s.

- Re-profiling of the waste material to create necessary topographic landform for the proposed capping solution, which has the potential to generate dust and encounter hot spots of higher contamination. If waste is emplaced below the mean water table in the central portion of the site, it has the potential to mobilise contamination. The use of slag in preference to other waste types which has lower leachable contaminant concentrations will minimise mobilisation of contaminants and the construction sequencing will include installation of the PES prior to this infill taking place which will prevent off-site impacts.

- Infiltration of surface water into the waste body following rainfall, collection of marine water seepage and infiltration to the waste body and during dry weather water spraying to supress dust generation on the site.

- Reuse of slag material to use as engineered fill and aggregate in the drainage system.

- Use of plant and machinery on site that requires diesel fuel with potential for accidental releases to ground from spillages caused by catastrophic failures of storage containment or refuelling activities.

In addition to aspects that could impact hydrogeology and thereby receiving waters, at this stage of the project, there will be the potential for dust blow of fine material with contamination and microscopic traces of asbestos that has been previously detected in the waste. Chapter 9 'Air Quality & Climate' of the EIS considers and assesses these risks further and provides mitigation measures to reduce potential impacts to human health.

Table 13.22 outlines the relevant aspect of the project, potential impacts and mitigation where considered necessary to prevent significant impacts. It should be noted that as the Construction Stage is temporary, potential impacts will be also be of temporary nature during this stage of the project.

Table 13.22: Relevant Aspects of the Project, Potential Impacts and Proposed Mitigation during Construction

Aspect of the Project	Potential Impact	Proposed Mitigation
Excavation and scrape back of waste material along the foreshore to install the perimeter engineered structure.	Interception of natural low tide seepage from the waste and top of the alluvial silt and possible disturbance of sediment and release to the marine environment.	Collection of intercepted seepages and recirculation and disposal into the waste body. Monitoring of marine water quality during construction stage. Sediment dispersion modelling has been conducted to further assess potential marine impacts (refer to Chapter 14 'Ecology') and a preferred option (Scenario A) has been selected in order to minimise potential sediment disturbance and mobilisation in marine waters.

Aspect of the Project	Potential Impact	Proposed Mitigation
Re-profiling of the waste material to create necessary topographic landform for the proposed solution and excavation of trench along the western boundary with the Naval site to facilitate construction of the PES at this location.	Potential to generate dust and mobilise dissolved phase contaminants if waste is emplaced below the tidal varying groundwater table in the waste.	Dust mitigation included within the Air Quality and Climate Chapter (Chapter 9 of EIS). Potential for mobilisation of dissolved phase contaminants will be mitigated through the Construction Environmental Management Plan and use of waste with less leachable contamination (e.g. slag waste only) where infilling of waste below the water table on site is required. The Perimeter Engineered Structure (PES) in the vicinity of these areas will also be constructed prior to the infill of waste which will prevent off-site impacts.
Infiltration of surface water into the waste body during construction and collection of marine water seepage and recirculation/infiltration into the waste body.	Potential to generate temporary higher groundwater levels in the infiltration areas which could temporarily change groundwater flow directions and contaminant transport on the site.	The relatively high permeability of the waste material will allow recirculated groundwater to dissipate without substantial head build-up. It is also proposed to use several infiltration areas across the site so as to spread the recirculation and provide infiltration areas in the same zones to where the groundwater seepage has been collected. The natural attenuating capacity of the silt alluvium will naturally mitigate any significant vertical downward increase in contaminant transport. No other mitigation required as there will be no significant change in the volume of groundwater flow and contaminant transport than occurring under the baseline condition.
Use of plant and machinery on site that requires diesel fuel with potential for accidental releases to ground from spillages caused by catastrophic failures of storage containment or refuelling activities.	Potential impacts to groundwater and surface water quality from any such significant spillage if uncontained.	The Construction Environmental Management Plan for the construction stage which will include specific measures to prevent accidents and mitigate impacts through the use of mobile bunding, spill containment systems, knowledge and awareness and routine auditing and inspection of the construction site.

13.4.4 Preferred Solution - End-Use, Aftercare and Maintenance

Potential impacts after the construction of the remedial solution will be positive for the environment:-

- Human health risks – the site will become available for public amenity use as the pathways between contaminated material in the waste (source) and human health (receptors) by direct contact, ingestion, and inhalation (pathways) will have been removed through provision of a barrier between the waste and site end users.

- Groundwater – groundwater quality within the waste material is expected to remain similar to current baseline conditions although there will be a significant reduction in rainfall infiltration due to the emplacement of the low permeability cap which will reduce rainfall infiltration and potential leachate generation, particularly in the centre of the waste mass where tidal effects are smallest. In addition, the installation of the perimeter engineered structure will significantly reduce the volume of seawater inflow to the waste during high tide as the permeability will have been reduced to a maximum value of $1x10^{-5}$ m/s. This structure will also reduce the volume of groundwater discharge from the site during low tide, thereby significantly reducing the flux of dissolved phase contamination emanating from the site. Additional geochemical modelling (WYG 2013b) concluded that overall groundwater chemistry is expected to become more reducing and that some of the contaminants of concern (notably chromium VI) were predicted to decrease over time following the remediation as chromium III is more stable under reducing conditions than chromium VI. Chromium oxide precipitates were also predicted, which will further reduce total chromium concentrations in groundwater

- Receiving Marine water – the reduced flux of contamination from the site following the installation of the Perimeter Engineered Structure and emplacement of the low permeability cap will have a positive (beneficial) impact on the quality of the receiving waters in the adjacent Cork Harbour as a result. The residual waste in the foreshore area is not predicted to have a detrimental impact on water quality in Cork Harbour (WYG 2013c).

The cumulative impact of dissolved phase discharge from the remediated East Tip (i.e. with CAP & PES) and from the waste remaining in the foreshore were calculated in the Foreshore Addendum DQRA (WYG 2013c). This conservative assessment predicted concentrations in surface water within 10m of the East Tip will be below the Water Quality Standards (WQS) used in the risk assessments.

A revised Conceptual Site Model (CSM) based on that prepared for the DQRA and illustrating the changes to the Source Pathway Receptor Linkages following the remediation of the East Tip is included in Figure 13.10. Source, pathway and receptor definition and numbering (e.g. R1 - Future Park Users) has been replicated from the DQRA for consistency. Relevant aspects of the project, potential impacts to the environment, changes to the CSM (compared with baseline or "Do Nothing") and the proposed mitigation are included in Table 13.23.

Table 13.23: Summary Potential Impacts and Revised Conceptual Site Model (CSM) During the End-Use Stage

Aspect of the Project	Potential Impact	Changes to CSM	Proposed Mitigation
Emplacement of surface cap across the site.	Human health risks - will have been significantly reduced for future end users of the site for public amenity as the pathways between contaminated material in the waste and human health by direct contact, ingestion, and inhalation will have been removed. In addition, further risk assessment has been completed that concludes there is no significant risk to human health from leaving residual waste material outside the line of the perimeter engineered structure.	Receptor R1 (future Park Users) and R3 (Navy football pitch users) are able to use the site safely as Pathways P1 (dermal contact, ingestion & inhalation) and P2 (inhalation of dusts and vapours) have been broken. Receptors R2 (construction workers) will require appropriate PPE based on health and safety planning for the construction activity associated with the placement of the cap. After which time PPE shall be required for construction workers which is appropriate to the nature of the maintenance works or construction works being undertaken.	Passive venting of ground gas via the PES.
Emplacement of surface cap across the site and perimeter engineered structure.	Groundwater – groundwater quality within the waste material will probably remain similar to current baseline conditions although there will be a significant reduction in rainfall infiltration due to the emplacement of the low permeability cap which will reduce	Pathway P3 (solid phase leaching to groundwater) will be significantly reduced in the unsaturated zone due to the emplacement of the low permeability cap that will reduce rainfall infiltration through the waste. Pathway P4 (contaminant migration in groundwater) will continue albeit at	Groundwater quality monitoring to ensure effectiveness of the solution.

Aspect of the Project	Potential Impact	Changes to CSM	Proposed Mitigation
	rainfall infiltration and potential leachate generation, particularly in the centre of the waste mass where tidal effects are smallest. In addition, the installation of the perimeter engineered structure will significantly reduce the volume of seawater inflow to the waste during high tide as this structure will have a permeability 100 times lower than the average permeability of the waste (used in the DQRA Tier 4 assessment). This structure will also reduce the volume of groundwater discharge from the site during low tide, thereby significantly reducing the flux of dissolved phase contamination emanating from the site.	significantly reduced flux due to the reduction in rainfall infiltration and reduced flow through the perimeter engineered structure with lower permeability than the average permeability of the waste (by up to a factor of 100). Pathway P5 (migration of ground gas) will continue and will be passively vented so as to avoid potential impacts to the adjacent naval base (R4).	
Emplacement of the perimeter engineered structure (PES).	Receiving Marine water – the reduced flux of contamination from the site following the installation of the PES will have a positive (beneficial) impact on the quality of the receiving waters in the adjacent Cork Harbour as a result.	The significant reduction in P4 (contaminant transport in groundwater) exiting the site through the perimeter engineered structure will significantly reduce the contaminant loading to receptors R5 (Cork Harbour) and R6 (Ecology – flora & fauna).	Surface water monitoring to ensure effectiveness of solution. Perimeter inspection to ensure effectiveness of solution.
Residual waste in the foreshore area outside the PES	Potential tidal interaction and flux of dissolved contaminants from the waste to receiving waters in Cork Harbour.	Waste retained in the foreshore area will be capped by rock armour in part to minimise future erosion. Potential dissolved phase migration P6 within tidal flux has been risk assessed.(WYG 2013c)	Surface water monitoring to ensure effectiveness of solution.

SOURCES

S1 Arsenic & lead contamination (waste). Hotspots of contamination.

S2 Asbestos (waste).

S3 Ground Gas (methane) in alluvium.

S4 Leachable chromium, chromium VI, copper, lead, cadmium, zinc & PAHs.

S5 Groundwater contaminants in waste: Arsenic, chromium VI, chromium, copper, zinc, lead, manganese, nickel, mercury, benzo(a)pyrene, benzo(k)fluoranthene, fluoranthene.

PATHWAYS

P1 Dermal contact ingestion & inhalation - eliminated by Remediation Solution.

P2 Inhalation of dusts & vapours - eliminated by Remediation Solution.

P3 Solid phase leaching to groundwater - significantly reduced by Remediation Solution.

P4 Contaminant migration in groundwater - significantly reduced by Remediation Solution.

P5 Migration of ground gas - passively vented via PES.

P6 Tidal Interaction and leaching from residual waste in foreshore

RECEPTORS

R1 Future Park users.

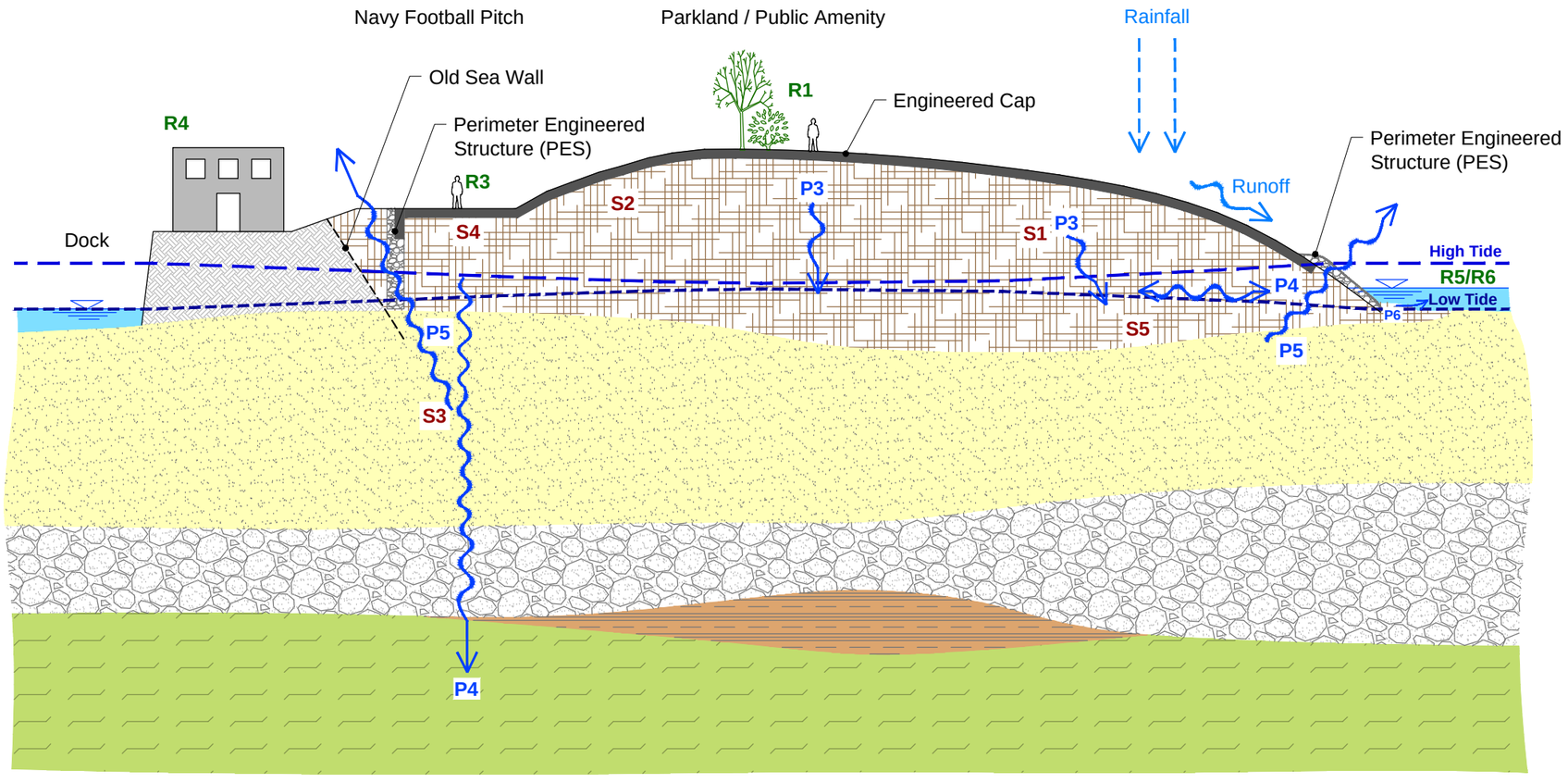
R2 Commercial site users/construction workers.

R3 Naval football pitch users.

R4 Adjacent Navy Base.

R5 Cork Harbour.

R6 Ecology - Flora & Fauna.



LEGEND

- Engineered Cap
- General Fill
- Waste
- Marine Alluvium
- Sands and Gravels
- Clay
- Limestone
- High Tide
- Low Tide

Title
CONCEPTUAL SITE MODEL
(Based on Enduse for the Site)

Figure 13.10

File Ref : MCE0734 Figure 13.10
Date : March 2013 Rev: F02

East Tip Remediation Project

EAST TIP REMEDIATION PROJECT

RPS

13.5 MITIGATION MEASURES – PREFERRED SOLUTION

13.5.1 Construction Stage

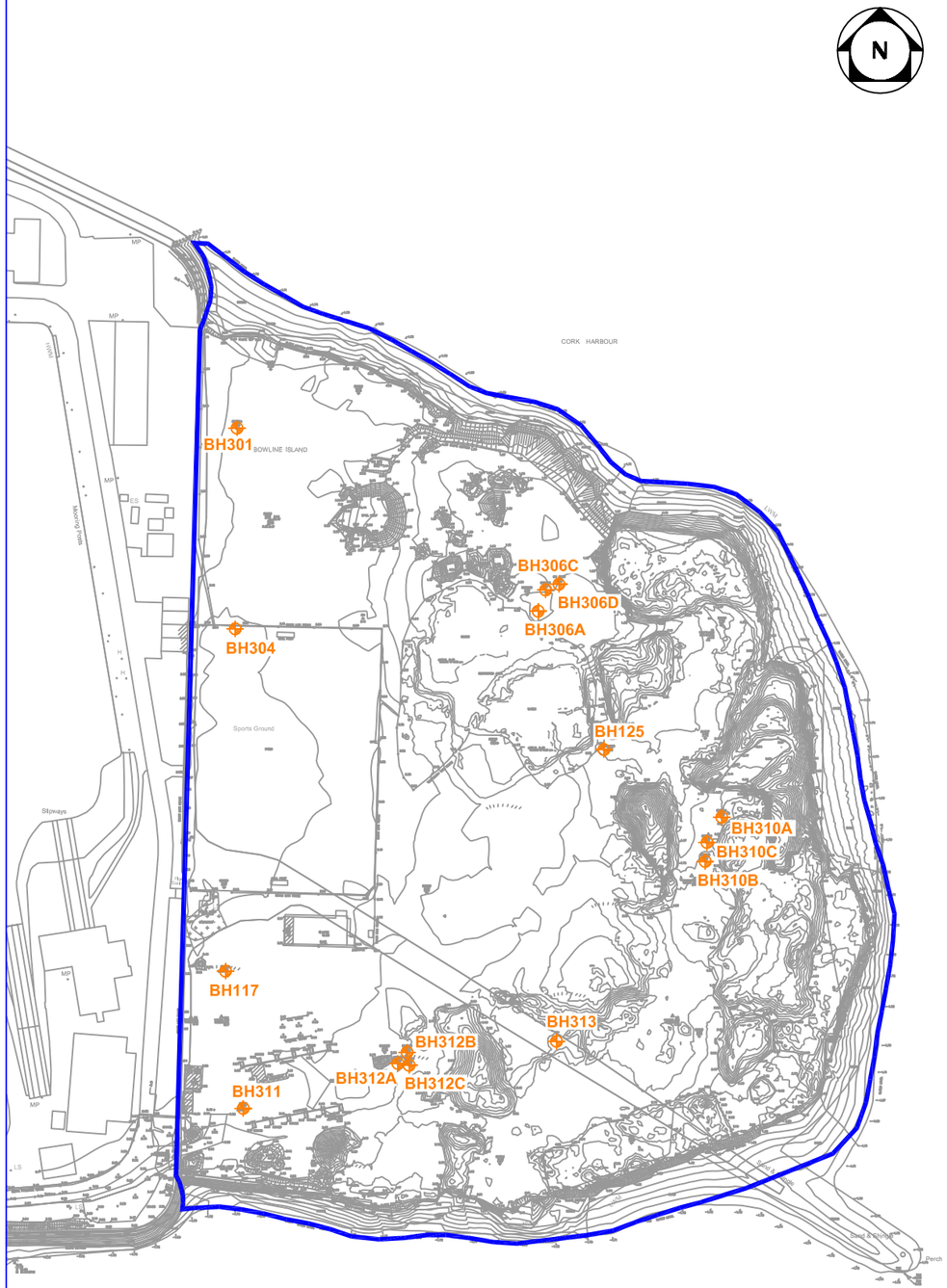
Several mitigation measures are recommended in the Air Quality Section (Chapter 9' Air Quality and Climate') in relation to prevention of dust blow which will reduce the potential negative impacts of dust blow during the construction stage.

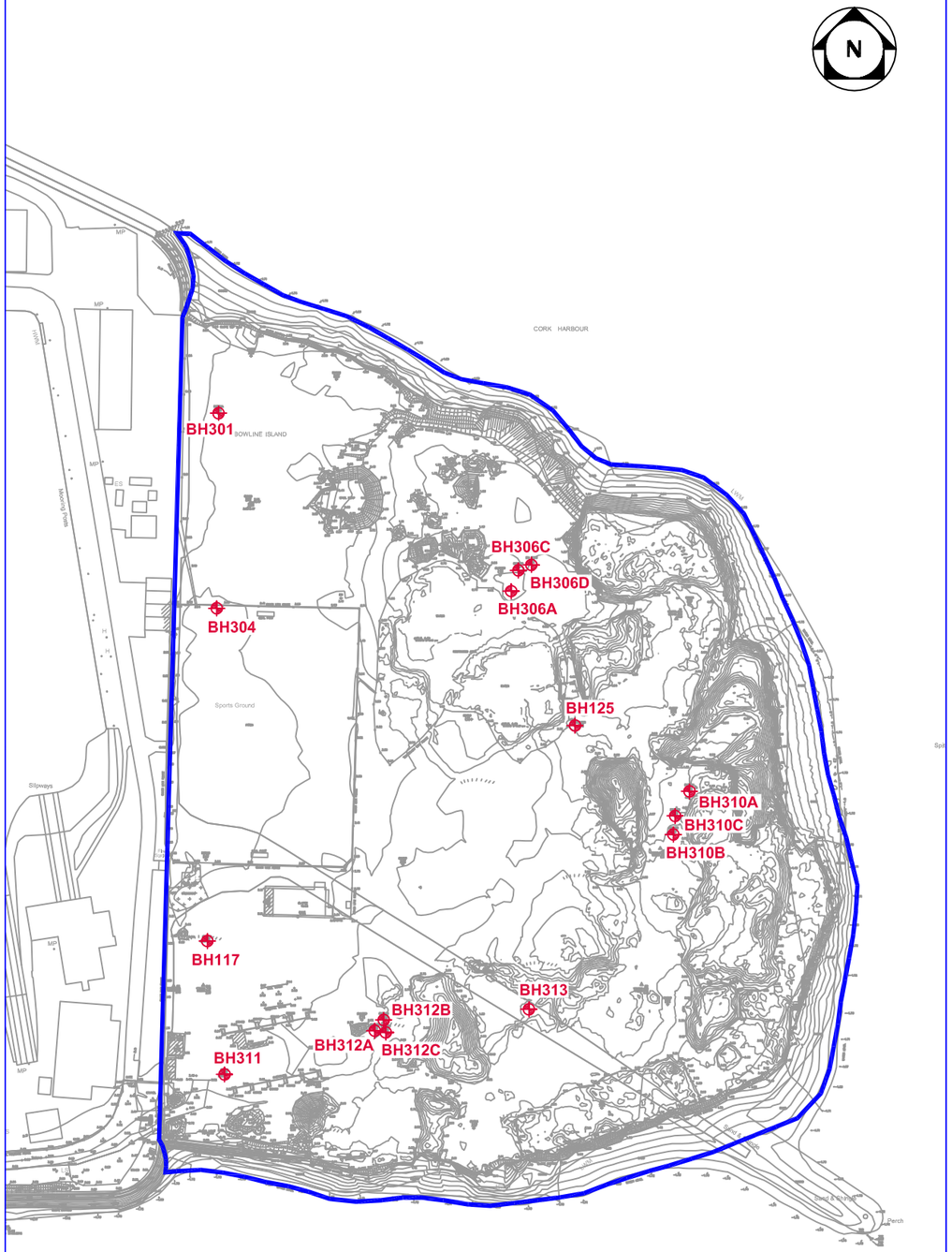
Water quality monitoring is recommended during the construction stage primarily in the receiving water to ensure that potential negative impacts are not occurring in the marine water as set out in Table 13.24. As seepage from the excavation and construction of the perimeter structure will be captured and recirculated and infiltrated back into the waste body, water quality monitoring of the seepages is considered to be of limited value and therefore not recommended. As the construction stage is anticipated to last 18 months (Chapter 5, 'Project Description'), it is recommended that groundwater monitoring is conducted at key representative locations in the waste and natural geological strata during two periods of the construction stage as outlined in Table 13.24. Due to the extensive investigation and monitoring that has been conducted on the site, it is possible to focus the monitoring parameters on only those that have been detected in groundwater, surface water or leachate analysis, rather than a very broad suite based on average landfills or other waste treatment facilities.

Table 13.24: Construction Stage Recommended Monitoring

Water Body	Frequency /Timing	Recommended Locations	Parameters	Rationale
Marine	Water - Once every two months for the duration of the construction stage Sediments - Once every 6 months.	As per baseline locations Figure 12 DQRA (WYG 2013a) (Shown on Figure 13.12 below)	Metals (As, Cd, Cr, CrVI, Cu, Zn, Pb, Mn, Ni, Hg, Al), Speciated PAH's, petroleum hydrocarbons.	High frequency (Bi-monthly) due to sensitivity of water body and direct proximity to the construction works. Sedimentary sampling to be undertaken once every 6 months. Visual inspection of all sediment screens during construction works.
Groundwater - Waste	Twice/ Months 6 & 12.	BH301, BH306A, BH310A, BH312A, BH311	Metals (As, Cd, Cr, CrVI, Cu, Zn, Pb, Mn, Ni, Hg, Al), Speciated PAH's, petroleum hydrocarbons, pH, Eh, DO, EC.	Low frequency to monitor impacts of recirculated infiltration and general construction activity on groundwater quality.
Groundwater - Silt/Alluvium	Twice/ Months 6 & 12.	BH306D,BH310B, BH312B, BH304	Metals (As, Cd, Cr, CrVI, Cu, Zn, Pb, Mn, Ni, Hg, Al), Speciated PAH's, petroleum hydrocarbons, pH, Eh, DO, EC.	Low frequency to monitor impacts of recirculated infiltration and general construction activity on groundwater quality.
Groundwater - Gravel & Limestone	Twice/ Months 6 & 12.	BH125R,BH117R, BH313, BH306C, BH312C, BH310C	Metals (As, Cd, Cr, CrVI, Cu, Zn, Pb, Mn, Ni, Hg, Al), Speciated PAH's, petroleum hydrocarbons, pH, Eh, DO, EC.	Low frequency to monitor impacts of recirculated infiltration and general construction activity on groundwater quality.

Boreholes have been selected to provide representative conditions and around the periphery of the waste (Refer to Figure 13.11). In addition, Health & Safety planning and implementation will reduce risks to on site construction workers during the construction stage that will be coming into contact with contaminated materials on the East Tip. Surface water sample locations have been selected from the existing baseline locations as identified in Figure 12 of the DQRA (WYG 2013a) and depicted on Figure 13.12 below.





LEGEND

- Site Boundary
- Monitoring Locations - Construction Stage
- Monitoring Locations - End Use Stage

Title
PROPOSED GROUNDWATER MONITORING LOCATIONS

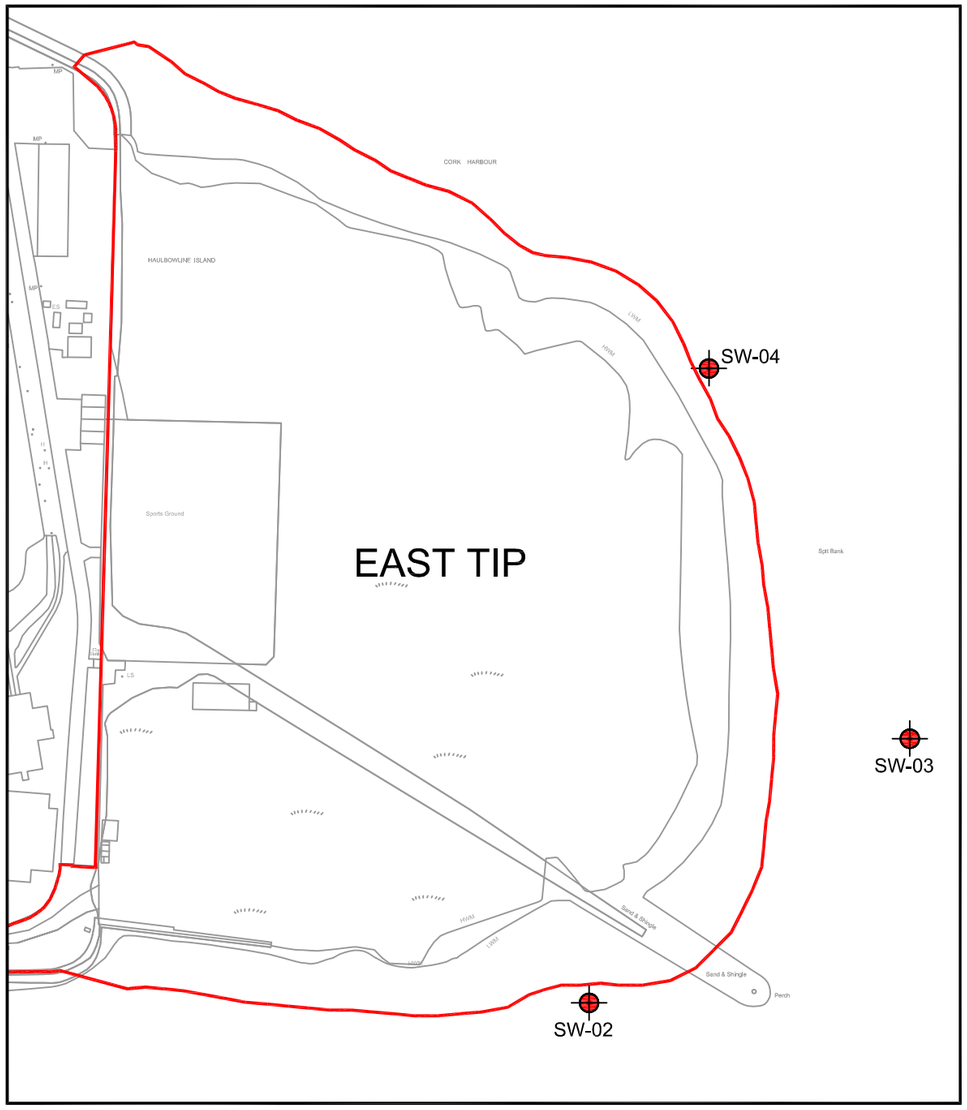
Figure 13.11

File Ref : MCE0734 Figure 13.11
Date : April 2013 Rev: F01

East Tip Remediation Project

EAST TIP REMEDIATION PROJECT

RPS



LEGEND:

- Proposed Marine Surface Water Monitoring Point
- Site Works Boundary

Title
PROPOSED MARINE SURFACE WATER MONITORING POINTS

Figure 13.12

File Ref : MCE0734 Figure 13.12
Date : April 2013 Rev : F01

East Tip Remediation Project

EAST TIP REMEDIATION PROJECT

RPS

13.5.2 End-Use, Aftercare & Maintenance

Water quality monitoring is recommended during the end-use, aftercare and maintenance stage primarily in the receiving water to ensure that potential negative impacts are not occurring in the marine waters (refer to Chapter 14, 'Ecology'). The remedial solution is intended to be a passive system that will not require proactive management of leachate or groundwater within the waste body, therefore a short phase of post construction monitoring is recommended to ensure that the remedial solution has achieved its objectives (refer to Table 13.25). Due to the extensive investigation and monitoring that has been conducted on the site, it is possible to focus the monitoring parameters on only those that have been detected in groundwater, surface water or leachate analysis, rather than a very broad suite based on average landfills or other waste treatment facilities.

Table 13.25: Recommended Enduse and Aftercare Monitoring

Water Body	Frequency/Timing	Recommended Locations	Parameters	Rationale
Marine	Quarterly – for 1 year followed by annually for 2 years.	As per baseline locations Figure 12 of DQRA (WYG 2013a)	Metals (As, Cd, Cr, CrVI, Cu, Zn, Pb, Mn, Ni, Hg, Al), Speciated PAH's	More frequent initial monitoring with review following first year. If all monitoring results are favourable, the frequency should be reduced to annual for a further two years with review at the completion to assess whether further monitoring is required.
Groundwater - Waste	Bi-Annual (twice per year) for 1 year followed by Annually for a further 2 years.	BH301, BH306A, BH310A, BH312A, BH311	Metals (As, Cd, Cr, CrVI, Cu, Zn, Pb, Mn, Ni, Hg, Al), Speciated PAH's, pH, Eh, DO, EC	More frequent initial monitoring with review following first year. If all monitoring results are favourable, the frequency should be reduced to annual for a further two years with review at the completion to assess whether further monitoring is required.
Groundwater - Silt/Alluvium	Bi-Annual (twice per year) for 1 year followed by Annually for a further 2 years.	BH306D, BH310B, BH312B, BH304	Metals (As, Cd, Cr, CrVI, Cu, Zn, Pb, Mn, Ni, Hg, Al), Speciated PAH's, pH, Eh, DO, EC	More frequent initial monitoring with review following first year. If all monitoring results are favourable, the frequency should be reduced to annual for a further two years with review at the completion to assess whether further monitoring is required.
Groundwater - Gravel & Limestone	Bi-Annual (twice per year) for 1 year followed by Annually for a further 2 years.	BH125R, BH117R, BH313, BH306C, BH312C, BH310C	Metals (As, Cd, Cr, CrVI, Cu, Zn, Pb, Mn, Ni, Hg, Al), Speciated PAH's, pH, Eh, DO, EC	More frequent initial monitoring with review following first year. If all monitoring results are favourable, the frequency should be reduced to annual for a further two years with review at the completion to assess whether further monitoring is required.

Boreholes have been selected to provide representative conditions and around the periphery of the waste (refer to Figure 13.17).

13.6 RESIDUAL IMPACT – PREFERRED SOLUTION

13.6.1 Construction Stage

Following implementation of the recommended mitigation measures, the magnitude and significance of the residual impacts during the construction stage are presented in Tables 13.26 and 13.27, according to the NRA (2009) criteria.

Table 13.26: Magnitude of Impacts – Construction Stage

Potential Impact	Magnitude of Impact	Comments
Impacts to Human Health through direct contact with exposed contamination on the East Tip.	Negligible	All construction activities will be conducted according to strict Health & Safety procedures in order to minimise risks to human health.
Impacts to Human Health through windblown dust containing contamination from the East Tip.	Slight - Refer to EIS Section 9 (Air Quality and Climate)	Potential for dust dispersion will increase through the construction stages as the material is processed and handled across the site through regarding, processing, etc. without mitigation measures proposed in Chapter 9' Air Quality and Climate' this impact would be considered to be Adverse Significant but with the proposed mitigation measures in place the impact is considered to be Slight.
Impacts to receiving water quality in surrounding Marine Environment from dissolved phase contaminants present in seepages.	Negligible	Seepage along the foreshore will be collected and recirculated for infiltration into the waste body at the working face of the construction of the perimeter engineered structure.
Mobilisation of dissolved phase contaminants in shallow groundwater following earthworks to infill areas currently below mean tide level.	Negligible	Slag waste will be only be used for such infilling on the site, which has lower leachable contamination than other waste types on the East Tip. Any increases in dissolved phase contamination in groundwater will be similar to current conditions and unlikely to result in any impact due to the construction of the PES and the emplacement of the low permeability Cap above the waste.
Mobilisation of suspended sediment in the marine environment due to local erosion at the working face of the PES.	Minor / Slight – Refer to Chapter 14 Ecology	All works will be contained by sediment abatement technologies to minimise any potential spread of contaminants. Any visible turbidity beyond these controls will result in a Stoppage procedure (refer to Chapter 14 'Ecology'). Completed PES will be erosion resistant.
Impacts to water quality in the Limestone Aquifer.	Negligible	Collected seepages and infiltration to the waste body is unlikely to significantly impact vertical head gradients on the site due to the permeability of the waste and degree of tidal influence on water levels. If temporary vertical gradients develop in the infiltration area, the Alluvium's lower permeability and attenuating capacity will limit potential migration of contamination to the deeper Limestone Aquifer. Groundwater quality in the Limestone Aquifer is saline and therefore not potable.

The significance of the potential impacts is therefore presented in Table 13.27 following NRA (2009).

Table 13.27: Significance of Impacts – Construction Stage

Environmental Attribute	Sensitivity & Importance	Magnitude of Impact	Significance of Impact	Comments
Human Health – Through Direct Contact Exposure to Contaminated Materials	Extremely High	Negligible	Imperceptible	Health & Safety mitigation will be in place for all construction workers and visitors to the site.
Impacts to Human Health Through Windblown Dust Containing Contamination from the East Tip	Extremely High	Refer to EIS Section 9 (Air Quality and Climate)	Refer to EIS Section 9 (Air Quality and Climate)	Refer to Chapter 9 which quantifies the significance of impacts and provides detailed mitigation.
Marine Water	Low	Negligible	Slight Imperceptible	Sediment Management Mitigation and Hydrodynamic Modelling.
Marine Sediments	Low	Minor / Slight	Imperceptible	Sediment Management mitigation. Surrounding sediments are of similar composition.
Groundwater in Locally Important Aquifer	Low	Negligible	Imperceptible	Groundwater quality is saline and not potable.

13.6.2 End-Use, Aftercare & Maintenance

Following implementation of the recommended mitigation measures, the magnitude and significance of the residual impacts following construction of the remedial solution are presented in Tables 13.28 and 13.29, according to the NRA (2009) criteria.

Table 13.28: Magnitude of Impacts – Enduse, Aftercare & Maintenance

Potential Impact	Magnitude of Impact	Comments
Impacts to Human Health through direct contact with exposed contamination on the East Tip.	Major Beneficial	The capping solution for the waste will break the pathway between contamination and human health (direct contact exposures) enabling the site to be of beneficial use for the community. Residual waste in the foreshore area will not come into direct contact due to its location in majority below rock armour, depth and location outside the proposed public amenity areas.
Impacts to Human Health through windblown dust containing contamination from the East Tip.	Major Beneficial	With the proposed remediation solution in place the pathway for the existing pollutant dispersion will be severed leading to a net permanent positive impact. Residual waste and potential dust blow generation from the foreshore area will be prevented by its location in majority below rock armour and wetting by tidal inundation.
Impacts to receiving water quality in surrounding Marine Environment.	Moderate Beneficial	Baseline water quality impacts to the surrounding water body are imperceptible, however the installation of the perimeter

Potential Impact	Magnitude of Impact	Comments
		engineered structure will significantly reduce the flux of dissolved contaminants into the surrounding marine waters as predicted in the DQRA (WYG 2013a) and further assessed through the Foreshore Addendum DQRA (WYG 2013c). Construction of the engineered structure will prevent erosion of the waste material and its release into the surrounding environment.
Impacts to water quality in the Limestone Aquifer.	Negligible to Minor Beneficial	Although no significant baseline impacts to water quality in the limestone aquifer have been detected, the cap will limit the potential rainfall infiltration into the waste body and thereby further reduce the potential for dissolved phase vertical migration of contamination.

The significance of the potential impacts is therefore presented in Table 13.29 following NRA (2009).

Table 13.29: Significance of Impacts – Enduse, Aftercare & Maintenance

Environmental Attribute	Sensitivity & Importance	Magnitude of Impact	Significance of Impact	Comments
Human Health – Through Direct Contact Exposure to Contaminated Materials.	Extremely High	Major Beneficial	Very Positive	Site will have a beneficial end use for the community.
Impacts to Human Health Through Windblown Dust Containing Contamination from the East Tip.	Extremely High	Major Beneficial	Very Positive	Pathway for contamination to become airborne will be severed.
Marine Water.	Low	Moderate Beneficial	Positive	Pathway for contaminated sediments on the East Tip to become eroded and redistributed will be severed by the emplacement of the PES. It is expected that residual waste in the foreshore area will be covered in majority by rock armour limiting potential remobilisation of this material.
Groundwater in Locally Important Aquifer.	Low	Negligible to Minor Beneficial	Imperceptible	Groundwater quality is saline and not potable

14 ECOLOGY

14.1 INTRODUCTION

This chapter of the Environmental Impact Statement (EIS) examines the potential for impacts on designated nature conservation sites (Natura 2000 sites and Natural Heritage Areas); flora, fauna and habitats, resulting from construction and end-use, aftercare and maintenanceof the proposed remediation and proposed end usage of the East Tip site on Haulbowline Island in Cork Harbour. An Appropriate Assessment Screening Report and Article 12 Screening Assessment (RPS, 2012) and a Natura Impact Statement (NIS) (RPS, 2013) have also been prepared as separate documents and are included as Volume 4 of this EIS document.

The principal objectives of this study are to:-

- Complete a desk study and field surveys to obtain relevant ecological data for the 'zone of influence' of the proposed works. The zone of influence is a conceptual tool rather than a fixed geographical unit and will vary in its geographical extent according to the nature of the ecological receptor and of the impact that is under consideration;
- Identify and describe sites and features of known or potential ecological interest;
- Identify any potential impacts on those features that may result from construction or end use, aftercare and maintenance of the proposed remediation works;
- Assess the significance of any identified impacts;
- Where possible, to propose mitigation measures to avoid identified significant impacts, or to reduce them to acceptable, non-significant, levels; and
- To identify any residual impacts that may remain following the implementation of mitigation measures.

The chapter initially sets out the methodology that has been used for the assessment (Section 14.2), then describes the existing environment (Section 14.3), sets out the potential impacts of the proposed works (Section 14.4), describes the avoidance and mitigation measures to be incorporated in the proposed design (Section 14.5) and details any residual impacts (Section 14.6).

Scientific names of flora and fauna species are given at the first mention of the species in the text.

14.2 METHODOLOGY

The assessment methodology and structure follows the statutory EPA Guidelines:

- EPA (2002), Guidelines on the information to be contained in Environmental Impact Statements. Environmental Protection Agency, and
- EPA (2003), Advice Notes on current practice in the preparation of Environmental Impact Statements. Environmental Protection Agency.

The methodology also takes account of guidelines produced by the National Roads Authority: *Guidelines for Assessment of Ecological Impacts of National Road Schemes Rev 2* (NRA, 2009) (referred to hereafter as the NRA Guidelines). Whilst the NRA Guidelines were written for the assessment of ecological impacts of road schemes, they are suitable for assessment of most proposed developments, and the criteria for quantifying the value of ecological features and the magnitude of impacts are widely used for non-road projects in Ireland. It is considered that the criteria in the NRA Guidelines are entirely suitable for use in this assessment.

Where relevant, the assessment is prepared also in accordance with the following guidelines referred to in Table 1.1 of Chapter 1 'Introduction' and outlined below:-

- DOEHLG (2010) Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities. Department of the Environment, Heritage and Local Government
- EC (2007a) Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, and opinion of the commission. European Commission,
- European Communities (Environmental Impact Assessment) Regulations, 1989 to 2001,
- Planning and Development Act, 2000 (as amended),
- European Communities (Birds and Natural Habitats) Regulations 2011,
- Wildlife Act 1976 and Wildlife (Amendment) Act 2000,
- Flora (Protection) Order 1999,
- EC (2007b) Interpretation Manual of European Union Habitats. Version EUR 27. European Commission, and

Consultation with public, statutory and other bodies/ individuals also informed the assessment

14.2.1 Desk Study

The sources of published material that were consulted as part of the desk study for the purposes of the EIS are as follows:-

- National Parks and Wildlife Service (NPWS) natural heritage database for designated areas of ecological interest and sites of nature conservation importance within and adjacent to the study area,
- NPWS Rare and Protected Species Database,
- Literature review to identify and collate relevant published information on both ecological aspects of the study area and relevant ecological studies conducted in other areas, and
- Review of Ordnance Survey maps and of aerial ortho-images.

The Site Synopses for the designated conservation areas within the study area produced by the NPWS contain a description of the scientific interest and conservation importance of each designated site. The Natura 2000 Data Forms also contain relevant background information on each of the designated sites, while the Conservation Objectives summarises the aims and objectives of the designation awarded to a particular site. All of these documents were referenced for each of the

designated conservation areas. Site Synopses of proposed Natural Heritage Areas (see Section 14.3.1.2) are not currently available on the NPWS website however these are held for reference by RPS and are referred to where relevant.

A full desktop review was conducted of the higher plant species recorded within the Ordinance Survey (OS) National Grid Square W76 (10km x 10km) within which Haulbowline East Tip is located; and of 10km Square W86, the boundary of which is located 200m to the east of the site. The principal source of information regarding the distribution of flora in Ireland is the *New Atlas of the British & Irish Flora* (Preston *et al.*, 2002). The records for the relevant Grid Squares were consulted and a search was carried out to investigate if any rare or protected plant species have been recorded in the square. Species considered 'rare or protected' in the desktop review are those which are listed in Annexes II or IV of the EU Habitats Directive, those listed on the Flora Protection Order (FPO) of 1999, the Wildlife Act 1976, the Irish Red Data Book (IRDB) or the NPWS Rare Plants Database. Results are presented in Section 14.3.4.1.

A review of aerial photographs of the study area was carried out prior to field visits (see Section 14.2.2 below). This exercise helped to delineate the extents and boundaries of different habitat types and to identify areas of low ecological value, such as; urban areas, waste area or under hard standing and roads. Conversely, the review of aerial photographs was also used to identify areas of potentially high ecological value such as foreshore, vegetation and grassland, so that field survey work could be targeted to focus upon these areas.

14.2.2 Field Surveys

Following a full desktop study of available biological information pertaining to the study area, RPS ecologists and other specialists carried out ecological field surveys during 2012 and 2013. These studies included:-

- Terrestrial Habitat Mapping and Flora Survey,
- Intertidal and Marine Habitat Mapping Survey
- Mammal and Birds survey,
- Amphibians and Reptiles,
- Terrestrial Invertebrates, and
- Marine Invertebrates.

The habitat mapping, botanical and mammal surveys were carried out in August 2012. The bird surveys were conducted during the period August to December 2012. The bat survey was conducted in September 2012 and the intertidal and benthic survey was undertaken in September – October 2012.

The East Tip site lacks permanent freshwater features. The substrate is highly permeable and rainwater percolates through the material, hence surface water is absent. As a result no freshwater ecological features are present at the site and because the site is a self-contained hydrological unit in terms of fresh water, freshwater organisms and habitats are not subject to any adverse effects either within the site or outside its boundary.

Percolating rainwater can potentially impact on ecological features as a result of dissolution of chemicals and leaching. The magnitude and possible extent of the effects of these processes are examined in Chapter 13'Soil, Geology & Hydrogeology'and the possible effects of these dissolved and suspended contaminants on habitats, flora and fauna are discussed in Section 14.4.1.

14.2.2.1 Terrestrial Habitat Mapping and Flora Survey

The field survey comprised of an examination of all habitats within the East Tip site. The habitats were classified in accordance with the Heritage Councils '*A Guide to Habitats in Ireland'* (Fossitt, 2000), and mapped (see Figure 14.3). Any correspondence with habitat types listed in Annex I of the EU Habitats Directive (92/43/EEC) is also described.

Common, dominant and noteworthy plant species were recorded as part of the Phase 1 Habitat Survey. The potential for the habitats encountered to support rare or protected plant species was considered, particularly those species discussed in Section 14.3.4.1.

14.2.2.2 Intertidal and Marine Habitat Mapping Survey

A Phase I intertidal survey was conducted in accordance with the methods of Wyn et al 2002 and in accordance with the survey methods of the Marine Institute and NPWS for intertidal survey of intertidal sites.

A subtidal benthic survey was conducted by grab sampling in accordance with the procedures from the JNCC (2010) Marine Monitoring Handbook.

14.2.2.3 Mammals and Birds

Mammal signs were actively searched for throughout the site during field surveys in August, and also along the shoreline during bird surveys in November 2012. A bat survey was conducted during September 2012. The potential of the site's habitats to support bird, mammal or other fauna species was assessed during all field surveys.

14.2.2.4 Marine Mammals

Observations and anecdotal evidence was collected during field surveys in August, the intertidal surveys in September, the marine surveys in October, the bird surveys in November 2012 and the bat survey was conducted during September 2012. The potential of the site's habitats to support marine mammal or other fauna species was assessed during all field surveys. No marine mammals were observed during any of the ecology surveys.

14.2.2.5 Amphibians and Reptiles

During the course of the Phase 1 Terrestrial Habitat Survey the presence of common frog (*Ranatemporaria*), smooth newt (*Triturus vulgaris*) and common lizard (*Lacerta* v*ivipara*), or of habitats suitable for these species, was considered and is discussed in this Chapter where relevant. These species were not observed in the intertidal Phase I survey.

14.2.2.6 Terrestrial Invertebrates

Where relevant, the possible presence of terrestrial invertebrate species or assemblages of conservation concern is considered and possible impacts on these species or populations are assessed in this Chapter. At the Scoping stage of the project it was determined that impacts on locations likely to support invertebrate populations (such as wetlands, semi-natural woodlands, diverse

semi-natural grasslands, etc) of significant ecological value were not likely to be affected by the proposed works. During the course of Phase 1 Habitat Survey no habitats likely to support ecologically significant invertebrate populations were encountered and hence no dedicated follow-up invertebrate surveys were considered necessary in order to assess impacts on invertebrates.

14.2.2.7 Marine Invertebrates

Benthic marine invertebrates were sampled and identified from sample sites around Haulbowline in October 2012. The species were identified in order to classify the habitats and communities in the sediments surrounding the site in order to assess the impacts. Selected sites could be re-sampled post construction works to monitor the communities, however no ecologically significant invertebrate populations were encountered. The communities are characteristic of estuarine sediments and hence no dedicated follow-up invertebrate surveys are considered necessary.

14.2.3 Hydrodynamic Modelling

Hydrodynamic modelling was undertaken as part of the study to investigate the impact of different potential works (which included modelling of 4 options) on the hydrodynamic regime around Haulbowline Island and on the sedimentation in the area during 'dredging' (excavation) operations. The modelling was used to examine the effect of:-

- The change in foreshore bathymetry on the tidal flows and water levels, and
- The dispersion and fate of material excavated during the period of the PES construction.

The report is provided in full in Appendix N: Coastal Processes Study. Two foreshore proposalswere evaluated in terms of hydrodynamic and sediment plume modelling in order to assess alternatives. Those proposals were:-

- Scenario A - Based on the construction of a rock armour keystone trench to facilitate the construction of the PES and rock armour protection and a protection berm on the landward side of that trench behind which the re-profiling works for the PES would be undertaken.
- Scenario B – The removal of contaminated waste material in the foreshore by bulk excavation prior to the construction of the PES.

As detailed inChapter 4 'Assessment of Alternatives', Section 4.4.6 Scenario B was not assessed further (see summary of potential impacts for Scenario B below) and therefore in the context of assessing impacts it is appropriate to refer to Scenario A as provided in Appendix N: Coastal Processes Study.As stated on Chapter 5 "Project Description" and Chapter 6 "Project Construction", it should be noted that the exact nature of the construction of the PES will not be determined until detailed design or Tender Award Stage. However it is considered that Scenario A is a realistic construction option for the installation of the PES.

The modelling for Scenario B shows in the event of all bulk waste removal from the foreshore and shallow subtidal area, in a worst case scenario without further sediment abatement mitigation, that sediments would be distributed over the local estuarine area. Suspended sediments in the vicinity of the site and deposition would result in highly localised smothering of marine organisms in the immediate vicinity of the East Tip site. Small amounts of suspended sediments (<0.1kg/m^3) would be distributed across the Cork Harbour area and whilst below detectable limits, could be deposited in Natura 2000 sites. The potential impacts therefore of removal of large areas of intertidal and subtidal habitat (where this waste material is already colonised by marine invertebrates and flora) and the

potential for these sediments to contribute, however minimally to cumulative deposition of such material in Natura 2000 sites, in conjunction with the low risk of leaving waste in-situ to humans and Cork Harbour waters as presented in the addendum to the DQRA, means that this proposal in not the best environmental option (Appendix A: DQRA). This is further supported by the results of marine water sampling and analysis which did not identifycontaminant concentrations in excess of relevant WQSs (WYG, 2013).

For model Scenario A re-suspension of material from the rock armour key-stone trench excavation works, in a worst case scenario, is redistributed locally within the site environs.Small volumes, below detectable limits may be suspended in the water column and distributed and deposited in the CorkHarbour area. There is minimal risk of any interaction of these sediments with Natura 2000 areas. It should be noted that the modelling results do not include for the additional sediment abatement mitigation proposed with respect to the trench excavation works.

As discussed in Chapter 4 “Assessment of Alternatives” of this EIS it is the intention that a portion of waste will remain permanently outside the PES. This material in situ has been colonised by marine flora and fauna and is comparable to the surrounding sediments. Surface sediments show no elevated contaminate levels above those detected in the surrounding area. None are above the effects range-median (ERM) or threshold effects levels (TEL) (Cronin et al,2004).

14.2.4 Evaluation and Impact Assessment Criteria

Where appropriate, ecological features were assessed according to the criteria for site evaluation outlined in the NRA ‘*Guidelines for Ecological Impact Assessment of National Road Schemes*’ (NRA, 2009).

The ecological value of the site is assessed based on whether it is of *international, national, regional or local importance* as this has a direct bearing on the potential magnitude and the significance of impacts (NRA, 2009).

The potential impact of the proposed works on each ecological feature was then characterised on the basis of the following parameters as set out in the NRA Guidelines:-

- Magnitude,
- Extent,
- Duration,
- Reversibility,
- Timing and Frequency, and
- Integration of Impact Characteristics.

14.2.5 Consultation

Throughout the environmental assessment process and the assessment of impacts to Natura 2000 sites RPS engaged in consultation with key stakeholders (refer to Chapter 3 ‘Consultation’). This engagement with stakeholders early in the process ensured that the concerns with regards to ecology raised by the key stakeholders including the NPWS, IFI, EPA and An BordPleanálawere addressed in both this Ecology Chapter and the NIS (contained in Volume 4).

In particular, the following items were raised and addressed:-

- Impacts from sedimentation and contaminant release;
- Possible impacts associated with excavation of waste in the foreshore;
- Biodiversity enhancement measures for the end use of the site;
- Impacts to fisheries and shellfish;
- Potential issues with regards to bioaccumulation in species;
- Cumulative impacts associated with other activities in the harbour including maintenance dredging undertaken by the Port of Cork;
- Mitigation measures including control measures during the construction phase;
- Monitoring including the appointment of an Environmental Clerk of Works by Cork County Council and/or the site agent during the construction stage to oversee the works.

14.3 EXISTING ENVIRONMENT

14.3.1 Designated Sites

The proposed works at East Tip are located close to a number of designated protected areas including Cork Harbour Special Protection Area (SPA), designated under the EU Birds Directive (79/409/EEC and 2009/147/EC) and protected under the provisions of the Habitats Directive (92/43/EEC), which is located within 1.4km of the site at its closest point. Post construction, footpath works and minor road resurfacing may be required on the access road to Haulbowline Island. At its nearest point these works may be 600m from the nearest Natura 2000 site.

SPAs together with Special Areas of Conservation form the Natura 2000 network of protected sites. A number of proposed Natural Heritage Areas (pNHA) which are proposed for designation as Natural Heritage Areas under the Irish Wildlife Act 1976 (as amended in 2000) are also present in the vicinity. The locations of Natura 2000 sites discussed in this chapter are presented in Figure 14.1; the locations of the pNHAs are presented in Figure 14.2.

14.3.1.1 Sites of International Importance

The potential for proposed works to result in significant negative impacts on Natura 2000 sites or on Habitats Directive Annex II or IV species (see Section 5) is also the subject of an Article 6 Appropriate Assessment and Article 12 Screening (RPS, 2012) and to Stage 2 Appropriate Assessment (RPS, 2013 as contained in Volume 4 of this EIS).

Two Natura 2000 sites (Table 14.1) are located within Cork Harbour; *Cork Harbour* SPA (site code 004030), which is comprised of several non-contiguous areas around the harbour, the closest of which to Haulbowline are at Lough Beg 1.4km to the south and at Monkstown Creek 2.2km to the west; and *Great Island Channel* candidate Special Area of Conservation (cSAC) (site code: 001058) which is located 4.2km to the north of Haulbowline (see Figure 14.1).

Table 14.1: Natura 2000 Sites in Cork Harbour

Site Name	Designation Type	Site Code	Approximate Location Relative to Proposed Works
Cork Harbour	SPA	004030	Haulbowline site is 1.4km to the north of Lough Beg section of the SPA; and 2.2km to the east of Monkstown Creek section of the SPA. Post construction, footpath works and minor road resurfacing may be required on the access road to Haulbowline Island. At its nearest point these works may be 600m north of Lough Beg section of the SPA.
Great Island Channel	cSAC	001058	Haulbowline site is 4.2km to the south of the cSAC in a direct overland line and 5.9km by a route over the sea.

The next closest Natura 2000 site to the proposed works at Haulbowline is *Ballycotton Bay* SPA (site code 004022), 17km to the east. Impacts on this and other more remote coastal SPAs and cSACs are not considered possible due to the large distances from the proposed works and the large areas of deep oceanic water that lie between the works location and the sites, which would buffer and dilute any possible contaminating chemical to such an extent that significant toxic effects could not be anticipated. Hence, this and other Natura 2000 sites outside Cork Harbour are not considered further in this impact assessment.

Great Island Channel cSAC (Site Code 001058)

GreatIsland lies between the cSAC to the north and Haulbowline Island to the south. The cSAC covers the channel between the north coast of Great Island from Little Island to the west to Midleton to the east. Whilst the distance to between the East Tip site and the cSAC boundary is 4.2km at its closest point, the distance between the two via a route over the sea is 5.9km (see Figure 14.1). The following information is taken from the NPWS Site Synopsis.

Great Island Channel, compared to the rest of CorkHarbour, is relatively undisturbed. Within the site is the estuary of the Owennacurra and Dungourney Rivers. These rivers, which flow through Midleton, provide the main source of freshwater to the North Channel. The main habitats of conservation interest are the sheltered tidal sand and mudflats and Atlantic salt meadows. Owing to the sheltered conditions, the intertidal flats are composed mainly of soft muds. Cordgrass (*Spartina*spp.) has colonised the intertidal flats in places, especially at Rossleague and Belvelly. The salt marshes are scattered through the site and are all of the estuarine type on mud substrate.

The site is extremely important for wintering waterfowl and is considered to contain three of the top five areas within Cork Harbour, namely North Channel, Harper's Island and Belvelly-Marino Point. Shelduck are the most frequent duck species with 800-1000 birds centred on the Fota/Marino Point area. There are also large flocks of Teal and Wigeon, especially at the eastern end. Waders occur in the greatest density north of Rosslague, with Dunlin, Black-tailed Godwit, Curlew and Golden Plover the commonest species. A population of about 80 Grey Plover is a notable feature of the area. All the mudflats support feeding birds; the main roost sites are at WeirIsland and BrownIsland and to the north of Fota at Killacloyne and Harper's Island. Ahanesk supports a roost also but is subject to disturbance. The populations of Grey Plover and Shelduckare of national importance. (NPWS, 2005)
While the main land use within the site is aquaculture (Oyster farming), the greatest threats to its conservation significance come from road works, infilling, sewage outflows and possible marina developments.

The defined Conservation Objectives specific to *Great Island Channel* cSAC are as follows:-

Objective 1: To maintain the favourable conservation status of the Qualifying Interests of the SAC; the Annex I habitats:-

- Mudflats and sandflats not covered by seawater at low tide (habitat code 1140);
- Atlantic salt meadows (Glauco-Puccinellietaliamaritimae) (1330).

Objective 2: To maintain the extent, species richness and biodiversity of the entire site.

Objective 3: To establish effective liaison and co-operation with landowners, legal users and relevant authorities (NPWS, 2010).

Cork Harbour SPA (Site Code 004030)

The SPA is comprised of several non-contiguous areas around the Harbour, the closest of which to the Haulbowline East Tip site are at Lough Beg 1.4km to the south and at Monkstown Creek 2.2m to the west (see Figure 14.1). The following information is taken from the NPWS Site Synopsis.

Cork Harbour is a large, sheltered bay system, with several river estuaries, principally those of the Rivers Lee, Douglas, Owenboy and Owennacurra. The SPA site comprises most of the main intertidal areas of CorkHarbour. Owing to the sheltered conditions, the intertidal flats are often muddy in character. Cordgrass (*Spartina* spp.) has colonised the intertidal flats in places, especially where good shelter exists, such as at Rossleague and Belvelly in the North Channel. Salt marshes are scattered through the site and these provide high tide roosts for the birds. Some shallow bay water is included in the site. RostellanLake is a small brackish lake that is used by swans throughout the winter. The site also includes some marginal wet grassland areas used by feeding and roosting birds.

Cork Harbour as a whole is an internationally important wetland site, regularly supporting in excess of 20,000 wintering waterfowl, for which it is amongst the top five sites in the country. The two-year mean of summed annual peaks for the entire harbour complex was 55,401 for the period 1995/96 and 1996/97. Of particular note is that the site supports internationally important populations of Black-tailed Godwit and Redshank. At least 18 other species have populations of national importance, as follows: Little Grebe, Great Crested Grebe, Cormorant, Grey Heron, Shelduck, Wigeon, Teal, Pintail, Shoveler, Red-breasted Merganser, Oystercatcher, Golden Plover, Grey Plover, Lapwing, Dunlin, Bar-tailed Godwit, Curlew and Greenshank. The Shelduck population is the largest in the country (over 10% of national total). CorkHarbour is a nationally important site for gulls in winter and autumn, especially Black-headedGull, Common Gull and Lesser Black-backed Gull. A range of passage waders occurs regularly in autumn, including such species as Ruff, Spotted Redshank and Green Sandpiper.

Cork Harbour has a nationally important breeding colony of Common Tern (3-year mean of 69 pairs for the period 1998-2000, with a maximum of 102 pairs in 1995). The birds have nested in Cork Harbour since about 1970, and since 1983 have nested on various artificial structures, notably derelict steel barges which were removed approximately ten years ago.

Currently the colony uses two locations each summer, with the population of approximately 90 pairs more or less evenly divided between them: the roof of a Martello Tower between Great Island and Fota Island, 5.2km from the East Tip site; and three mooring dolphins within the deep water port at Ringaskiddy1.8km from the East Tip site. The waters around Haulbowline Island, particularly the shallow waters over Spit Bank to the east, are an important feeding area for breeding Common Terns from both colonies (RM *pers. obs*.).

Conservation Objectives specific to *Cork Harbour* SPA are as follows:-

Objective 1: To maintain the favourable conservation status of the Qualifying Interests of the SAC; the bird species:-

- Wintering Little Grebe (*Tachybaptus ruficollis*) (species code: A004);
- Wintering Great Crested Grebe (*Podicep scristatus*) (A005);
- Wintering Cormorant (*Phalacrocorax carbo*) (A017);
- Wintering Grey Heron (*Ardea cinerea*) (A028);
- Wintering Shelduck (*Tadorna tadorna*) (A048);
- Wintering Wigeon (*Anas penelope*) (A050);
- Wintering Teal (*Anas crecca*) (A052);
- Wintering Pintail (*Anas acuta*) (A054);
- Wintering Shoveler (*Ana sclypeata*) (A056);
- Wintering Red-breasted Merganser (*Mergus serrator*) (A069);
- Wintering Oystercatcher (*Haematopus ostralegus*) (A130);
- Wintering Golden Plover (*Pluvialis apricaria*) (A140);
- Wintering Grey Plover (*Pluvialis squatarola*) (A141);
- Wintering Lapwing (*Vanellus vanellus*) (A142);
- Wintering Dunlin (*Calidris alpina*) (A149);
- Wintering Black-tailed Godwit (*Limosa limosa*) (A156);
- Wintering Bar-tailed Godwit (*Limosa lapponica*) (A157);
- Wintering Curlew (*Numenius arquata*) (A160);
- Wintering Redshank (*Tringa totanus*) (A162);
- Wintering Black-headed Gull (*Chroicocephalus ridibundus*) (A179);
- Wintering Common Gull (*Larus canus*) (A182);
- Wintering Lesser Black-backed Gull (*Larus fuscus*) (A183); and
- Breeding Common Tern (*Sterna hirundo*) (A193).

And the Qualifying Feature:-

- Wetlands & Waterbirds (code A999)

Objective 2: To maintain the extent, species richness and biodiversity of the entire site.

Objective 3: To establish effective liaison and co-operation with landowners, legal users and relevant authorities.

14.3.1.2 Sites of National Importance

A total of ten proposed Natural Heritage Areas (pNHAs) are designated within Cork Harbour, details of their locations relative to the East Tip, Haulbowline site are presented in Table 14.2 and in Figure 14.2. Most of these correspond to the Natura 2000 designations discussed in Sections 14.3.1.1 above(see Figure 14.1).Site Synopses for pNHAs are not currently available on the NPWS website, however RPS hold the old Site Synopses on file and the ecological features discussed in Section14.3.1.1 are those discussed in these, with additional information taken from the 'Maps and Data' section of the NPWS website (http://webgis.npws.ie/npwsviewer/).

Table 14.2: Natura 2000 Sites Included in this Screening Assessment

Site Name	Designation Type	Site Code	Location Relative to Haulbowline East Tip	
			Direct	By Sea
Lough Beg (Cork)*	pNHA	001066	1.4km to the South *	1.4km
Monkstown Creek	pNHA	001979	2.2km to the west	2.2km
Whitegate Bay	pNHA	001084	2.5km to the east	2.5km
Cuskinny Marsh	pNHA	001987	2.7km to the northeast	2.9km
Rostellan Lough, Aghada Shore	pNHA	001076	4.2km to the east	4.2km
GreatIsland Channel	pNHA	001058	4.2km to the north	6.0km
Owenboy River	pNHA	001990	4.3km to the southwest	6.8km
Douglas River Estuary	pNHA	001046	5.3km to the northwest	6.4km
Rockfarm Quarry, Little Island	pNHA	001074	6.1km to the northwest	7.2km
Dunkettle Shore	pNHA	001082	8.9km to the northwest	10.1km
* Post construction, footpath works and minor road resurfacing may be required on the access road to Haulbowline Island. At its nearest point Lough Beg may be 600m south of these works.				

Birds and Bird Habitats in the pNHAs

The majority of the pNHA sites in Cork Harbour(see Table 14.2) are designated on the basis of intertidal mudflats and the important bird populations that they support. This is reflected by the fact that all of the sites other than *Cuskinny Marsh* pNHA, *Rockfarm Quarry, Little Island* pNHA and the Aghada shoreline of Rostellan *Lough, Aghada Shore and Poulnabibe Inlet* pNHA, are included within Cork Harbour SPA, and the Conservation Objectives described for the SPA in Section 14.3.1.1. Therefore thesesimilarly apply to these pNHAs, and this Section (14.3.1.1) should be referred to. Features protected within the pNHAs other than birds and their habitats are discussed below.

Other Ecological Features in the pNHAs

Cuskinny Marsh pNHAis of interest because it contains a good mix of habitats, within a small area, and supports locally important numbers of wildfowl. It is a small site with the dominant habitat being a brackish lake, joined to the sea through a sluice gate, and fed by streams flowing from the west and north. The lake is fringed with Common Reed (*Phragmites australis*), with wet deciduous woodland composed of Alder (*Alnus glutinosa*) and willow (*Salix* spp.) to the north and west.

Rock Farm Quarry, Little IslandpNHA has been largely replaced by a golf course development and most of the site's ecological interest is now gone (RM *pers. obs*.). Formerly, the habitats within the site included unimproved lowland dry grassland, scrub woodland and the exposed rock and spoil of the quarries. On the floor of the quarries and around their edges, a rich calcareous flora had developed and within this small area (30ha) there was a considerable diversity of species. Many orchids were found at the site including Early Purple Orchid (*Orchis mascula*), Dense-flowered Orchid (*Nestinea maculata*) and the Red Data book species Bee Orchid (*Ophry sapifera*). Also of note was the presence of the Red Data Book species Ivy Broomrape (*Orobanche hederae*).

Great Island Channel pNHA supports important examples of saltmarsh and extensive areas of undisturbed mudfalts which correspond to the Habitats Directive Annex I habitat types 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)' (habitat code 1330) and 'mudflats and sandflats not covered by seawater at low tide' (habitat code 1140) respectively. The pNHA includes all of the cSAC which is designated on the basis of the presence of these Annex I habitats (see Section 14.3.1.1).

Douglas Estuary pNHA includes some saltmarsh with characteristic species including Arrowgrass (*Triglochin* sp.), Sea Aster (*Aster tripolium*) and sedges (*Carex* spp.). There is a narrow fringe of Common Reed along parts of the shore. The Irish Biogeographical Society (Newsletter, March l990) report that the saltmarsh supports an unusual assemblage of moths.

Lough Beg pNHA includes a sandy beach at Lough More where Sea Sandwort (*Honkenyapeploides*), Orach (*Atriplex hastata*) and Wild Carrot (*Daucus carota*) are common above the tideline along with Mugwort (*Artemisia vulgaris*) Yellow Horned Poppy (*Glaucium flavum*) and the introduced Hoary Cress (*Cardaria draba*); and patches of saltmarsh also occur. Parts of the inner section of the bay have been reclaimed behind embankments but much of this ground remains brackish and poorly drained with marsh and wet grassland vegetation present. Rush species (*Juncus acutiflorus*, *J. effusus* and locally *J. gerardii*) are frequent here with Creeping Bent (*Agrostis stolonifera*), GlaucousSedge (*Carex flacca*), Fox Sedge(*C. otrubae*), Fleabane (*Pulicariadysenterica*), Greater Bird's-foot Trefoil (*Lotus uliginosus*) and willowherbs (*Epilobiumparviflorum*, *E. palustre* and *E. hirsutum*). Clubrushes (*Bolboschoenus maritimus* and *Schoenoplectus tabernaemontani*) grow in many of the drains and there are small areas of Common Reed.

Monkstown Creek pNHAincludes a brackish lake that is separated from the sea by a sluice gate. The mudflats and tidal creeks are fringed by a small amount of saltmarsh vegetation. Two areas of semi-natural woodland occur on the southern shore and support Spindle (*Euonymus europaeus*) and a thick carpet of Bluebell (*Hyacintnoides non-scripta*) and Ramsons (*Allium ursinum*).

14.3.2 Habitats Within The East Tip Site

An extended habitat survey of the site was conducted on the 14th August 2012. All accessible parts of the site were examined; however, a fenced-off area in the northern part of the site, where tidal water rises through the sediment forming pools, was not examined in detail. It is considered highly unlikely that this area supports species or habitats of significant ecological value. Results of the survey are presented below and in Figure 14.3.

With the exception of the sports field, buildings, hardstanding areas and a mound of topsoil close to the sports field (see Figure 14.3), the substrate at the East Tip is fairly uniform in nature, being composed of mounds and flatter areas of heavily weathered stone-based spoil. The spoil is a mix of fine and course-grained slag material, with some larger pieces of metal, wood and concrete. In most parts of the site the spoil has agglomerated into a hard, rock-like substance but in some locations remains unconsolidated and gravel-like. In general this substrate is well-drained producing a very dry surface. Fine sediments are generally absent, but some silt accumulations in depressions and hollows have taken on the appearance of poorly-developed soils where some growth of mosses and liverworts occurs, particularly where small patches of impermeable material allow rain water to puddle. However in general there is no significant soil development away from the sports field. It is assumed that topsoil was imported to the site for creation of the sports field.

14.3.2.1 Mosaic of: 'Recolonising Bare Ground (ED3)' and 'Spoil and Bare Ground (ED2)'

The majority of the ground area of the site is classified as a complex mosaic of these two habitat types. Vegetation cover in general is below 50%, making 'Spoil and bare ground' the appropriate category for the majority of the site, however the area is not really typical of this habitat type because there is no ongoing human 'disturbance or maintenance' preventing vegetation and soil from developing (Fossitt, 2000). At this site it appears that soils have failed to develop and that vegetation has failed to colonise much of the bare ground.

14.3.2.2 'Amenity Grassland (Improved) (GA2)'

The sports pitch is classified under this habitat. Whilst of no intrinsic ecological value, the grass pitch provides feeding habitat for birds and the margin of scrubby Sycamore and other woody species around the perimeter fence of the field may also provide nesting habitat for small numbers of common bird species (see Section 14.3.7.4).

14.3.2.3 'Dry Meadows and Grassy Verges (GS2)'

The verges which line both side of the approach road from Ringaskiddy to Haulbowline are classified under Dry meadows and Grassy Verges (GS2).The grasses include rye grass, false oat-grass, cock's-foot and Yorkshire-fog. The broadleaved herb component is characterised by clovers (*Trifolium*spp.). The marginal nature of this habitat is of little ecological value to local wildlife.

14.3.2.4 'Hedgerows (WL1)'

Hedgerows comprise willow and birch line both sides of the road from Ringaskiddytothe bridge to Haulbowline. These hedgerows are dense and may provide some roosting habitat and shelter for local bird species. A number of bat species also forage and commute along linear features such as hedgerows.

14.3.2.5 'Buildings and Artificial Surfaces (BL3)'

The site includes the administration building and a number of other man-made structures that are best placed in this category along with hardstanding areas within the site such as roads. These areas often overlap with the habitat type 'recolonising bare ground (ED3)' in locations where tarmac or concrete has begun to degenerate into a loose matrix and plants are becoming established. The buildings and other structures provide nesting habitat for a number of bird species (see Section 14.3.7.4) but are otherwise of no ecological value; the bat survey did not record any roosting bats using the buildings (see Section 14.3.7.1).

14.3.3 Marine and Intertidal Habitats around the East Tip Site

An intertidal site walkover was conducted on the 29thSeptember 2012. The methodologies and recording were in accordance with the Marine Institute and NPWS guidance, and in accordance with the JNCC Marine Monitoring Handbook. Habitats were recorded as per Wyn et al 2002, and where possible biotopes were recorded to EUNIS system.

A subtidal survey was undertaken on the 10th and 11th October 2012. Grab sampling was undertaken in accordance with the Marine Institute and NPWS guidance, and in accordance with the JNCC Marine Monitoring Handbook.

14.3.3.1 Intertidal Habitats

The intertidal Phase I survey of the site characterised the foreshore as predominantly mixed sediments, with fucoid cover on areas of coarser substrate (boulder and cobble). There are two areas in the extreme north west of the site and in the lee of the causeway where the foreshore is shingle and shell gravel. Sediments were predominantly characterised as LLR.F.FvesX*Fucusvesiculosus* on mid eulittoral mixed substrata, (A1.322/B).

14.3.3.2 Subtidal Habitats

The subtidal survey characterised much of the surrounding area as 'Infralittoral muddy sand A5.24', and 'Infralittoral mixed sediment A5.43' biotopes. The area within the south channel showed patches of '*Sabella pavonina* with sponges and anemones on infralittoral mixed sediment A5.4.3.2' (these communities are classified under the EUNIS system).

Mixed sediment habitats are by their nature robust to temporal and physical change given the conditions in which they occur. No species of conservational interest were identified during the surveys.

14.3.4 Terrestrial Flora

14.3.4.1 Rare and Legally Protected Species of Flora

During the extended Phase I habitat survey (14th August 2012), no rare or legally protected flora species were observed at the site and no habitat types likely to support such species were recorded; no such species are suspected to occur.

Table 14.3 presents details of the rare or protected flora species that are recorded by Preston *et al*. (2002) from National Grid 10km Squares W76 within which the East Tip is located; and of 10km Square W86, the boundary of which is located 200m to the east of the site.

Table 14.3: Rare or Protected Plant Species Recorded from 10km square W76 and W86 as Indicated in Preston *et al*. (2002)

Species	Status in 10km square W76	Status in 10km square W86	Rare / Protected Status
Annual Knawel	Pre 1970	Pre 1970	**Flora Protection Order**
Bird Cherry	Pre 1970	N/A	Red Data BookTN = 6 'Rare'
Bee Orchid	1987-1999	1987-1999	Red Data BookTN = 5 'Rare'
Corn Chamomile	Pre 1970	Pre 1970	Red Data BookTN = Extinct
Cowslip	1987-1999	1970-1999	Red Data BookTN = 8 'Rare'
Greater Broomrape	1987-1999	1970-1999	Red Data BookTN = 7 'Rare'
Ivy Broomrape	1987-1999	1987-1999	Red Data BookTN = 5 'Rare'
Meadow Barley	Pre 1970	Pre 1970	**Flora Protection Order** Red Data BookTN = 9 'Vulnerable'

Species	Status in 10km square W76	Status in 10km square W86	Rare / Protected Status
Penny Royal	Pre 1970	Pre 1970	**Flora Protection Order** Red Data BookTN = 9 'Vulnerable'
Sea Kale	Pre 1970	1970-1986	Red Data BookTN = 5 'Rare'
Shepherd's Needle	Pre 1970	Pre 1970	Red Data BookTN = Extinct

Flora (Protection) Order, 1999

Three species protected under the Flora (Protection) Order of 1999 are known from both 10km squares W76 and W86, however none of the three, Annual Knawel, Meadow Barley nor Penny Royal has been recorded since 1970 (Preston *et al*. 2000). Annual Knawel is found in *waste places and roadsides on dry, sandy soils* (Webb *et al*., 1996). Meadow Barley is found on *damp grassland, chiefly near the sea* (Webb *et al*., 1996). Penny Royal is found in *damp, sandy places* (Webb *et al*., 1996). No highly suitable habitat for any of these species is present at the site and it is considered highly unlikely that any of them occur.

Irish Red Data Book

In addition to Meadow Barley and Penny Royal which are discussed above, a further eight species listed in the Irish Red Data Book (Curtis and McGough, 1988) have been recorded in 10km Squares W76 or W86 (see Table 14.3). Suitable habitat for any of these species is absent at the East Tip site, and it is considered highly unlikely that any of these species occur at the site.

14.3.4.2 Field Survey

Considering the absence of soil development and uniformity of conditions at the site, a relatively high diversity of plant species have colonised the area, albeit sparsely, including a number of typically coastal species. Details of the flora species recorded during the habitat survey of the 14th August 2012 are presented in Table O1-6 (Appendix O1: Ecology Supporting Information).

The majority of the flora species occur as scattered patches across the bare ground of the site. Some typically coastal species occur, notably Rock Samphire, Sea Plantain, Yellow-horned Poppy, Sea Beet, Common Scurveygrass and Thyme-leaved Sandwort, and their distribution is concentrated along the shoreline of the site, particularly along the southern shore. A few woody shrubs are present; Buddleia, Common Gorse and Bramble; single specimens of Beech and Grey Willow are also present; with denser growth of small Sycamores and Bramble along the fence-line of the sports field.

14.3.5 Invasive Alien Plant Species

The extended Phase I habitat survey on the 14thof August 2012 included examination of the site for the presence of invasive non-native plant species, and of the possibility that they might be spread or otherwise benefited by the proposed works.

A number of non-native plant species are present at the site including Canadian Fleabane / Bilbao Fleabane (*Conyza canadensis / C. bilbaoana*) and / or hybrids of the two species (which is abundant); Biting Stonecrop (*Sedum acre*) (which is abundant) and Buddleia (*Buddleia davidii*) (which is occasional). However, none of these is considered invasive and no Japanese Knotweed or other invasive alien plant species listed under the Third Schedule of the 2011 Natural Habitats Regulations[1] were found.

It is not considered that the proposed construction works have any potential to result in the spread of Japanese Knotweed or any other invasive alien plant species listed under the Third Schedule of the 2011 Natural Habitats Regulations.

14.3.6 Marine Flora

The Phase I habitat survey on the 29th September 2012 identified no marine angiosperms at the site. Foreshore algal species were fucoids typical of this type of site. They were no species of significant conservation value and no invasive or non native species identified.

14.3.7 Fauna

14.3.7.1 Non-Marine Mammals

Hayden and Harrington (2000) give the distribution of mammal species in Ireland by 20km squares, each of which is composed of four National Grid 10km squares. The subject lands lie within the 20km square comprising National Grid 10km squares, W66, W67, W76, and W77. Appendix O1 Table O1-1 shows the protected non-marine mammal species recorded in this 20km square by Hayden and Harrington (2000).

The habitats and general character of the site indicate that it is unsuitable to support any of these legally protected mammal species other than otter. The site lacks mature vegetation or permanent fresh water.

Otter

Otter occurs in most freshwater and coastal habitats throughout Ireland. The East Tip site has been examined in detail for signs of otter activity and to assess the quality of the habitat for otters.

All accessible sections of coastline were searched for otter signs during the course of the ecological site survey on the 14th of August, and further searches for spraint were conducted during October and November 2012, but no signs have been found, despite the presence of many highly suitable locations for spraint sites. Whilst the site provides a relatively undisturbed coastline which may be attractive to otters, there is little sheltered shallow water which would provide high quality feeding habitat for otters, and similarly quiet, undisturbed coastline is also present in many other locations locally, such as on Spike Island, Rocky Island and along large sections of shoreline at Golden Rock and Cuskinny. There is no evidence that the site is of any importance to otters.

[1] S.I. No. 477/2011 — European Communities (Birds and Natural Habitats) Regulations 2011.

The East Tip site lacks sources of permanent fresh water and this probably explains the absence of resident otters at the site. A number of studies have shown that for otters which inhabit salt water environments, access to fresh water is essential for washing and maintainable of the quality of their coats; and that the distribution of holts is closely correlated with the availability of fresh water (e.g. Kruuk*et al*, 1989; Beja. 1991).

Otters are present throughout Cork Harbour and Haulbowline's central position at the heart of the harbour, and bordering the narrowest part of the River Lee's channel through the harbour, means that it is highly likely that otters occur along the shoreline of the East Tip site on a regular basis when foraging or commuting between other locations in the vicinity.

Overall it is concluded that whilst otters are likely to pass along the coastline of the East Tip site on a regular basis, neither the shoreline or inland areas of the site are used heavily by otters; and the site does not constitute and important area of habitat for otters. This is likely to be due to the absence of fresh water.

Bats

A full bat survey of the site was undertaken on the 12thof September 2012. The survey included both day-time examination of the site, particularly of buildings and other man-made structures, to investigate bat usage and the possible presence of roost sites; and night-time detector work to investigate the usage of the site by foraging or commuting bats. The report is presented in full in Appendix O: Ecology Supporting Information (Appendix O.2:Bat Report).

No bat roosts were found or suspected to occur; the site was deemed generally unsuitable for bats, and there was only a single detector record of a common pipistrelle, flying briefly over the western boundary of the site close to the sports pitch.

The survey assessment concluded that: "As no bat roost was identified on-site and the existing habitats are exceptionally poor for these animals, the impact of any development on the favourable conservation status of local bat populations is expected to be negligible."

14.3.7.2 Marine Mammals

No specific studies into marine mammals were conducted at the site. During site visits and walkovers, no species were observed. Anecdotal evidence suggested adult seals occasionally travel along the south side of the island to access areas inshore of the location.

Cetaceans

Whilst there have been very occasional records of other cetacean species such as common dolphin (*Delphinus delphis*) and orca (killer whale; *Orcinus orca*) (June 2001) in Cork Harbour, only two species occur, or are at a likely to occur, on a regular basis: harbour porpoise and bottle-nosed dolphin; both are listed under Annexes II and IV of the Habitats Directive. Between February 2006 and March 2011 a pod of six bottle-nosed dolphins were regular visitors to the Outer Cork Harbour area. None have been observed in the vicinity or Cobh or Haulbowline.Appendix O1 - Table O1-2 outlines the species present in the region.

Pinnipeds

Both common (harbour) seal and grey seal occur regularly in small numbers in CorkHarbour, including the immediate vicinity of Haulbowline Island. Both species are listed under Annex II of the Habitats Directive. There is little evidence of seals using the site. The nearest NPWS recorded haulouts and sensitive habitats for seals are in Kinsale.

Incidental sightings of seal have occurred in the vicinity of the site and the naval base. These are expected to be adults transiting the area. There is no evidence of seals using the site.

Common (or harbour) seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) are common in Irish waters, and are mainly concentrated inshore. Both the common seal and the grey seal are listed under Annex II of the EC Habitats and Species Directive as species whose conservation requires the designation of Special Areas of Conservation. In addition Common Seals and Grey Seals are protected under the Conservation of Seals Act 1970.

Seals are known to forage over a wide area, often straying up to 2,000 kilometres from their haul-out site (JNCC, 2007*;* Connell *et al.* 1999). There are no haul-out sites in the immediate vicinity of the proposed works where moulting or pupping may occur, the nearest is at Kinsale (Ó Cadhla*et al.*, 2008).

Common Seals

The common seal is the smaller of the two species of pinniped that breed in Ireland and is also an important predator in this area of the north Atlantic. The main prey of common seals is considered to be Sandeels, Lesser Octopus, Whiting, Flounder and Cod (Tollit & Thompson, 1996). During the pupping (June) and moulting seasons (late July/August) they spend more time ashore than at other times of the year.

These haul-out groups have tended historically to be found among inshore bays and islands, coves and estuaries (Lockley, 1966; Summers *et al.,* 1980), particularly around the hours of lowest tide. The nearest haul-out site is at Kinsale (Ó Cadhla*et al*., 2008).

Grey Seals

Grey seals are widespread in Ireland, with the greatest concentrations found on the exposed south-western, western and northern coasts (Lyons, 2004). Haulouts are recorded with breeding potential at Kinsale and Dungarvin, though the 2005 population estimates did not record significant numbers at these sites. Grey seals can be gregarious at these haul-outs, sometimes forming large groups of several hundred animals, especially when they are moulting their fur in spring following the winter pupping season.

14.3.7.3 Non-Protected Mammal Species

A number of non-protected mammals occur at the East Tip site. The site supports large numbers of rabbits, and the site foreman indicated that red foxes visit the site at night, crossing the bridge from the mainland. Brown rat is highly likely to be present, and house mouse may be present.

14.3.7.4 Breeding Birds Within the East Tip Site

The site provides suitable breeding habitat for a very limited number of bird species. Appendix O1 TableO1-3 presents details of the bird species recorded at the site during the site visit on the 14th of August 2012, and includes species which were not recorded during the site visit but for which potentially suitable breeding habitat is present at the site.

The breeding bird community of the site consists of common bird species of lowland Ireland; the site does not support habitats that are suitable to be of importance to any breeding bird species of high conservation concern or of limited range.

14.3.7.5 Breeding Birds from Outside the East Tip Site

Common Terns breeding at both the Deep Water Port at Ringaskiddy and at the Martello Tower between Fota Island and Great Island feed in the vicinity of GreatIsland, particularly to the east at Spit Bank. Breeding Common Terns are present in the area during the period between early April and late August each year.

Other bird species which bred locally and on occasion use the area around Haulbowline Island for feeding include Grey Heron and Little Egret.

14.3.7.6 Non-Breeding Birds

During autumn and winter, and to a lesser extent at other seasons, CorkHarbour supports Internationally Important populations of non-breeding waterbirds. The shoreline of the site provides limited feeding habitat for various species of gulls, waders and other waterbirds; however the relatively undisturbed and remote situation of the shoreline around site makes it potentially suitable as a high tide roost location for these species. This possibility was investigated by conducting a series of high tide surveys of the shoreline of the East Tip between October 2012 and January 2013. Table 14.4 presents results of these surveys (refer to Appendix O3 Ecology Supporting Information also).

Table 14.4: Usage of Haulbowline East Tip site by Waterbirds During Winter 2012 / 2013

Species	23rd October	9th November	23rd November	4th January
Grey Heron	0	1	3	0
Little Egret	0	3	0	0
Sanderling	2	0	0	0
Snipe	0	0	5	0
Redshank	0	3	0	0

Results of the survey indicate that very small numbers of birds roost along the shoreline of the site, and indeed, all of the Grey Herons and one of the Little Egrets that were recorded were feeding rather than roosting. Hence, it is concluded that the site is not currently of any importance to roosting waterbirds (waders, gulls, ducks, herons, cormorants, etc).

The open water areas around Haulbowline are used for feeding by a range of species including, most frequently, Great Crested Grebe, Great Northern Diver, Gannet, Cormorant, Shag, Black-headed Gull, Common Gull, Mediterranean Gull, Kittiwake, Herring Gull, Lesser Black-backed Gull, Great Black-backed Gull, Sandwich Tern and Common Tern (see also Section 14.3.7.5). A range of other species are also recorded in the area on occasion.

14.3.7.7 Amphibians and Reptiles

The absence of permanent fresh water at the site, or close to the site, means that habitat for amphibian species is absent and none are suspected to occur.

The site's habitats appear to be superficially suitable for viviparous lizard. No lizards were recorded at the site during the field survey in August 2012, and no records are known from Haulbowline Island, however the presence of this species cannot be ruled out. The history of the site as an active industrial waste dump that was reclaimed from the sea means that if lizards are present, they could only be relatively recent colonists from the western part of Haulbowline Island, arriving at the East Tip site during the past 10 years or so as habitats became suitable. Whilst this scenario is a possibility it is considered unlikely, and the species is not thought likely to be present at the site.

14.3.7.8 Fish

There is no specific guidance in relation to estuarine fish and development activities; however, there is a need to consider the conservation status of estuarine and marine fish species, and the species of conservation and commercial importance. Potential species that may occur adjacent to the development are outlined in Table 14.5. Baseline historical data for such species are usually sparse, therefore, a generalised assessment on species that occur in Irish estuarine waters has been considered.

Table 14.5: Fish Species of Conservation Concern and Likely Occurrence in the Area (DECC, 2009)

Species	Habitat	Eastern Irish Sea	Southern Irish Sea
River Lamprey	Anadromous	High	High
Sea lamprey	Anadromous	High	High
Common Skate	Marine	Medium	Medium
Angel Shark	Marine	Medium	Medium
Basking Shark	Marine	High	Medium
Sturgeon	Marine / Estuarine	Medium	Medium
Seahorses	Marine	None	None
Shad (Allis / Twaite)	Anadromous	Medium	Medium
Salmon	Anadromous	High	High
Smelt	Estuarine	Medium	None
High is defined as likely to be present and of concern. Medium is historically recorded or may be present, may be present occasionally or are data deficient. None is defined as unlikely to be present in the area.			

There is some additional consideration of diadromous species (diadromous species are those species that move between fresh and marine environments during their life cycle; these may be ‘anadromous’ (i.e. species of fish that typically live in the marine environment as adults, and migrate up rivers to breed) or ‘catadromous’ (i.e. species of fish that typically live in fresh water as adults, and migrate to the sea to breed)). These species access may be present in the vicinity of the site at specific times of the year only (Table 14.6).

Table 14.6: Anadromous Fish Movements (Based on UK Rivers) (DECC, 2009)

Species	Timing of Upstream Migration
Sea Lamprey	Move from sea to estuaries in April / May[2] spawning in May / June [1,2]
Salmon	Spawn in late October to early January[1,2]
Sea Trout	Spawn October / February [1]
Allis Shad	Move into estuaries in late spring[2], spawning April / May[1]
TwaiteShad	Start upstream April / May[2], spawning June/July [1,2]
Common Eel	Elver migrate upstream January to June, peaking in May [2]
References [1] Wheeler et al, 1969, [2] Maitland and Campbell, 1992	

The site is predominantly intertidal and shallow and therefore of limited value to fish species. Appendix O1 Table O1-4 presents details of the fish species likely to occur at the site based on the relevant literature.

14.3.7.9 Non-Marine Invertebrates

The habitats of the site comprise a plant community of limited diversity;and lack structural complexity in the vegetation, which consists almost entirely of low-growing ground vegetation. The site also lacks properly developed soils or permanent fresh water; and is very exposed to wind and salt spray. Coastal grassland and heath-type habitats are not sufficiently developed to support specialist coastal grassland species of Lepidoptera or other orders of invertebrate. Given these factors it is considered highly unlikely that any terrestrial (i.e. non-marine) invertebrate species or communities of significant ecological value occur at the site.

14.3.7.10 Marine Invertebrates

Benthic marine invertebrates were sampled and identified from sample sites around Haulbowline in October 2012. These were classified as being three biotopes using the EUNIS classification scheme. These were A5.432: *Sabella pavonina* with sponges and anemones on infralittoral mixed sediment, A5.24: Infralittoral muddy sand, and A5.43: Infralittoral mixed sediments. Appendix O1-Tables01-5 (a-c) shows the species characterising these biotopes. These species lists are consistent with the core EUNIS biotopes records (Connor et al, 2004). Appendix O1 -Tables O1-5(a-c) outlines the species composition of the samples in relation to their biotope.

Figure 14.4 show the spatial distribution of sediment type and bottom communities in the survey area. The coarsest sediment are located to the south of the island in the vicinity of the bridge. This area is subject to considerable tidal scouring. Most of the remaining stations are mixed sediments. Mixed sediments occur when an area is subjected to periods of both erosion and deposition. The presence of mixed sediments in an area is an indication that the currents and sediment deposition patterns are subject to a considerable amount of variability. Stations MS02 and MS19 were classified as sand and muddy sand, while station 6 was classified as mud and sandy mud. Most stations were classified as A5.43 Infralittoral Mixed sediments. A5.432 is a subset of A5.43. This is a very diverse highly variable biotope, subject to great deal of temporal variability (Connor et al 2004). The stations that were classified as A5.24 Infralittoral Muddy sand may be subject to a great deal of temporal variability also. They are located in an area that is generally subject to fluctuating periods of deposition and erosion.

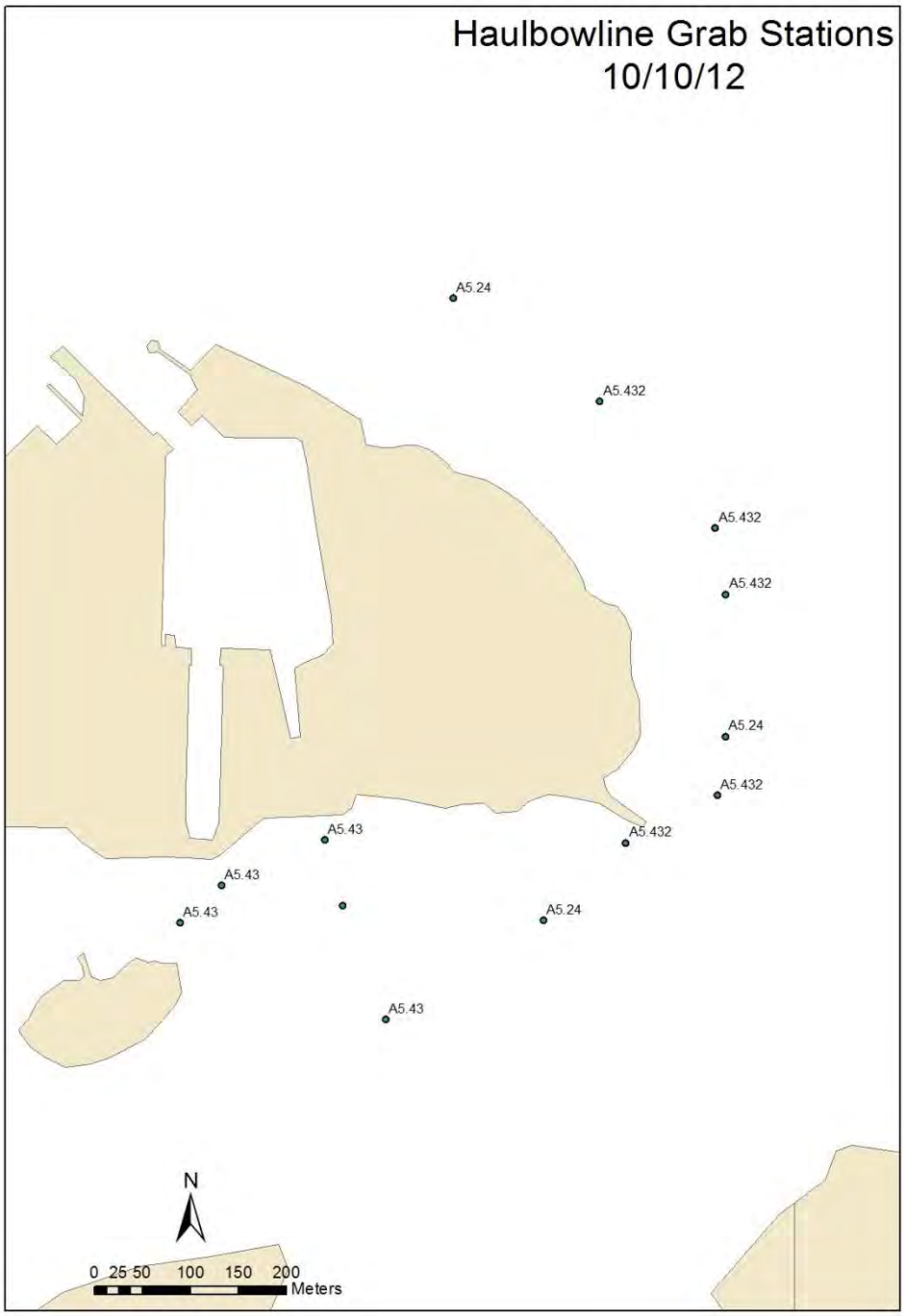


Figure 14.4: Benthic Grab Stations at Haulbowline, Cork Harbour, October 2012, Labelled by EUNIS Biotope Type

14.4 POTENTIAL IMPACTS

14.4.1 Construction Stage

14.4.1.1 Designated Sites

Direct Impacts

The closest Natura 2000 site (part of *Cork Harbour* SPA),and the closest pNHA (Lough Beg pNHA) to the East Tip site are at Lough Beg, 1.4km to the south, therefore no direct impact will occur within the boundary of any designated site as a result of the proposed works. Road resurfacing works and footpath works may be required on the approach road from Ringaskiddyto Haulbowline. This work may occur at 600m from the Lough Beg SPA, however, the works proposed are minor and no direct affects are anticipated.

Indirect Impacts

Indirect effects may include hydrological changes, siltation or turbidity in areas around the site either as a result of excavation operations during construction works at the East Tip or as a result of hydrological changes from the completed works (see Appendix N:Coastal Processes Study). Based on model Scenario A a maximum deposition of approximately 50mm in the immediate vicinity of the proposed perimeter area is predicted and increased suspended sediments are likely to be restricted to the area around the East Tip, with maximum predicted increases of 500mg/lextending 0.1km and 0.17km to the north and east of the area respectively. Resuspended sediment effects will therefore be localised. These estimates do not include additional sediment abatement mitigation measures which are expected to further restrict any sediments to the site environs.

The temporary presence of the construction works may cause localised avoidance of the East Tip site.

14.4.1.2 Habitats and Flora

Direct Impacts

The possible issues and impacts that could arise during the construction include:-

- Submarine acoustic noise disturbance and physical disturbance, in particular during any piling activity (that maybe required) and foreshore activity;
- Loss of intertidal habitat; and
- Effect of increased suspended sediments and sedimentation during construction works.

The construction works will result in a minor loss of intertidal habitat as a result of the construction proposed. The current foreshore is degraded mixed sediments with fucoid communities. There are barren areas of waste in the foreshore, especially in association with the breach repaired area. No habitats of significant ecological value are located within the proposed works site. Existing habitats are degraded as a result of the site. These areas will be sealed by construction and it is expected that infralittoral rock communities will establish on rock armour.

Subtidal areas are expected to be minimally affected, and are characteristic of the surrounding sediments and habitats. There are habitats of significant ecological value in the vicinity of the site. The communities in mixed sediments are robust to localised changes in sedimentation and disturbance and have rapid recovery and recolonisation times.

No non-marine habitats of significant ecological value are located within the proposed works site at the East Tip and no flora species of conservation concern are considered to occur. Hence, no impacts on non-marine habitats or flora species of significant ecological value are considered possible as a result of the proposed works at the East Tip.

Indirect Impacts

Indirect effects include changes in siltation, water flow and turbidity in areas around the site either as a result of construction or as a result in hydrological changes from the completed works.

Indirect effects of these changes can lead to changes in food sources for benthic invertebrates and this can lead to changes in community composition.

The nature of the works is such that impacts on habitats or flora outside the site boundary are only possible as a result of water-borne pathways via the surrounding marine waters. It is not considered possible that any non-marine ecosystems or plant species could be adversely affected by any such transport of contaminants or significant quantities of inert sediments. Hence, no indirect impacts on non-marine habitats or flora species of significant ecological value are considered possible as a result of the proposed works at the East Tip.

14.4.1.3 Fauna

14.4.1.3.1 Direct Impacts

Non-Marine Mammals

Of the legally protected non-marine mammal species that occur in the Cork Harbour / Haulbowline area, it is considered that only otter and bat species could potentially be using the East Tip site (see Section 14.3.7.1) and could therefore experience direct negative impacts as a result of the proposed works.

Bats

No bat roosts were found or suspected to occur; the site was deemed generally unsuitable for bats, and there was only a single detector record of a common pipistrelle, flying briefly over the western boundary of the site close to the sports pitch.

The survey assessment concluded that: "As no bat roost was identified on-site and the existing habitats are exceptionally poor for these animals, the impact of any development on the favourable conservation status of local bat populations is expected to be negligible."

The assessment also concluded that remediation of the site can potentially have positive benefits for bats: "Any future development on-site will change the local environment as existing structures and vegetation will be removed and, potentially, new structures and vegetation will be erected and planted. Such development is not expected to negatively affect bats as the existing habitats and site use are quite unsuitable for these animals and the area is avoided as a result. The favourability of the area for these animals and other wildlife may however be improved through its future development if the development proposals are sensitively designed and constructed in a sustainable manner with consideration of the needs of the local fauna."

Hence, it is concluded that the proposed works will have no negative effect on bat populations, significant or otherwise, and that end uses of the site which include extensive vegetation planting and the establishment of freshwater features, are likely to have a positive effect on local bat populations.

Otter

Overall, it has been concluded that whilst otters are likely to pass along the coastline of the East Tip site on a regular basis, neither the shoreline or inland areas of the site are used heavily by otters; and the site does not constitute and important area of habitat for otters. This is likely to be due to the absence of fresh water. Hence, it is considered highly unlikely that the proposed works will have any detrimental effect on either individual otters or on wider otter populations on the vicinity.

Remediation of the site includes a wet grassland area, which may encourage otters to use the site more frequently.

Marine Mammals

The possible issues and impacts that could arise during the construction include:-

- Submarine acoustic noise disturbance to marine mammals, in particular during the piling activity, if required;
- Noise and visual disturbance to seals from intertidal activities;
- Physical disturbance to marine mammals due to construction vessel activity in the area;
- Effect of increased suspended sediments and sedimentation on the behaviour of marine mammals during construction works; and
- Indirect effects of prey availability due to changes in the fish and shellfish resources as a result of the proposed construction works.

Submarine Acoustic Noise Disturbance on Marine Mammals

The two main potential sources of underwater noise disturbance on marine mammals as a result of the development proposals are sheet piling operations and general construction activities in the foreshore (i.e. excavation required for the rock armour trench which extends into the subtidal zone).

Full details of the development proposals, including a detailed description of the proposed activities, are presented in Chapter 5 ‘Project Description’. Piling operations may be required (worst case) in order to enclose the proposed operations from tidal exposure. If required piling will be in the form of both sheet piles and/or tubular steel piles, with diameters varying between approximately 800mm and 1500mm. Piles will be installed by driving, although there may also be a need for drilling to assist in installation of piles. Full details of piling activity will be determined at the detailed design stage.

Full details of the schedule of engineering works are provided in Chapter 5 ‘Project Description’ and Chapter 6 ‘Project Construction’. The majority of the marine works are scheduled to be conducted over a 9 month period.

Some minor road resurfacing works (cold milling (planning), resurfacing) will be required prior to commencement of the marine works to ensure the haul routes to the site can accommodate the construction traffic (See Chapter 8 'Traffic and Transport'). Works will also be required post the waste remediation works to reinstate the roads from any damage that may have occurred during the construction stage and to provide access for the operation of the site as an amenity area (including the provision of an upgraded access road (see Figure 5.3).

Marine Mammals and Noise

Sound plays an important role in the life-histories of marine mammals. Marine mammals use sound to communicate, find prey, avoid predators, and navigate about their environment. Anthropogenic noise which exceeds natural background levels has the potential to cause disturbance, and in extreme cases, injury to marine mammals. The effects of noise depend on the hearing sensitivity of a species together with the components of the noise itself (e.g. intensity, duration, frequency bandwidth) and the distance to the noise source. The range of potential effects will also be shaped by the physical and environmental parameters, including water depth, salinity and substrate (Parvin, et al 2006). The impacts of underwater sound can be broadly summarised into three categories: physical injury and mortality, auditory damage (either permanent or temporary) and behavioural responses:-

- **Physical injury/fatality:** Intense underwater noise can have a severe effect on marine mammals from blast type injuries. Lethal effects may result in immediate mortality or physiological damage such that an animal is debilitated and mortality will ensue after a period of time. Lethal effects may occur where peak to peak pressure levels exceed 240dB re 1µPa, whilst physical injury may occur where peak to peak pressure exceeds 220dB re 1µPa (Parvin, et al 2006).

- **Auditory damage:** Damage to auditory structures may either result from a single pulsed sound of high magnitude or from longer exposure to lower magnitude sound, depending on the frequency and duration. One potential effect is a shift in the threshold at which sounds can be detected, the level of which increases after a trauma and sounds can become more difficult to detect. The threshold shifts can either be temporary (TTS) or permanent (PTS) and it is likely that animals experiencing PTS will be unable to forage successfully, detect predators or navigate. As a result PTS may eventually lead to mortality. Noise levels at which TTS and PTS may occur are described below based on two different modelling approaches.

- **Behavioural responses:** At lower noise levels than those causing auditory injury, there may be behavioural effects on a species, of which the most significant would be avoidance of the ensonified area. Avoidance may have negative effects on an animal if it causes a migratory species to be delayed or diverted, inhibits feeding in an important foraging area, or generally leads to stresses on an individual that may reduce fitness and have biological consequences such as reduced breeding success. In other cases, avoidance of an area may have no effect on the individual, particularly where prey species are abundant or species are wide-ranging in nature showing no particular affinity for an area. The magnitude of effect also depends on the duration of avoidance and this is considered for each species for which there is a potential noise impact.

Table 14.7: Underwater Noise Levels and Frequency from Anthropogenic Sources

Source	Noise Level (dB)	Dominant Frequency (Hz)
Piling	135-145*	50-200
Sheet Piling	140-155	50-200
5m Zodiac with Outboard Motor	152	6-300
Jack up Drilling Rig	140-160*	100
Typical Fishing Boat	150-160**	100
Tug / Barge at 10 Knots	162*	6-300
Tanker / Cruiser	177*	100

(Source: Southeran et al 2002, * Richardson et al 1995, ** Gulland and Walker (1998)
(Db) reported at 1µPa@ one metre in water (Richardson et al 1995)

The potential for physical or auditory injury to marine mammals as a consequence of any piling that maybe required at the East Tip is low.

Information on underwater noise levels from shore works is sparse, with a limited number of published reports investigating impacts associated with shore work or shore dredging related noise. Studies reporting noise levels associated with suction dredging have reported broadband noise levels of up to 188dB re 1µPa @ 1m (Nedwell, *et al*., 2008; Robinson *et al*., 2011). These noise levels are considerably lower than the than those expected for piling operations (see Table 14.7) and also well below the levels associated with marine mammal physical or auditory injury. Behavioural impacts on marine mammals due to shore operations are also likely to be limited, given the noise levels associated with these activities, the nature of the site (i.e. shallow water or intertidal and enclosed site leading to rapid noise attenuation from the source) and the low numbers of marine mammals expected to occur in the vicinity of Haulbowline.

In summary, due to the nature of the noise levels associated with the construction operations (i.e. not likely to cause physical or auditory injury and not likely to result in behavioural effects over a wide area) and the low number of marine mammals in the vicinity of construction site, impacts on marine mammals due to construction related submarine acoustic noise is predicted to be of *negligible magnitude and negligible significance* to marine mammal populations in the area.

Physical Disturbance to Marine Mammals Due to Vessel and Vehicle Activity in the Area

There is a risk of disturbance of marine mammals, including collision risk, as a result of construction activities at Haulbowline. In terms of vessel strikes, Wilson *et al*. (2007) identified the main drivers in influencing the number and severity of strikes as a result of shipping as follows:-

- Vessel type and speed;
- High levels of ambient noise resulting in difficulty in detection of approaching vessels;
- Weather conditions and time of navigation affecting the ability of crew to locate marine mammals and ambient noise levels; and
- Marine mammal behaviour, which is species-specific, though collision appears to affect juveniles and sick individuals more severely.

A review of marine mammals and ships by Laist*et al*. (2001) concluded that collision leading to serious injuries to marine mammals occurred infrequently at vessel speeds below 14kn and rarely at speeds below 10kn.

Vessel movements will be limited to safety support, inspection or the transport of materials to site. No significant vessel movements are anticipated during the works and no movements at speed are likely to occur.

Onshore vehicles and vehicles presence is minor in comparison and limited to the foreshore. As there are no haulout sites at the location there is no interaction.

Due to the low number of marine mammals in the vicinity of the construction site, and low occurrence of the impacts, interactions or impacts on marine mammals due to construction related physical disturbance is predicted to be of *negligible magnitude and negligible significance* to marine mammal populations in the area.

Effect of Increased Suspended Sediments and Sedimentation on the Behaviour of Marine Mammals during Excavation Works

As per the modelling results for model scenario A sediments may be re-suspended into the water column as a result of excavation operations during construction works at Haulbowline (refer to Appendix N: Coastal Processes Study for full details). Increased turbidity may affect the foraging ability of marine mammals, principally seals, which are dependent upon visual cues to track prey. Porpoises use echolocation regularly when foraging and are unlikely to be affected by increases in turbidity.

However, whilst seals are known to use eyesight for finding prey and navigating, they can successfully hunt in turbid and unlit waters, such as those in the Outer Cork Estuary. As discussed in the baseline conditions section, harbour porpoise and grey seal are unlikely to forage in the area, while the Outer Cork Estuary is likely to be at the edge of common seal feeding habitat in the area. Coastal process modelling showed that predicted sediment deposition for model scenario A will be restricted to the immediate vicinity of East Tip(see Appendix N: Coastal Processes Study) with a maximum deposition of approximately 50mm in the immediate vicinity of the proposed perimeter area. In addition increased suspended sediments are likely to be restricted to the area around the East Tip, with maximum increases of 500mg/l extending 0.1km and 0.17km to the north and east of the area respectively.

Resuspended site material may include elevated levels of heavy metals or other contaminants whether from the site boundary or sediments in the area. Concentrations are comparable to sediments located in the Cork Inner Estuary and therefore no additional impacts are anticipated. In addition, the contaminants are in most cases likely to remain bound to the particulate matter. There would be no anticipated effects from exposure or ingestion of such material if it occurred in the immediate vicinity of the site.

Given the relatively short term nature of the construction operations, the relatively small area potentially affected and the low numbers of marine mammals in the area, it is predicted impacts on marine mammal behaviour as a result of increased suspended sediments and sedimentation during excavation works in the foreshore will be of *negligible magnitude and negligible significance* to marine mammal populations in the area.

Common Lizard

The dry open sunny habitats at the site appear superficially to be suitable for viviparous lizard. No lizards were recorded at the site during the field survey in August 2012, and no records are known from Haulbowline Island, however the presence of this species cannot be entirely ruled out. The history of the site as an active industrial waste dump that was reclaimed from the sea means that if lizards are present, they could only be so as relatively recent colonists from the western part of Haulbowline Island, arriving at the East Tip site during the past 10 years or so as habitats became suitable. Whilst this scenario is a possibility it is considered unlikely, and should such a 'source' population of this species indeed exist on the western part of Haulbowline Island, then a similar colonisation will likely occur post-construction, following the completion of the currently proposed works.

Other Fauna

No direct impacts on other faunal groups such as birds, invertebrates or amphibians are possible as no significant populations occur at the site.

14.4.1.3.2 Indirect Impacts

This Section discusses the potential for indirect impacts on ecologically significant populations or individuals of those faunal species and groups which it is considered could be present within the 'Zone of Influence' of the proposed works and thereby susceptible to adverse effects.

Marine Mammals

Indirect Effects of Prey Availability Due to Changes in the Fish and Shellfish Resources as a Result of the Proposed Construction Works

As discussed in the baseline condition section of this Chapter, harbour porpoise and grey seal in the CorkHarbour are unlikely to use the area around the East Tip as a foraging habitat.

The only species identified as potentially in the area, are adult common seals. Common seal take a wide variety of prey including sandeels, gadoids, herring and sprat, flatfish, octopus and squid (Tollit & Thompson, 1996). The fish communities in the vicinity of the Haulbowline, is characterised from information on likely species in Irelands estuaries, which include flatfish, gadoids, bass, clupeids (e.g. sprat and herring) and small demersal fish species (e.g. goby and pogge), therefore common seal prey species may be present in the area. Impacts on these prey species (e.g. from piling and construction operations) are likely to be minimal and the high mobility and large foraging ranges of common seal means that they are likely to be able to accommodate such localised changes in prey distribution and abundance. As highlighted in Section 14.4.2 the magnitude of the impact is considered to be of *negligible magnitude and negligible significance*.

Given the low importance of the CorkHarbour as foraging habitat for marine mammals (including common seal) and the relatively minor impacts on prey species, it is predicted that the impacts on marine mammals as a result of changes in prey availability will be of *negligible magnitude and negligible significance* to marine mammal populations in the area.

Birds - Feeding Common Terns in Summer, Cormorant and Red Breasted Merganser and Other Seabirds at all Seasons

Indirect Effects of Prey Availability Due to Changes in the Fish Resources as a Result of the Proposed Construction Works

East Tip and the immediate environs were not identified as a potentially important bird feeding ground. The nearest site which may be of foraging importance is the Spit Bank area to the east of the East Tip site. Whilst there is potential for a localised reduction in prey availability at this site as a result of marine noise, the species of interest – sandeels, juvenile flatfish etc, are anticipated to remain on the Spit Bank area. Gadoids may be reduced in numbers for a period of up to 5 days following piling works (Southeran et al 2004), but affects will be short term and temporary.

Given the predicted highly localised effects of the proposed works, and the relatively minor impacts on prey species, it is predicted that the impacts on seabirds as a result of changes in prey availability will be of *negligible magnitude and negligible significance* to marine mammal populations in the area.

Indirect Effects of Contamination to Fish Resources as a Result of the Proposed Construction Works

The potential for effects on Common Terns comes from the potential for bioaccumulation of heavy metal in the food chain. Terns feed almost exclusively on shoaling pelagic fish such up to about 10cm in length, typicallysand-eel species, small clupeids (particularly sprat), gadoids and rockling fry.

West *etal*., (1975) investigated the breeding season diet of Cormorant at seven coastal colonies in Ireland and found that Wrasse comprised 60% of the diet in terms of biomass, with Eel being the second most important prey item (20%) and salmonids representing 2% of the diet. Roach and Perch are also important prey species.

Fish comprise the major component of the diet of Red Breasted Merganser, predominantly small cod, hake and plaice.

Hence, any effect on these fish populations could potentially have an effect on the food resource of the terns, either in terms of food availability or in terms of contamination of the birds with heavy metals.

Given the predicted highly localised effects of the proposed works, the potential impacts or contamination of the food source for the Seabirds is considered therefore to be of *minor significance*.

Fish

Indirect Effects of Nursery / Spawning Due to Changes in the Fish and Shellfish Resources as a Result of the Proposed Construction Works

The fish communities in the vicinity of Haulbowline Island are expected to include flatfish, gadoids, bass, clupeids (e.g. sprat and herring) and small demersal fish species (e.g. goby and pogge).

The Cork Estuaries are potentially nursery and spawning grounds for some species, however, in relation to the wider area the site footprint is likely to be of very low importance. The area affected is small and the duration of each phase of the works is less than the spawning season of most of the relevant species, therefore the effects are likely to be of *minor significance*.

Indirect Effects of Reduction in Sediment or Water Quality as a Result of the Proposed Construction Works

If sediment material from the site was introduced into the water column, given the contaminant levels in the waste material and surrounding sediments there is the possibility of chronic effects of bioaccumulation of chemicals in the fish. The levels are insufficient to cause any acute effects and levels are only marginally above the Detectable Environmental Effect levels as indicated in Cronin et al 2004. Material on the site has been exposed to inundation and only the ingestion of particulate matter is the likely route for any such effects. The material has elevated levels of heavy metals, though comparable to surrounding sediments. Marine invertebrate reworking of sediments should this material be deposited at distances from the site would result in low level residues that may bio-accumulate in fish species.

Given the predicted highly localised effects of the proposed works and the containment methods proposed, the potential impacts or contamination of the fish resource or its food source is considered therefore to be of *minor significance.*

Introduction of invasive species or anti- biofouling contaminants to the area during end-use, aftercare and maintenance phase*.*

The facility will not include any vessel areas, as a result the likelihood of the introduction of invasive species or bio toxins is greatly reduced.

No vessels are expected to be involved in the project of significant size to require ballast water. Ballast water is another potential vector for invasive species. There are strict international and national legislative controls in relation to the discharge of ballast water, and as a result it is not anticipated that this activity will occur at Haubowline or approaches to it as a result of the works. Smaller vessels may be used to assist in the works. These are likely to be contracted locally and therefore the introduction of any species from hulls or equipment is negligible.

Biofouling preventative chemicals may be introduced into sediment near the facility by the loss of flakes of marine paints during operations, loading or unloading. Any such loss would be of minute quantities and constitute a *negligible impact* to the marine sediments.

Marine Invertebrates

Coastal process modelling showed that predicted sediment deposition for model scenario A will be restricted to the immediate vicinity of East Tip (see Appendix N: Coastal Processes Study) with a maximum deposition of approximately 50mm in the immediate vicinity of the proposed perimeter area. In addition increased suspended sediments are likely to be restricted to the area around the East Tip, with maximum increases of 500mg/l extending 0.1km and 0.17km to the north and east of the area respectively.

Localised deposition of sediments may cause smothering to benthic invertebrates during the initial construction works. Due the estuarine nature of this habitat the communities have high tolerance and rapid recoverability to such events and any potential localised impact would be temporary. The community recorded with lower tolerance to such impacts is the mixed sediments with sponges and ascidians which occur outside the highest depositional area. Only areas inside the proposed sediment abatement measures would be affected.

Re-suspended site material may include elevated levels of heavy metals or other contaminants whether from the site boundary or sediments in the area. Concentrations are comparable to sediments located in the Cork Inner Estuary and therefore no additional impacts are anticipated. In addition, the contaminants are in most cases likely to remain bound to the particulate matter. The levels are insufficient to cause any acute effects and levels are only marginally above the Detectable Environmental Effect levels as indicated in Cronin et al 2004. Material on the site has been exposed to inundation and only the ingestion of particulate matter is the likely route for any such effects. The material has elevated levels of heavy metals, though comparable to surrounding sediments. There would be no anticipated effects from exposure or ingestion of such material if it occurred in the immediate vicinity of the site. Therefore it is predicted that the works will be of *negligible magnitude and negligible significance* to marine invertebrates in the area.

Indirect Impacts on Other Non-marine Faunal Species

The nature of the works is such that impacts outside the site boundary are only possible as a result of water-borne pathways via the surrounding marine waters. It is not considered possible that any non-marine fauna species other than those discussed abovecould be adversely affected by any such transport of contaminants or significant quantities of inert sediments. Hence, *no indirect impacts on non-marine* fauna species are considered possible as a result of the proposed works at the East Tip.

14.4.2 End-Use, Aftercare and MaintenanceStage

The end use, aftercare and maintenance phase at the site will be very limited, involving only routine maintenance works such as grass cutting, drain maintenance and so on, for the upkeep of the site for recreational use. Hence, no indirect negative ecological impacts will occur during end use, aftercare and maintenance activitiesatthe site or at any location remote from the site itself.

During the end use, aftercare and maintenance phase of the development, possible issues and impacts may include:-

- Disturbance to marine mammals from potential change in site usage and increased human presence;
- Disturbance to marine mammals from potential increase in the number of vessels accessing the site, and a potential increased risk of collision;
- Change in prey species (i.e. benthic, fish and shellfish species) as a result of change in light levels from the development, change in hydrodynamic regime, colonisation of structures or change in recreational fishing in the area; and
- Disturbance to birds.

Disturbance to Marine Mammals from Potential Change in Site Usage and Increased Human Presence;
and
Disturbance to Marine Mammals from Potential Change or Increase in the Number of Vessels, as well as an Increased Risk of Collision

As discussed there is a risk of disturbance of marine mammals, including collision risk, during the construction of the development works at the East Tip site. Recreational or small vessel usage is also not likely to increase, though there may be small changes to the usage of the waters around the site, i.e. more small boats may choose to use the area as the site's amenity value increases and it becomes more visually attractive as on completion of remediation and landscaping.

Shipping activity around the island of Haulbowline is not expected to increase as a result of the proposed developments and any construction support vessels associated with the proposed East Tip development are also likely to travel at low speeds (considerably less than 10kn), therefore reducing the collision risk. As a result, impacts due to physical disturbance to marine mammals (including increased collision risk) due to vessel activity in the area are predicted to be of negligible magnitude and negligible significance to marine mammal populations in the area.

Change in Prey Species (i.e. Benthic, Fish and Shellfish Species) as a Result of Change in Light Levels from the Development, Change in the Hydrodynamic Regime, Colonisation of Structures and Change

Changes in the communities and biotopes in the immediate vicinity of the site are expected to be predominantly limited intertidal habitats with the construction of rock armour or berms and therefore are not affect marine mammal prey distribution. Hydrological modelling has been conducted of the proposed end use, aftercare and maintenance phase and no hydrological changes of concern have been identified. Therefore impacts are predicted to be of negligible magnitude and negligible significance to marine mammal populations in the area.

Potential Disturbance to Birds

The small scale, infrequent and short-term nature of routine landscaping maintenance works are such that birds using areas in the vicinity of Haulbowline will not be significantly disturbed or otherwise affected.

The works description includes detailed proposals for landscaping and development of amenity usage of the site. The proposals include a number of features designed to be of benefit to flora and fauna biodiversity, these are discussed in detail in Section 14.5.2.

14.4.3 Possible Cumulative Impacts with Other Plans and Projects in the Area

Cumulative or "Combined effects" (sometimes referred to as Type 1 cumulative effects) occur when two or more different environmental effects from the proposed development act together to produce a different level of effect/impact experienced by a particular receptor. There may be potential for the impacts identified above to combine resulting in an impact on fish species in the region. These combined effects can be additive or synergistic such that the sum of the impacts can be less or more than the individual impacts (i.e. because they may exacerbate or neutralise one another).

'Cumulative' effects (or Type 2 effects) are those that accrue over time and space from a number of different development activities and projects in geographical proximity to one another. Any effect that arises as a result of incremental changes caused by other developments or impact sources (which are present or reasonably foreseeable) in combination with the effects of the development is a "cumulative" effect. The developments which are to be considered for the cumulative effects are to be agreed with the wider EIS project team, to ensure consistency of approach across all disciplines. A common set of criteria for determining which cumulative developments are included should be established across all disciplines (at least as far as is practical).

The EIA (see Chapter 16'Indirect and Cumulative Impacts and Impact Interactions') will consider all cumulative effects arising from developments which are:-

(a) of a type, duration and scale that have the potential to cause significant environmental effects in their own right; and

(b) are reasonably foreseeable in terms of delivery (i.e. committed developments which have planning consent).

Marine Mammals

During the construction phase, the only potential combined impact on marine mammals would be the interaction between submarine noise and increased suspended sediments during works. The area of influence of these two impacts are, however, likely to be similar, with noise impacts (i.e. effects on behaviour) and likely to be restricted to the area around the proposed development site and increased suspended sediment concentrations primarily in the immediate vicinity of the East Tip.

Cumulative impacts of noise, physical presence and potential suspended sediment release for associated works include the planned restoration of the HaulbowlineBridge and planned dredging operations by the Port of Cork should they occur simultanesouly. However, remediation works for the bridge will occur in advance of remdiation works at East Tip.

Remediation works to the bridge are anticipated to be undertaken prior to the site works. While this extends the exposure of marine mammals to additional anthropogenic effects in the region, it is not anticipated that the works will be of long duration, and will have limited cumulative effects with this project. The project will be subject to its own assessment and mitigation to prevent or limit any potential impacts.

The Port of Cork must maintain water depth for safety reasons in the port and approaches including the piers and jetties around Cobh and near the site. Dredging operations are unlikely to be scheduled during the construction period. Should these operations be conducted at the same time as construction, there would be a low risk of suspended sediment and noise cumulative impacts. Through consultation with the Port of Cork it is anticipated that activities can be scheduled so as not to overlap. In this case cumulative impacts would be minimised.

Due to the short term nature of construction works in the foreshore from this project and the low numbers of marine mammals expected to be impacted by the works, it is predicted that the cumulative impacts on marine mammals from submarine noise disturbance and increased suspended sediment concentrations and sedimentation during dredging operations will be of *negligible magnitude and negligible significance* to marine mammals in the region.

It is unlikely that combined noise impacts on seals (i.e. from submarine construction noise and airborne noise disturbance) will occur during the construction phase of the development. This is primarily due to the fact that the distance between the proposed development site and the closest seal haul out site (including temporary rest points) is extensive (over 30km to Kinsale haul-out and over 500m from nearest sighting) .

Fish

Cumulative impacts on fish and shellfish ecology may arise from the interaction of impacts originating from the construction or end use, aftercare and maintenance works as previously described with similar impacts arising from other marine developments in the wider region, port and harbour dredging, commercial navigations and commercial fishing and the proposed bridge rehabilitations works.

During construction, the cumulative impacts on fish and shellfish and their key habitats may arise from noise disturbance, suspended sediments, increased vessel traffic and temporary, physical disturbance of the seabed. The area impacted is small; the nature of the works temporary and the areas does not represent a significant proportion of the habitat, spawning or nursery area available to any particular species. During the end use, aftercare and maintenance phase, cumulative impacts may arise from loss of fish and shellfish habitat due to presence of PES and associated loss of intertidal habitat. Any changes in sedimentation or hydrology may also result in minor loss of habitat for fish and shellfish.

14.4.4 'Do Nothing Scenario'

In the event the site is left as it is, the waste material will be eroded from the shoreline overtime, dispersing waste material and contaminants into the surrounding sediments. Much of the site has been subject to ‘flushing’ by seawater over a period of time. There are therefore minimal dissolvable contaminants expected to remain at the site. The DQRA concluded that remediation should be undertaken in order to sever pathways through the provision of a capping layer to isolate the waste from the site users and through the use of a Perimeter Engineered Structure to reduce potential contaminant movement into the harbour.

The DQRA (WYG 2013) has predicted that there is a theoretical minor measurable impact from contaminated groundwater flux from the site in the near shore marine waters (refer to Table 13.18 and DQRA Table 39). However, as discussed in Chapter 13 “Soil, Geology and Hyrogeology” this measurable impact is considered highly conservative.

The baseline marine water analysis suggests that the site is having a negligible impact on dissolved concentrations of the water environment in its current condition. Therefore under a “Do-nothing” scenario, it is predicted that there would be no significant change to this and dissolved concentration impacts in the marine receiving water environment would remain imperceptible.

Under a “Do-nothing” scenario erosive effects on the East Tip could however continue causing localised impacts as additional solid waste is eroded from the shoreline and, if allowed to continue, contamination from heavy metals and other elements recorded at the site may be dispersed. As sediments these would be worked or consumed by the fauna surrounding the site. This could lead to localised community changes as a result. Shellfish (particularly *Mytilus edulis)* which already shows elevated levels of contaminants, particularly manganese with copper is elevated in the wider Cork Harbour Area (WYG, 2008, Marine Institute 2009) and seasonal biotoxin levels above those safe for human consumption (WYG, 2008) and polychaetes would accumulate these chemicals which would then be available to birds, fish and other vertebrates with potential health consequences for these organisms.

In addition to this should the site remain in its current condition with contaminant concentrations in the waste material exposed at surface and shallow depth, the site poses a risk to birds and mammals. In addition, the site in it’s current state is hazardous to birds and mammals due to the waste material, tangle hazards and other issues from the surface waste and facilities.

14.5 MITIGATION MEASURES

14.5.1 Construction Stage

Following from a recommendation by the NPWS, Cork County Council and/or its site agentis to employan Environmental Clerk of Works (ECoW) who will be based on-site for the duration of the construction works and will form part of the Employer's Site Representative Team. The ECoW shall have suitable qualifications and report directly to the Local Authority. The ECoW will also be the Client's Liaison for the purposes of consulting environmental bodies including the National Parks and Wildlife Service. The ECoWwill be responsible for carrying out regular Audits of the Contractor's Environmental Operating Plan and CEMP on behalf of the Local Authority. In addition, the ECoW shall be the primary person involved in the monitoring role described in detail in Section 14.5.2.

Although all impacts on marine mammals, fish and shellfish as a result of the proposals at the East Tip, Haulbowline are predicted to be of negligible magnitude and negligible significance to local population additional mitigation has been proposed.

For any proposed piling operations that maybe deemed necessary at detailed design/construction stage, the use of 'soft start' methods should be employed in order to minimise any potential noise impacts on marine mammals and fish species. This is a common technique that is generally utilised as a matter of good practice and ensures that noise emissions start at relatively low levels and are gradually increased over a 20 minute period until full operational power is achieved. If there is a pause in the piling operations for a period of greater than 10 minutes, then the soft-start procedure should be repeated. This would ensure that mammals and fish which are present within the zone of ensonification would be able to move away from this area before full operational power is achieved.

Operations (i.e. piling, if required) will be conducted in accordance with the *NPWS (2012) Draft Guidance on the Minimisation of Man Made Noise.* Where piling operations may need to be conducted in periods of low light or poor visibility, Passive Acoustic Monitoring Systems (PAMS) equipment may be used as an alternative to Marine Mammal Observer scans of the area.If piling activities are deemed necessary, detailed method statements will be prepared and agreed with NPWS, which will outline measures to avoid and minimise impacts on seabirds, marine mammals and fish. Consideration will be given to the scheduling of the works between the end of May and August, which is a particularly sensitive time for seabirds, marine mammals and fish.

Hydraulic flow model simulations from the Coastal Processes Study (RPS 2013) in Appendix N: Coastal Processes Studyshowed that there were no changes in the flow regime away from the immediate area around the proposed works site. Even the changes in current velocities in the immediate vicinity of the construction area were predicted to be very small, typically in the range -0.1 to +0.04m/s. The proposed development will have no significant impact on the wave climate in the area and will not affect the overall sediment transport regime in CorkHarbour. Thus it is concluded that the proposed remedation solution will not have a significant impact on the coastal processes of Cork Harbour.

Areas of construction are to be protected from sediment resuspension by the use of, geotextile tubes, sediment screens,sheet pilingor other sediment abatement measures(See Chapter6'Project Construction'). Additional mitigation such as sediment screens will be considered in areas where there is a risk of resuspension during sheet piling, protective berms or geotextile tube placement as determined by the sediment modelling (Appendix N: Coastal Processes Study). Coastal process modelling showed that predicted sediment deposition for model Scenario A will be restricted to the immediate vicinity of East Tipwith a maximum deposition of approximately 50mm in the immediate vicinity of the proposed perimeter area. In addition increased suspended sediments are likely to be restricted to the area around the East Tip, with maximum increases of 500mg/l extending 0.1km and

0.17km to the north and east of the area respectively. Model Scenario A did not include any of the additional sediment abatement measures as outlined above with respect to the excavation of the rock armour keystone trench. In addition to this Scenario A is considered to be a conservative model as it has assumed that all works in the foreshore are executed over a 1 month tidal cycle as opposed to predicted 9 month period (refer to chapter 6 “Project Construction”. As discussed in Section 14.2.3 model Scenario A has been referred to in order to assess impacts from the envisaged works.

In order to monitor water and sediment quality associated with the works, two-monthly water quality monitoring and bi-annual sediment monitoring will be conducted at 6 reference sites around the East Tip (see Chapter 13’ Soils, Geology and Hydrogeology’ Figure 13.2 and Table 13.24). Works containment by sheet piling, protective berm, geotextile tubes or sediment screens are intended to contain all materials within the working site area.

As part of the Environmental Clerk of Works (ECoW) responsibilities, visual monitoring of the sediment screens and works containment measures will be undertaken during foreshore operations. In the event any turbidity is observed during works outside this containment, works will cease, and an investigation of the source and deployment of additional screens will be undertaken prior to recommencement (see Site Management below).

As far as possible, night workingon the site will be avoided. Due to the requirement for tidal dependant working in the foreshore, where it is required it will be limited to foreshore works where contractors will be working with the tidal cycle. For the majority of operations site works will only occur during normal daytime hours minimising the need for lighting and reducing potential physical presence effects. Most operations are planned to occur in normal working hours and therefore have minimal additional affects, above the existing port, naval base and vessel operations and traffic in the vicinity, to which any marine mammals present can be assumed to be acclimatised. Late working may be required as operations in the foreshore are tidal window dependant. Where possible these operations will be minimised and will be limited to excavation works. Any proposed piling operations will occur only during daylight hours and be subject to the NPWS 2012 guidance for mitigation.

Any piling works that maybe required will be subject to the NPWS 2012 Draft Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources. The ECoW will be responsible for ensuring that an appointed Marine Mammal Observer is present on site for these works and that the scans and soft starts within the guidance are adhered to.

Site management will also be present during construction. Management will include observation and direction of dust and sediment abatement as well as enforcement of best practice and guidelines. Whilst mitigation for sediment and noise control is anticipated to mitigate any effects, this will provide further observatory monitoring for any site issues.

14.5.2 End- Use, Aftercare and MaintenanceStage

An BordPleanála, in their submission to Cork County Council of the 4th of January 2013, requested that “A full programme for measuring impacts during and after reclamation on wildlife shall be included – this shall build upon existing baseline data.”

Whilst negative effects on wildlife during construction are not anticipated, the construction contract will include a requirement for the contractor to complete the following:-

- To employ a suitably qualified ecologist who will, in consultation with National Parks and Wildlife Service, develop an appropriate monitoring programme that will be designed to identify any negative effects on wildlife that may occur during the construction period. The monitoring programme will include provision for mechanisms whereby measures can be taken to stop works wherever significant negative effects on wildlife are detected.

The licencee will contract a suitable qualified ecologist, who will, in consultation with National Parks and Wildlife Service, develop an appropriate monitoring programme that will be designed to examine the long-term future usage of the site by wildlife. Specifically, the monitoring will include examination of the usage by wildlife of the features that have been included in the end-use design of the site to be of benefit to wildlife including *inter alia*, the bird roosting area (see Figure 5.7) and the wetland area. The monitoring programme should aim to determine whether or not these features have been successful. At minimum this will include regular examination (the timeframe to be agreed with NPWS) of the flora species present in the wetland area; examination of bat usage of the site, and monitoring of the numbers of birds roosting along the shoreline of the site. Where monitoring indicates that measures are 'failing' in their objectives, or that simple modification could readily improve their effectiveness, the licencee will, under recommendation from the contracted ecologist, and in consultation with NPWS, undertake remedial actions to attempt to improve the success of the measures.

14.6 PREDICTED RESIDUAL IMPACT

14.6.1 Construction Stage

14.6.1.1 Designated Sites

14.6.1.1.1 Sites of International Importance

Two Natura 2000 sites are located within Cork Harbour; Cork Harbour SPA (site code 004030), which is comprised of several non-contiguous areas around the harbour, the closest of which to Haulbowline are at Lough Beg 1.4km to the south and at Monkstown Creek 2.2km to the west; and Great Island Channel cSAC (site code: 001058) which is located 4.2km to the north of Haulbowline.

Coastal process modelling showed that predicted sediment deposition for model scenario A will be restricted to the immediate vicinity of East Tip (see Appendix N: Coastal Processes Study) with a maximum deposition of approximately 50mm in the immediate vicinity of the proposed perimeter area. In addition increased suspended sediments are likely to be restricted to the area around the East Tip, with maximum increases of 500mg/l extending 0.1km and 0.17km to the north and east of the area respectively. The Natura 2000 sites are therefore outside the zone of influence of the proposed works.In addition the hydraulic flow model simulations (refer to Appendix N: Coastal Processes Study) showed that there were no changes in the flow regime away from the immediate area around the proposed works site.

Post construction, footpath works and minor road resurfacing may be required on the access road to Haulbowline Island. At its nearest point these works may be 600m from the nearest Natura 2000 site.

Robust and effective mitigation measures have been proposed for the minimisation of any impacts affecting water quality within all relevant Natura 2000 sites. Specific mitigation measures have been proposed for the prevention of impacts to all relevant Annex II species. Likewise, precautions will be taken in relation to non-native invasive species during the construction phase.

The Natura 2000 sites are outside the zone of influence of the proposed works and here will be no potential for cumulative impacts arising in combination with any other plans or proposals. Therefore with the implementation of best practice and the recommended mitigation measures; it is considered that the proposed East Tip Remediation Project will not adversely affect the integrity of Cork Harbour SPA and Great Island Channel cSAC.

14.6.1.1.2 Sites of National Importance

A total of ten proposed Natural Heritage Areas (pNHAs) are designated within CorkHarbour and are located within 1.4 and 10.1km of the East Tip, Haulbowline. Most of these correspond to the Natura 2000 designations as discussed above. Similarly all of these sites are outside the zone of influence of the proposed works and therefore will not be impacted by the development.

14.6.1.2 Habitats and Flora

The construction works will result in a minor loss of intertidal habitat as a result of the construction proposed.

Subtidal areas are expected to be minimally affected, and are characteristic of the surrounding sediments and habitats. There are habitats of significant ecological value in the vicinity of the site. The communities in mixed sediments are robust to localised changes in sedimentation, and disturbance and have rapid recovery and recolonisation times.

No non-marine habitats of significant ecological value are located within the proposed works site at the East Tip and no flora species of conservation concern are considered to occur. Hence, no impacts on non-marine habitats or flora species of significant ecological value are considered possible as a result of the proposed works at the East Tip.

Minor loss of improved grassland associated with the access road edge may be required to facilitate the post construction footpath improvement work.

14.6.1.3 Fauna

It is concluded that the proposed works will have no negative effect on bat populations, significant or otherwise. The end use landscaping of the site, which include extensive vegetation planting and the establishment of a periodically wet grassland area, are likely to have a positive effect on the overall biodiversity of the site and local bat populations (see Appendix O: Ecology Supporting Information: Bat Report (Appendix O.2) and Section 14.5.2). Usage of the site by bats will be monitored (see Section 14.5.2).

It is concluded that the proposed works will not have any detrimental effect on either individual otters or on wider otter populations on the vicinity. Whilst otters are likely to pass along the coastline of the East Tip site on a regular basis, the site is not used heavily by otters; and the site does not constitute and important area of habitat for otters. This is likely to be due to the absence of fresh water. Remediation of the site includes the establishment of a wet grassland area which will, on occasion support standing fresh water which may encourage otters to use the area more frequently (see Section 14.6.2).

The southeastern promontory of the site has been screened from the remainder of the site and the rock armouring of the shoreline will be modified, to increase its attractiveness as a roosting location for waterbirds. Whilst the success or otherwise of this measure is difficult to anticipate, and will be monitored (see Section 14.5.2), any increase in the number of waterbirds using the shoreline of the site as a high tide roost should be considered as a positive impact.

There are residual temporary avoidance potential effects from noise, physical presence and suspended sediments to mobile marine species. These are of short duration and do not form a barrier to species movement. No areas or species of particular conservation interest have been identified as being affected beyond a negligible level and these effects individually or in combination will not for a barrier to species movement.

There will be a residual loss of foreshore habitat as a result of construction. This will be replaced with rock armour. The area lost is negligible in comparison to the range of habitat in the local area, and the habitat present at the site at East Tip is highly degraded with waste and rubbish in the foreshore. As a result this residual impact is deemed to be negligible.

It is anticipated that as a result of the works there will be a residual positive effect to surrounding sediment and faunal communities as a result of the removal of the pathways of site material to the East Tip foreshore areas by erosion and distribution of waste material.

14.6.2 End-Use, Aftercare and Maintenance Stage

The end-use, aftercare and maintenance works at the site will be very limited, involving only routine maintenance works such as grass cutting, and so on, for the upkeep of the site for recreational use. Hence, no indirect negative ecological impacts will occur during end use, aftercare and maintenance of the site or at any location remote from the site itself.

The small scale, infrequent and short-term nature of routine landscaping maintenance works are such that birds using areas in the vicinity of Haulbowline will not be significantly disturbed or otherwise affected.

The works description includes detailed proposals for landscaping and development of amenity usage of the site. The proposals include a number of features designed to enhance biodiversity as follows:

14.6.2.1 Bird Roosting Area

In order to provide an area of shoreline which will be undisturbed and attractive to roosting birds, landscaping, site profiling and vegetation planting have been designed to include an area along the eastern boundary of the site that will be visually screened from pathways and other locations where people will be present. Vegetation planting in this area will be of low-growing species so that trees that overlook the area will not be present. In addition, the attractiveness of the area for roosting birds will be further enhanced along the shoreline by modifications to the slope of armouring to form ‘platform(s)’ to break the slope to make it more suitable for roosting birds. Each ‘platform’ will measure approximately $20m^2$ to $40m^2$ and will be situated just above mean high tide mark.

14.6.2.2 Soil Cover and Creation of Wet Grassland Area

The coverage of the site with topsoil and amenity grassland will provide suitable feeding and perhaps loafing/ roosting habitat for a number of bird species such as Oystercatcher. The creation of a wet grassland area will further enhance the attractiveness of the site to such species.

Cork Harbour SPA

Martello Tower Common Tern Colony

Great Island Channel cSAC

Cork Harbour SPA

Haulbowline East Tip Site

Cork Harbour SPA, Monkstown Creek

Spit Bank

Deep Water Port Common Tern Colony

Cork Harbour SPA,
Lough Beg

Cork Harbour SPA

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Legend

- Cork Harbour Special Protection Area (SPA)
- Great Island Channel candidate Special Area of Conservation (cSAC)
- Study Area Boundary / Extent of works

Title

HAULBOWLINE ISLAND
STUDY AREA
LOCATION OF NATURA 2000 SITES AND OTHER FEATURES

Figure 14.1

File Ref: MCE0734MI0020F01
Date: April 2013
Rev : F01

East Tip Remediation Project

EAST TIP REMEDIATION PROJECT

RPS

Glanmire Wood pNHA
Site Code 001054

Dunkettle Shore pNHA
Site Code 001082

Rockfarm Quarry pNHA
Site Code 001074

Great Island Channel pNHA
Site Code 001058

Douglas River
Estuary pNHA
Site Code 001046

Cuskinny Marsh pNHA
Site Code 001987

Rostellan Lough,
Aghada Shore and
Poulnabibe Inlet pNHA
Site Code 001076

Monkstown Creek pNHA
Site Code 001979

Whitegate Bay pNHA
Site Code 001084

Owenboy River pNHA
Site Code 001990

Lough Beg (Cork) pNHA
Site Code 001066

Legend

proposed Natural Heritage Areas (pNHAs)

Study Area Boundary / Extent of works

Title

Haulbowline Island
Study Area
Location of proposed
Natural Heritage
Areas (pNHAs)

Figure 14.2

File Ref: MCE0734MI0019F02
Date: October 2013

East Tip Remediation Project

EAST TIP REMEDIATION PROJECT

RPS

Legend

- Mosaic of 'Recolonising bare ground' (ED3) and 'Spoil and bare ground' (ED2)
- Approximate extent of 'Buildings and artificial surfaces' (BL3).
- 'Amenity grassland (improved)' (GA2)
- Study Area Boundary / Extent of works

Title

HAULBOWLINE ISLAND
STUDY AREA
HABITAT DETAILS

Figure 14.3

File Ref: MCE0734MI0018F01
Date: April 2013
Rev : F01

East Tip Remediation Project

EAST TIP REMEDIATION PROJECT

RPS