3FMProject

Bringing Dublin Port To 2040

Environmental Impact Assessment Report

Chapter 8

Lands, Soils, Geology and Hydrogeology

Volume 2 Part 2

COMHLACHT CHALAFORT ÁTHA CLIATH
DUBLIN PORT COMPANY

rps
A TETRA TECH COMPANY

Third & Final Masterplan Project

8 LAND, SOILS, GEOLOGY & HYDROGEOLOGY

8.1 Introduction

This chapter comprises an appraisal of the existing ground conditions at the 3FM Project development site and addresses the potential effects of the 3FM Project on the land, soils, geology and hydrogeology of the site and surrounding areas. The assessment is based on the development as described in Chapter 5 of the EIAR. Where potential adverse impacts are identified, the assessment identifies mitigation measures that will be implemented to prevent, reduce or offset potential adverse effects, or enhance potential beneficial effects where possible.

A Preliminary Risk Assessment (PRA), Generic Quantitative Risk Assessment (GQRA) and Remedial Strategy have been prepared to support this assessment. The PRA, GQRA and Remedial Strategy reports are contained within Appendix 8-1, 8-2 and 8-3 of the EIAR.

8.2 Assessment Methodology

This section describes the methodology which has been used in the assessment of land, soils, geology and hydrogeology which may impact, or be impacted by, the 3FM Project.

8.2.1 Guidance

The methodology outlined within the following guidance documents was used in the assessment:

- 'Geology in Environmental Impact Statements', published by The Institute of Geologists of Ireland in September 2002.
- Institute for Geologists Ireland (IGI) Guidance for the preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements, April 2013.
- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports, Environmental Protection Agency, May 2022.
- The National Roads Authority's guidelines; 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes', published in 2008. These guidelines aim to provide guidance on the assessment of geological, hydrological and hydrogeological impacts through the EIA process.

A Preliminary Risk Assessment (PRA) Desk Top Assessment (EIAR Appendix 8-1) was prepared using guidance provided by the UK Environment Agency (EA). The UK technical guidance for assessing and managing risks from contaminated land is detailed in 'Land Contamination Risk Management' (LCRM) published by the Environment Agency in 2020 and this guidance is accepted by the EPA (in the absence of Ireland Government guidance).

Underpinning the guidance within LCRM is a source-pathway-receptor methodology, which is used to identify Significant Pollutant Linkages (SPLs).

The following definitions apply:-

- Source: identification of contamination source
- Pathway: the means by which the contamination can come into contact with the receptor
- Receptor: the entity which is vulnerable to harm from the contamination source

An important thread throughout the overall process of risk assessment is the need to formulate and develop a conceptual model for the site, which supports the identification and assessment of pollutant linkages. Development of the conceptual model forms the main part of the preliminary risk assessment, and the model is subsequently refined or revised as more information and understanding is obtained through the risk assessment process. A risk is present only when a source-pathway-receptor linkage is present and active.

A phased approach in line with LCRM guidance has been taken with regard to the assessment of contaminated land at the site. As part of this phased approach, the initial desk study of available information was carried out which was used to plan and focus the ground investigation.

8.2.2 Human Health Risk Assessment

In the absence of Irish guidance on contaminated land risk assessment, current guidance provided by the UK Environment Agency (EA) has been utilised to form the basis of this assessment.

The EA has published guidance in relation to assessing the potential risk from contaminated land to human health. The EA's Science Report SR2 'Human Health Toxicological Assessment of Contaminants in Soil' and Science Report SR3 'Updated Technical Background to the CLEA Model', together with LCRM provide the most up to date framework for human health risk assessment within the UK and Ireland.

In order to assess the human health and environmental risks posed by potential contaminants within the underlying soils, RPS undertook an initial screening of the laboratory results using the 2015 LQM/CIEH (Land Quality Management/Chartered Institute of Environmental Health) Suitable 4 Use Levels (S4ULs) (Copyright Land Quality management Limited reproduced with permission; Publication Number S4UL3474, all Rights Reserved) as trigger values. These LQM/CIEH S4ULs replace the second edition of the LQM/CIEH Generic Assessment Criteria (GAC) published in 2009. Differences in modelling assumptions and added land uses and substances create the difference between these S4ULs and the previous GAC. These values are provided for six land use classifications:

- Residential with homegrown produce
- Residential without homegrown produce
- Allotments
- Commercial
- Public open space near residential housing
- Public park

For pollutants with no relevant S4ULs, assessment criteria were provided by Soil Guideline Values (SGVs) and CL:AIRE's (Contaminated Land: Applications in Real Environments) GAC. In light of the publication of SR2 and

SR3 the Environment Agency published SGVs for a number of contaminants for the following standard land use scenarios assuming a Sandy Loam soil and Soil Organic Matter (SOM) content of 6%:

- Residential
- Allotments
- Commercial

CL:AIRE in association with the Environmental Industries Commission (EIC) and Association of Geotechnical and Geo-environmental Specialists (AGS) published a set of GAC in 2009 for previously unpublished contaminants which are intended to complement the SGVs derived by the EA. The GACs have been derived predominantly for VOCs and SVOCs using CLEA v1.06 for a number of different Soil Organic Matter contents (1%, 2.5% and 6%).

Commercial screening values have been used in this assessment where a commercial/port activity will be undertaken. Public Open Space near Residential (POSresi) end use screening values have been used in areas of public open space such as the proposed Port Park.

8.2.3 European Union Legislation

European Union legislation is a significant consideration in assessing the effects of a scheme on the geological and hydrogeological attributes of a site, and is outlined below.

The Water Framework Directive (2000/60/EC) establishes a framework for community action in the field of water policy. The main objective of the Directive is for all groundwater, surface water and coastal water bodies to achieve ‘good’ status by 2015. The Directive introduced new broader ecological objectives as well as aims to prevent deterioration of all water bodies. The Directive must be considered in any scheme that has the potential to impact on any part of the water environment. The Water Framework Directive has been transposed into Irish law by means of a number of statutory instruments. The European Communities (Environmental Liability) Regulations 2008 (S.I. 547 of 2008) came into force in Ireland in April 2009. EU Directive 2004/35/CE on environmental liability with regard to the prevention and remedying of environmental damage is transposed into Irish law via these regulations. Their purpose is to establish a framework of environmental liability based on the 'polluter-pays' principle, to prevent and remedy environmental damage.

8.2.4 Sources of Information

The following sources of information were used in the compilation of this assessment:

- Environmental Protection Agency Map viewer - http://gis.epa.ie/Envision/;
- Geological Survey of Ireland Spatial Resources;
- http://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228;
- Environmental Protection Agency Radon Map - http://www.epa.ie/radiation/radonmap;
- Irish Aquifer Properties – A Reference Manual and Guide, Environmental Protection Agency and Geological Survey Ireland, March 2015;
- Internet based aerial photography.

8.2.5 Assessment of Significance

8.2.5.1 Sensitivity of Receptor

Effects of the development on land, soils, geology and hydrogeology receptors have been assessed taking into account sensitivity of the receptor and magnitude of the effect. The sensitivity of the receptors is determined according to the methodology shown in Table 8.1.

Table 8.1 Sensitivity of receptor (Amended from 'NRA Guidelines on procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes')

Sensitivity	Criteria	Typical Examples
Very High	Attribute has a high quality and rarity on regional or national scale.	• Geology: World Heritage Sites; sites protected under EU wildlife legislation (SAC, SPA, SSSI, Ramsar site) or • Geological features that are rare on a regional or national scale. • Surface waters: River, wetland or surface water body ecosystem protected by EU legislation.
High	Attribute has a high quality and rarity on Local scale.	• Geology: Regional important geological sites. • Soils; Well drained and/or high fertility soils. • Surface water: Ecosystem protected by national legislation. • Groundwater: Regionally important potable water source supplying >2500 homes, groundwater vulnerability is classified as high; principal aquifer providing a regionally or locally important resource or supporting site protected under wildlife legislation. • Future site users: Sensitive land uses proposed such as residential housing with gardens, allotments, schools. • Built Environment: Sites of international Importance, World Heritage Sites, Listed Buildings, and Scheduled Monuments
Medium	Attribute has a medium quality and rarity on local scale.	• Soils: Moderately drained and/or moderate fertility soils. • Groundwater: Local potable water source supplying >50 homes, moderate classification of groundwater vulnerability; secondary aquifer providing water for agricultural or industrial use with limited connection to surface water. • Geology: Regionally Important Geological Sites. • Future site users: Moderately sensitive land uses such as residential housing without gardens, commercial developments and open spaces. • Built Environment: Sites with local interest for education or cultural appreciation.
Low	Attribute has a low quality and rarity on local scale	• Soils: Poorly drained and/or low fertility soils. • Groundwater: Local potable water source supplying <50 homes, deep secondary aquifer with poor water quality not providing baseflow to rivers. • Geology: Rock exposures. • Future Site Users: Low sensitivity land use such as Industrial Sites, highways and rail. • Built Environment: Infrastructure (e.g. Roads, railways, tramways).
Neutral	Very low importance and rarity on local scale.	• Geology: No rock exposures. • Soils: Urban classified soils. • Groundwater: Non-aquifer/Unproductive Strata.

For the purposes of this assessment it is considered that Regionally Important (R) Aquifers are Principal Aquifers; Locally Important (L) Aquifers are Secondary Aquifers and Poor (P) Aquifers are Unproductive Strata. Different classifications exist for each of the aquifer types, as listed below:

Regionally Important (R) Aquifers:

- Karstified bedrock (Rk) where Rkc represents an aquifer dominated by conduit flow and Rkd represents an aquifer dominated by diffuse flow
- Fissured bedrock (Rf)
- Extensive sand and gravel (Rg)

Locally Important (L) Aquifers:

- Bedrock which is generally moderately productive (Lm)
- Bedrock which is moderately productive only in local zones (Ll)
- Sand & gravel (Lg)
- Locally important karstified bedrock (Lk)

Poor (P) Aquifers:

- Bedrock which is generally unproductive except for local zones (Pl)
- Bedrock which is generally unproductive (Pu)

8.2.6 Impact Assessment

The magnitude of a potential effect is independent of the sensitivity of the feature. The magnitude considers the scale of the predicted change to the baseline condition considering its duration (i.e. the magnitude may be moderated by the effects being temporary rather than permanent, short term rather than long term) and whether the effect is direct or indirect. Definitions for impact magnitude are described in Table 8.2.

Table 8.2 Criteria to determine the magnitude of effect (Amended from 'NRA Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes')

Magnitude	Criteria	Typical Examples
Major Adverse	Total loss or major alteration to key features of the baseline conditions such that post development character / composition of baseline condition will be fundamentally changed.	• Irreversible loss of high proportion of local high fertility soils/sediments. • Pollution of potable sources of water abstraction • Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. • Loss of, or extensive change, to nationally important geological features. • Sterilisation of high-quality mineral resource • Long-term (chronic) risk to human health or short-term (acute) risk to human health. • Short- term risk of pollution of sensitive water resources. • Extensive damage to buildings / infrastructure (on or off site). • Generation of significant quantities of waste sediment or soils for landfill; and • Contamination of offsite soils. • Substantial geomorphology changes due to cutting
Moderate Adverse	Loss or alteration to one or more key features of the baseline conditions such that post development character / composition of baseline condition will be materially changed.	• Irreversible loss of moderate proportion of local high fertility soils/sediments. • Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. • Partial loss or change to an aquifer. • Partial loss of the integrity of groundwater supported designated wetlands. • Permanent loss of, regionally important geological features, or substantial changes to nationally important geological features. • Sterilisation of low quality mineral resources. • Easily preventable, permanent health impacts on humans or medium-term (chronic) risk to human health. • Medium long-term risk of pollution of sensitive water resources; damage to buildings / infrastructure (on or off site); and • Localised damage to buildings/ infrastructure (on or off site).
Minor Adverse	Results in some measurable change in attributes quality or vulnerability compared to baseline conditions. Changes arising from the alteration will be detectable but not material; the underlying character / composition of baseline condition will be similar to the pre-development situation.	• Irreversible loss of small proportion of local high fertility soils/sediments and/or high proportion of local low fertility soils/sediments • Changes to made ground deposits only. • Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems. • Minor effects on groundwater supported wetlands. • Loss of, or extensive change, to locally important geological features. • Easily preventable, non-permanent health impacts on humans. • Minor low-level and localised contamination of on-site soils/sediments.

Magnitude	Criteria	Typical Examples
		• Pollution of non-sensitive water resource or low long-term risk of pollution to sensitive water resource; and • Easily repairable damage to buildings / infrastructure.
Neutral	Very little change from baseline conditions. Change is barely distinguishable approximately to a “no change” situation.	• No measurable impact upon surface waters or groundwater. • No measurable impact on geological features. • No measurable impact on soils/sediments. • No discernible change with regards to contaminated land
Beneficial	Benefit to, or addition of, key characteristics, features or elements compared to baseline conditions.	• Improvement to geological features. • Remediation of widespread high levels of soil/sediment contamination • Removal of source of groundwater and surface water contamination • Re-use of significant quantities of excavated soils on-site to avoid disposal to landfill.

8.2.7 Significance Criteria

The significance of a specific potential effect is derived from both the sensitivity of the feature and the magnitude of the effect, and can be then determined using the matrix presented in Table 8.3 (has been amended from ‘NRA Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes’). Effects can be beneficial, adverse or neutral and their significance Very Large, Large, Moderate, Slight or Neutral or an intermediary designation as cases dictate based on professional judgement. The significance of an impact should also be qualified based on the likelihood of an effect occurring (using a scale of certain, likely or unlikely) and the confidence in the accuracy of the assessment.

Professional judgement can be used to vary the category where specific circumstances dictate, for example due to the vulnerability or condition of the receptor.

Table 8.3 Assessment of Significance Matrix (Amended from ‘NRA Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes’)

		Magnitude of Effect			
		Major	**Moderate**	**Minor**	**Neutral**
Sensitivity of Attribute	**High**	Major	Minor/Moderate	Minor/Moderate	Neutral
	Medium	Major	Moderate	Minor	Neutral
	Low	Minor/Moderate	Minor	Neutral	Neutral
	Neutral	Neutral	Neutral	Neutral	Neutral

8.2.8 Significance of Residual Effects

The significance of effects for land, soils, geology and hydrogeology has been assessed initially without taking mitigation measures into account. Residual effects (effects that remain once mitigation measures are taken into consideration) are then identified. Temporary effects are considered in the construction period whilst permanent effects are discussed in the operational phase, albeit that the effect may first occur during construction.

8.3 Consultation

Significant consultation regarding the overall Dublin Port Masterplan 2040, reviewed 2018, and the 3FM Project has been completed with the local community, An Bord Pleanála, Dublin City Council and various other statutory bodies (see Chapter 3 Scoping and Consultation). No concerns with regard to contaminated land were raised.

8.4 Receiving environment

8.4.1 Land

The Guidelines on the Information to be contained in Environmental Impact Assessment Reports (May 2022) published by the Environmental Protection Agency [EPA] state that the amended Directive introduces Land as a prescribed environmental factor. Recital 9 gives context to this addition, showing that it relates to the issue of ‘land take’. This change aligns the Directive with proceedings of the United Nations Conference on Sustainable Development (Rio de Janeiro, 2012) and with Commission strategy.

Land is also defined in Section 2 of the Planning and Development Act 2000, as amended as including “any structure and any land covered with water (whether inland or coastal)”, that is, Foreshore is included in the definition.

The baseline characteristics of the 3FM Project in relation to Land are set out as follows:

- Land-take, sustainable availability of land
- Quantity of land used
- Removal of productive land from potential agricultural or other beneficial uses
- Location and physical characteristics of the land
- Existing land use

8.4.1.1 Land-take, sustainable availability of land

The Dublin Port Masterplan 2040, reviewed 2018, recognises the finite availability of land for port-related activity. Dublin Port lies immediately adjacent to the South Dublin Bay and Tolka Estuary SPA and the Masterplan commits to no further port expansion within the Tolka Estuary. Instead, the Masterplan focuses on the redevelopment of existing brownfield lands, berthing pockets and navigation channel in order to provide for the 77.2m gross tonnes projected by 2040.

The 3FM Project aims to provide port infrastructure which will improve the efficiency of port operations and thereby increase the throughput of unitised cargo in the Ro-Ro and Lo-Lo modes.

8.4.1.2 Quantity of land used

Dublin Port is the largest port in Ireland. The Northern Lands and Southern Lands of Dublin Port (Dublin Port Estate) comprise an area of 265ha. of land entirely within the ownership of Dublin Port Company. The entire Port Estate comprises 309ha, including the lands at the Dublin Inland Port. The 3FM Project area enclosed by the planning application boundary is c.1,000ha extending into Dublin Bay to include the licenced offshore dump site.

8.4.1.3 Removal of productive land from potential agricultural or other beneficial uses

The future land use within the footprint of the 3FM Project will therefore not significantly change, however, a significant area of port-owned lands will be given over to the public realm initiatives including the development of the proposed Maritime Village, Active Travel, Port Park, Coastal Park, and Irishtown Nature Park. The proposed Port Park in particular, will enhance the sustainability of the wider port area and the 3FM Project. The inclusion of wildflower meadow and woodland trees will encourage biodiversity within an area of land which is currently predominantly concrete hardstanding. The provision of amenity facilities such as sports pitches, play tower and park land will provide a more productive land use for local residents of the area with regards to social, health and wellbeing.

8.4.1.4 Location and physical characteristics of the land

The application boundary for the 3FM Project is provided in Chapter 5: Project Description. Land required to facilitate the proposed 3FM Project comprises areas of existing port infrastructure and areas of marine foreshore.

8.4.1.5 Existing land use

The existing port-related land uses within the footprint of the 3FM Project comprise the manoeuvring and berthing of vessels, the handling of Lo-Lo cargo and HGV traffic distributing cargo to and from Dublin Port. Other lands owned by Dublin Port Company are currently in industrial use.

8.4.2 Solid Geology

The bedrock geology anticipated in the vicinity of the site is shown on Figure 8.1. The entire Dublin area is underlain by the Lucan Formation. The formation comprises dark-grey to black, fine-grained, occasionally cherty, micritic limestones that weather paler, usually to pale grey. There are also rare, dark, coarser grained, calcarenitic limestones, which are sometimes graded, present. The formation ranges from 300m to 800m in thickness and is Carboniferous.

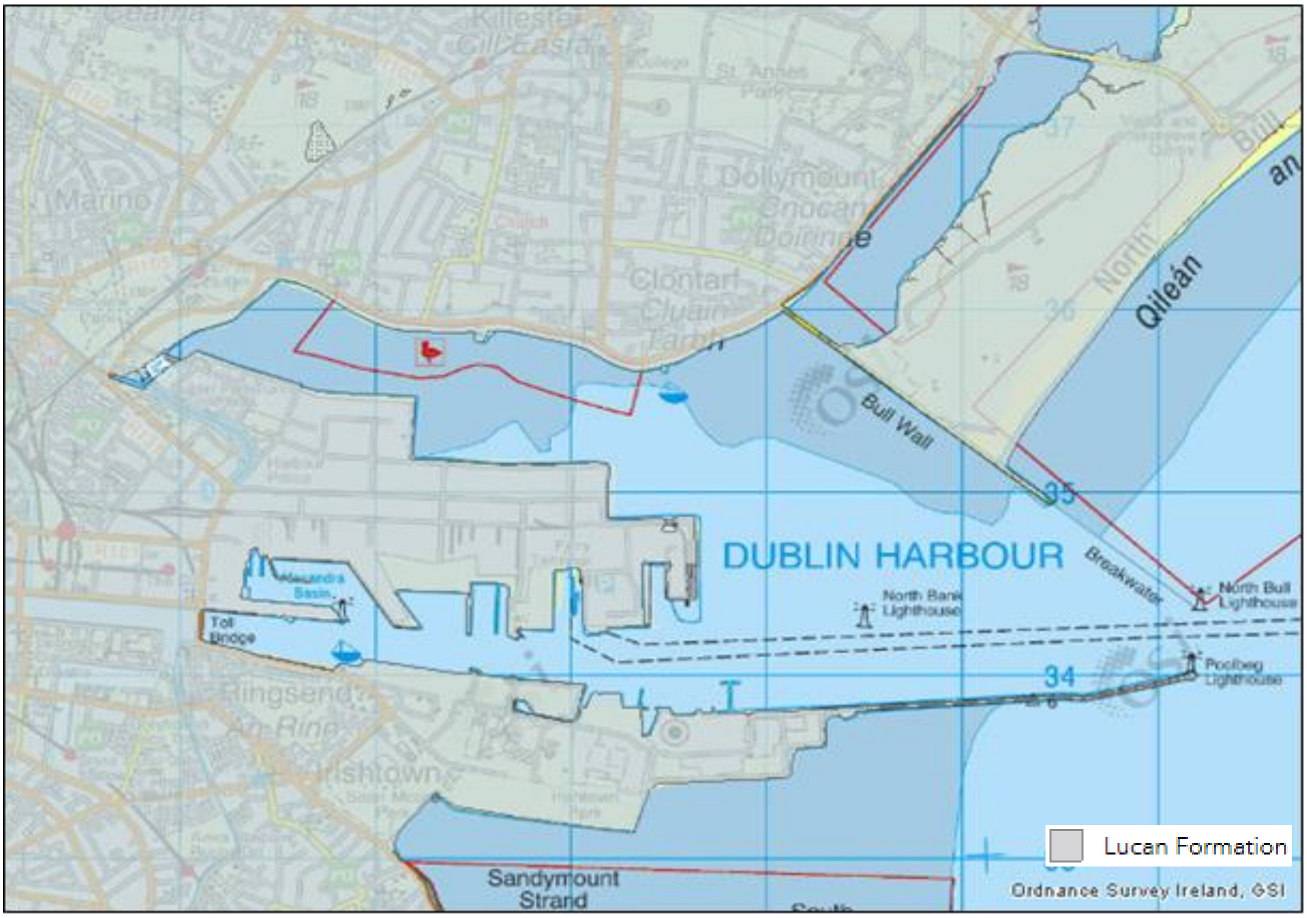


Figure 8.1 Solid geology (taken from GSI's Spatial Resources portal)

8.4.3 Drift Geology and Recent Deposits

Drift is a general term applied to all mineral material (clay, sand, silt, boulders) transported by a glacier and deposited directly by or from the ice, or by running water emanating from the glacier. It generally applies to Pleistocene glacial deposits.

The drift geology of the area is expected to principally reflect the depositional process of the last glaciation when an extensive ice sheet that extended into the Irish Sea covered the region. Typically during the ice advance boulder clays were deposited sub-glacially as lodgement till over the eroded rock head surface, whilst moraine deposits were laid down at the glacier margins. Subsequently, with the progressive retreat of the ice sheet from the region, fluvio-glacial deposits (sand, gravel and silt) were laid down by melt waters discharging from the front of the glacier. Recent deposition prior to reclamation of the site principally reflects marine erosional and depositional processes, which have modified the glacial deposits.

As shown on Figure 8.2, the site is anticipated to be underlain by made ground. Dublin Port is located entirely on made ground (fill deposits). Available mapping provided by Geological Survey Ireland has not been updated to reflect the reclamation and presence of made ground across the wider expanse of Dublin Port, hence, some areas are shown to be void of 'urban' sediments.

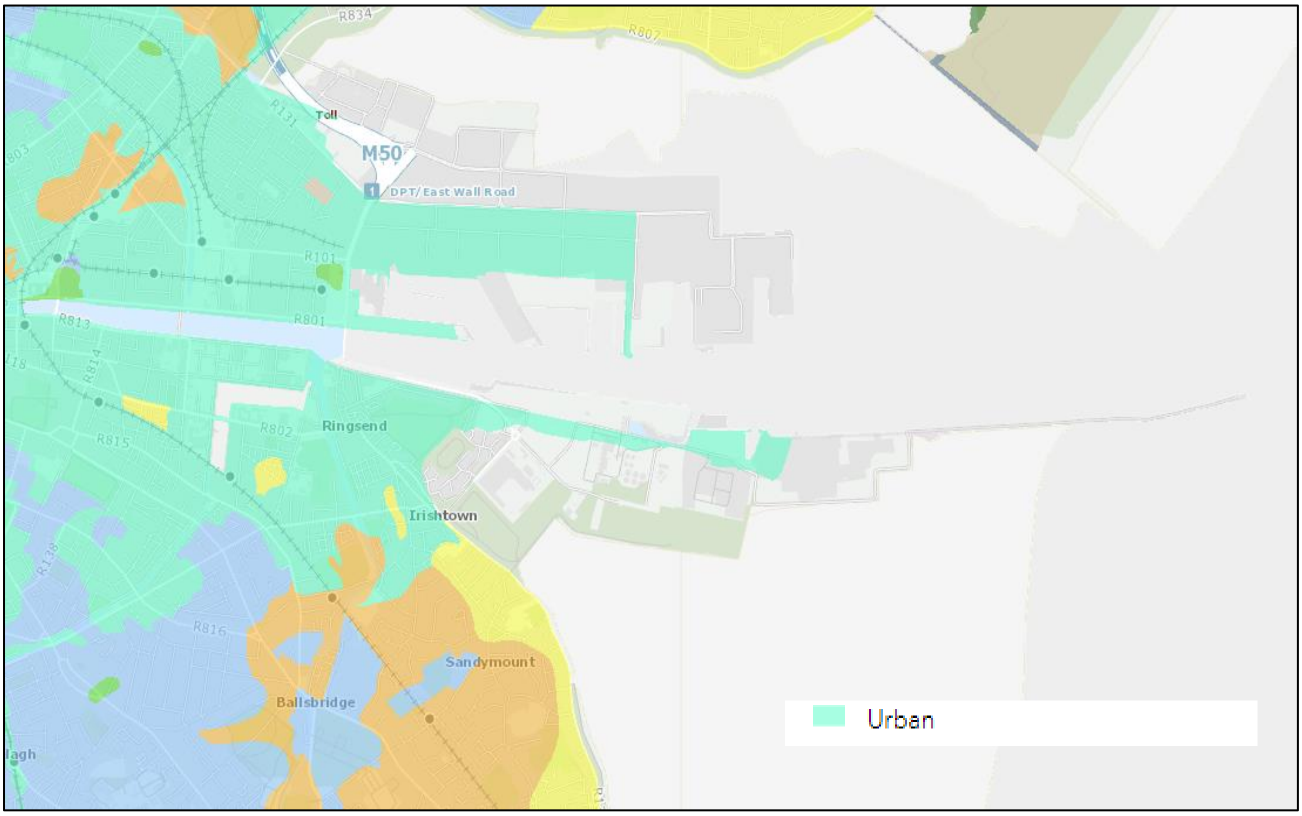


Figure 8.2 Quaternary sediments (taken from GSI's Spatial Resources portal)

8.4.4 Hydrogeology

The hydrogeology of the area has been described by the Geological Survey of Ireland as complex and very variable. The Limestone bedrock is generally considered to be indurated and hence dominated by fissure permeability (e.g. joints and faults). Such permeability is likely to be low except where coarse, clean Limestones where present, have been karstified, dolomitised or are highly fractured.

The Lower Carboniferous rocks that underlie the region have been classified by the Geological Survey of Ireland as "Locally Important Aquifer, bedrock which is moderately productive only in local zones" (Figure 8.3). These locally productive zones are due to the presence of more permeable strata that are encountered in different parts of the outcrop area due to substantial faults, fractures or fissures. The limited groundwater movement within the rock tends to be restricted to the weathered horizons or to non-extensive fractured zones. These zones tend to have a limited hydraulic continuity, low storage capacity and low potential yield.

The Quaternary drift is considered the principal medium for groundwater movement in the area. The infiltration capacity of the clay deposits would be limited due to their low permeability and hence groundwater movement is likely to be confined to the fluvio-glacial sand and gravel deposits that overlie the clays. The potential importance of the Quaternary drift deposits as a groundwater resource is a function of their permeability, thickness and extent. The low permeable fine grained glacial clays represent aquitards that limit infiltration and restrict recharge to bedrock aquifers when sufficiently thick. The overlying fluvio-glacial sand and gravel deposits represent material with a significantly higher permeability. Consequently these deposits have a high potential recharge and storage capacity.

It is generally expected that groundwater levels beneath the site will remain close to sea level and may exhibit tidal variation. Groundwater at the site is expected to be brackish / saline and unsuitable for potable supply.

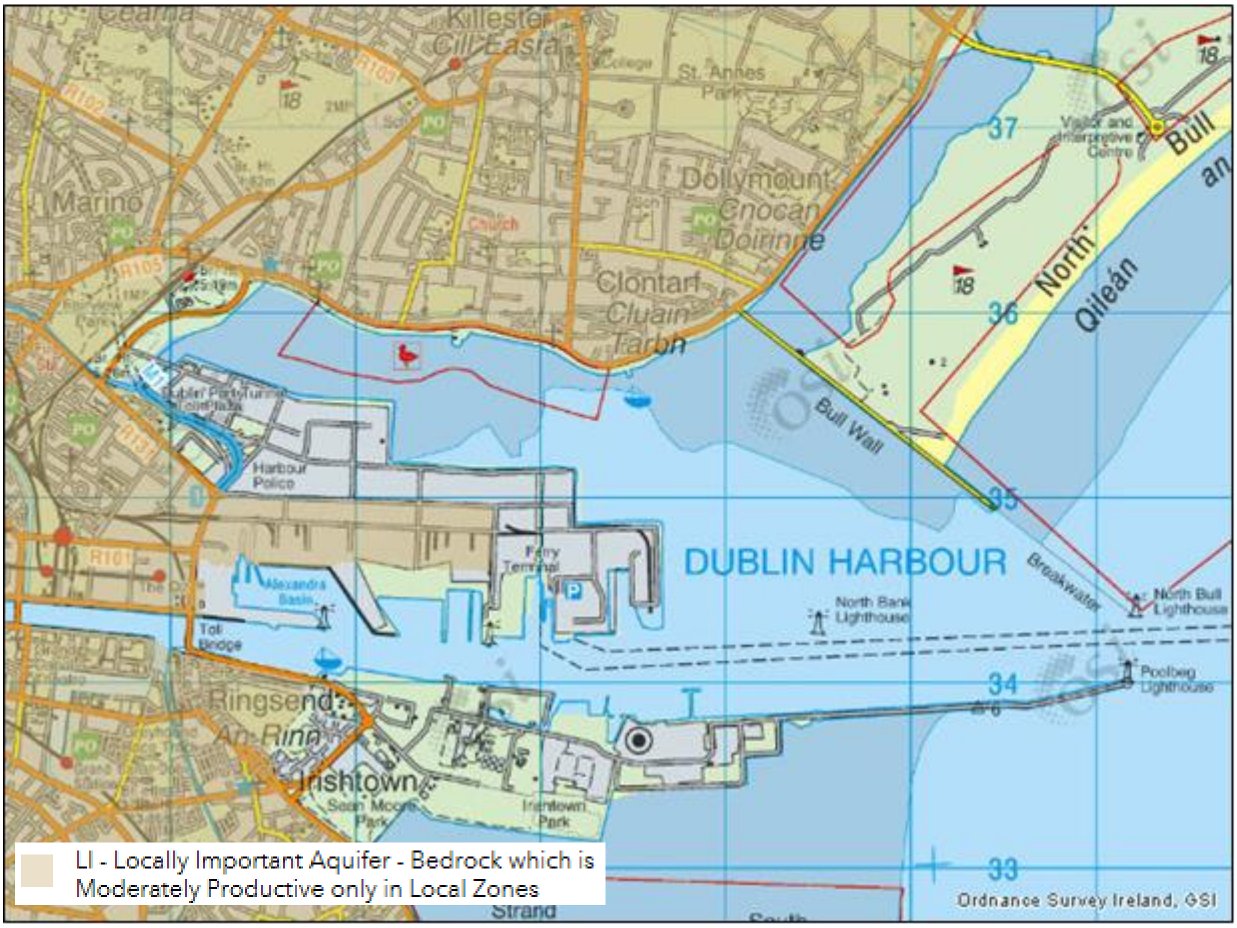


Figure 8.3 Groundwater aquifer (taken from GSI's Spatial Resources portal)

In accordance with the Water Framework Directive (2000/60/EC) it is necessary to understand the groundwater vulnerability of the site, which is defined as the tendency and likelihood for general contaminants to reach the water table after introduction at the ground surface.

The site falls within an area of low groundwater vulnerability (Figure 8.4).

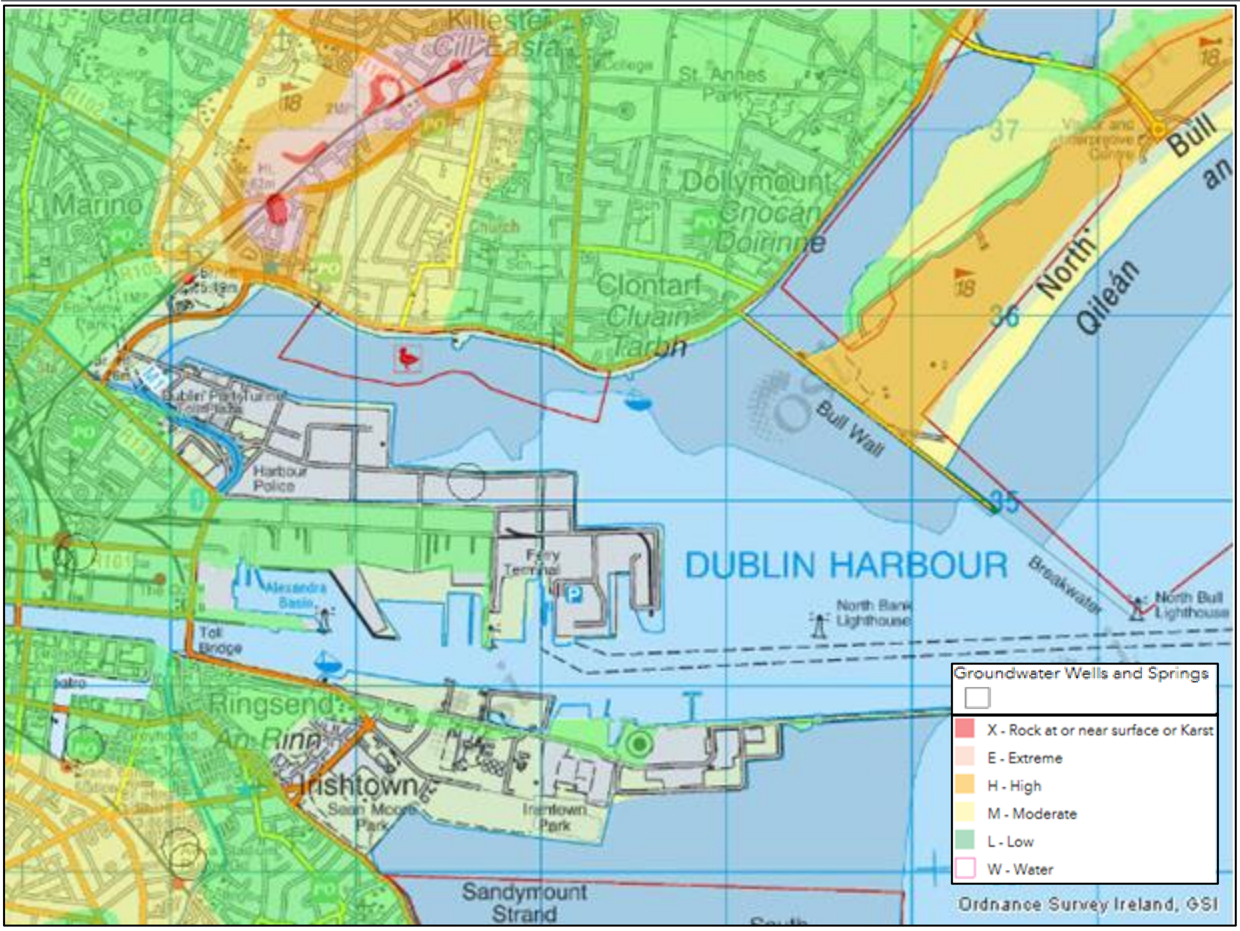


Figure 8.4 Groundwater vulnerability (taken from GSI’s Spatial Resources portal)

Groundwater at the site is expected to be brackish / saline and unsuitable for potable supply.

The South Dublin Bay and River Tolka Estuary SPA is present north and south of the site. The River Liffey is present directly north of the site. The Dodder River flows into the River Liffey just west of Tom Clarke Bridge.

The Tolka Estuary and Liffey Estuary Lower are noted to be ‘of risk’ and of moderate status on the EPA map viewer. The Liffey Estuary Lower is noted to be unpolluted for the 2010-2012 reporting period, while the Tolka Estuary is noted to be potentially eutrophic for the same period. The Dublin groundwater body is noted to be ‘not at risk’ and of good status.

Tolka Estuary and the Liffey Estuary are classified as nutrient sensitive estuaries under the Urban Waste Water Treatment Directive 91/271/EEC. North Dublin Bay and South Dublin Bay are proposed Natural Heritage Areas.

8.4.5 Geological Heritage Areas

North Bull Island is located north-east of the site adjacent to Clontarf and is described under the Irish Geological Heritage Programme (IGH) as being an area of geological heritage due to its coastal geomorphology (IGH 13 Theme). The island is a result of human intervention in Dublin Bay and contains sand flats, beach, dune, lagoon and slack features.

Bottle Quay is located in Sutton South and is described under the Irish Geological Heritage Programme (IGH) as being an area of geological heritage due to coastal cliffs (IGH 4,7 Theme). The site is an excellent example of both Cambrian and Quaternary features along the same short stretch of shoreline.

The Hill of Howth is located in Sutton North and is described under the Irish Geological Heritage Programme (IGH) as being an area of geological heritage due to the valleys and rock outcrops on the Hill of Howth (IGH 4,12 Theme). The site demonstrates both small and large scale structural deformation with Cambrian rocks.

8.4.6 Licenses and Permits

A search was undertaken on the Environmental Protection Agency map viewer to investigate if any Industrial Emission Licences (IELs) and Integrated Pollution Control (IPC) sites which are present surrounding the scheme area. As seen from Figure 8.5 there are two IEL located within the 3FM Project area; at the Hammond Lane Metal Company Limited and Synergen Power Limited. Both are categorised as being licensed and industrial in nature. Figure 8.5 also outlines two IELs off site but within proximity to the 3FM application boundary. These licences are associated with Dublin Waste to Energy Limited and Electricity Supply Board (ESB) (Poolbeg). Both are categorised as industrial in nature.

There are no IPC licences noted within the 3FM application site. The available mapping notes a surrendered IPC licence at the former Becbay Limited site i.e. the former Irish Glass Bottle factory site (since 1994). The surrendered IPC licence is categorised as being previously industrial in nature before being surrendered to state control in 2009. The EPA monitored the clean up of the industrial contaminants across this 25-acre site by the Becbay owners prior to it being surrendered; concluding all environmental pollutants linked to the manufacturing legacy were cleared. Previous site investigations as well as general information revealed that the entire Poolbeg Peninsula area was constructed on a former landfill, with reports of up to 7m of fill material which this clean-up did not include.

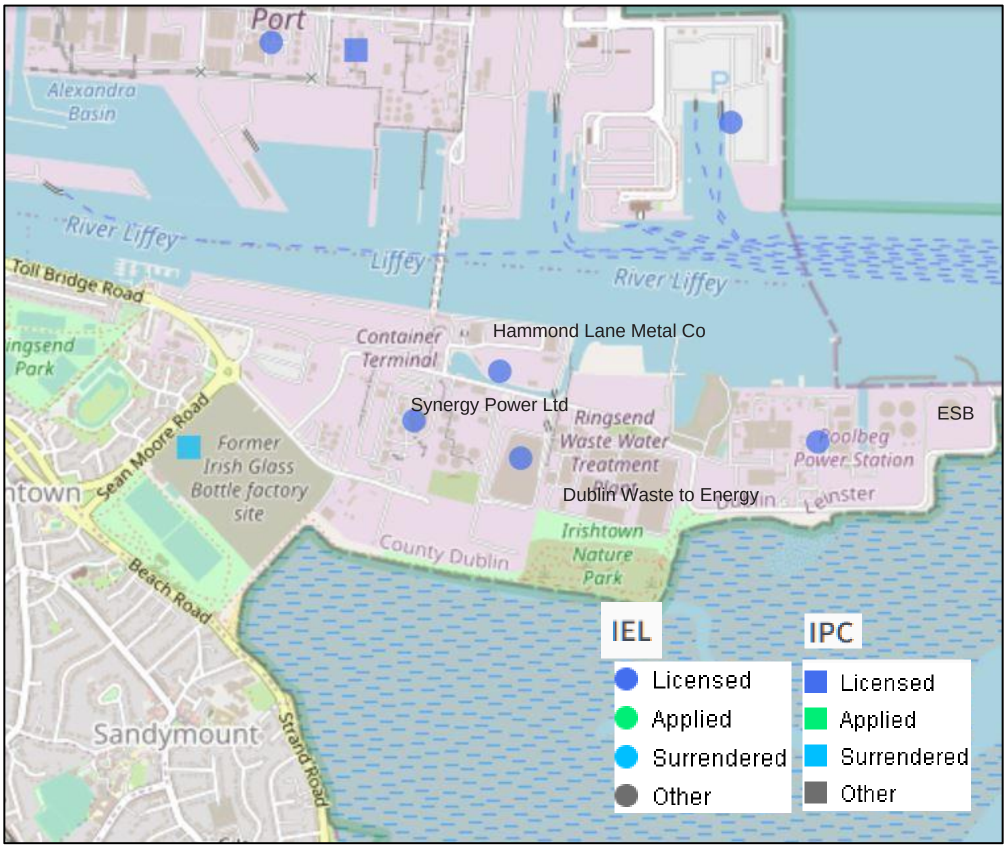


Figure 8.5 Licenses and Permits

8.4.7 Ground Investigation

As discussed within the GQRA Report (Appendix 8-2), a ground investigation was undertaken by Causeway Geotech Ltd between 8th November 2022 and 10th February 2023. The locations of the exploratory holes are presented in GQRA Report (Appendix 8-2).

Additional ground investigation works were carried out between March 2024 and June 2024 to provide further information on ground conditions within Area O, and to obtain information within Area L which was not originally included within the scope of works.

A total of 51 no. boreholes were used across the 3FM Project area to provide information on ground conditions and soil and groundwater quality (Figure 8.6). Road cores and slit trenches were also undertaken to gain information on ground conditions and location of utility services.

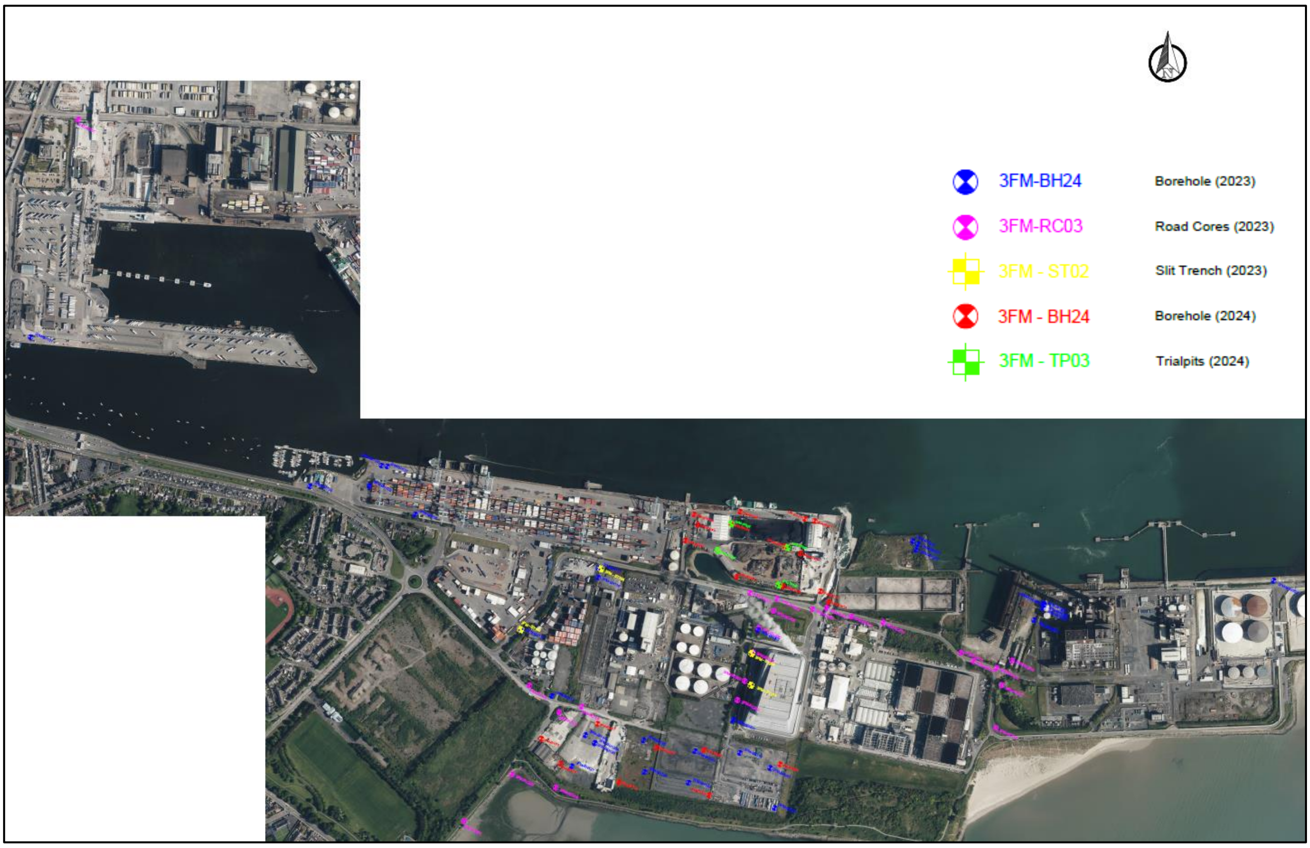


Figure 8.6 3FM Ground Investigation Locations

The PRA undertaken for the 3FM Project identified a history of landfilled waste within the vicinity of the former Irish Glass Bottling factory which lies outside the 3FM boundary. It is unclear how far east the former landfill expanded as there is little existing information on ground conditions within the proposed Port Park and Area O. The ground investigation targeted Port Park and Area O in order to determine the presence of potential pollutant linkages identified within the PRA associated with former landfilling activities.

A rationale for the 2023 ground investigation locations is provided below:

- BH101 – deep borehole to 30m below ground level (bgl) which provides information on the ground conditions and soil and groundwater quality within the area linking the north and south port areas.
- BH102 – borehole to 3.00m bgl which provides information on ground conditions and soil and groundwater quality in this area.
- BH103 – borehole to 4.00m bgl which provides information on ground conditions and soil and groundwater quality in this area.
- BH105 – borehole to 2.50m bgl which provides information on ground conditions and soil and groundwater quality in this area.
- BH112 – borehole to 4.0m bgl which provides information on ground conditions and soil and groundwater quality in this area.
- BH116 - borehole to 1.6m bgl which provides information on ground conditions.
- BH117 – borehole to 1.6m bgl which provides information on ground conditions.
- BH130 – deep borehole to 21m bgl which provides information on ground conditions.

- BH131 – deep borehole to 17m bgl which provides information on ground conditions.
- ST04 – slit trench to 1.60m bgl which provides information on ground conditions and the presence of utility services.
- BH203 – hand pit to 0.60m bgl which provides information on ground conditions.
- BH208, BH208A, BH208B & BH208C – hand pits (0.90, 0.40, 0.80m bgl respectively) which provide information on ground conditions and the presence of utility services.
- ST203 – slit trench to 1.10m bgl which provides information on ground conditions and the presence of utility services.
- ST204 – slit trench to 1.50m bgl which provides information on ground conditions and the presence of utility services.
- BH215 – deep borehole to 40m bgl which provides information on ground conditions and soil quality to facilitate a waste classification for soils in this area. This area will be removed to facilitate the proposed turning circle.
- BH216 – deep borehole to 40.50m bgl which provides information on ground conditions and soil quality to facilitate a waste classification for soils in this area. This area will be removed to facilitate the proposed turning circle.
- BH217 - deep borehole to 41m bgl which provides information on ground conditions and soil quality to facilitate a waste classification for soils in this area. This area will be removed to facilitate the proposed turning circle.

The rationale for the following boreholes listed below was primarily to target potential pollutant linkages and delineate the extent of historic landfilling within the proposed Lo-Lo Terminal Transit Container Yard (Area O) and the proposed Port Park:

- BH119 – borehole to 3.50m bgl which provides information on the ground conditions and soil quality within the area.
- BH120 – deep borehole to 40.50m bgl which provides information on the ground conditions and soil and groundwater quality within the area.
- BH121 - deep borehole to 32.45m bgl which provides information on the ground conditions and soil and groundwater quality within the area.
- BH122 - deep borehole to 20.35m bgl which provides information on the ground conditions and soil and groundwater quality within the area.
- BH123 - deep borehole to 41m bgl which provides information on the ground conditions and soil and groundwater quality within the area.
- BH124 - deep borehole to 40m bgl which provides information on the ground conditions and soil and groundwater quality within the area.
- BH125 - deep borehole to 36.50m bgl which provides information on the ground conditions and soil and groundwater quality within the area.
- BH126 – borehole to 1.50m bgl which provides information on the ground conditions and soil quality within the area.

- BH126A - borehole to 1.50m bgl which provides information on the ground conditions and soil and groundwater quality within the area.
- BH127 - borehole to 3.00m bgl which provides information on the ground conditions and soil and groundwater quality within the area.
- BH128 – borehole to 2.60m bgl which provides information on the ground conditions and soil and groundwater quality within the area.

A rationale for the 2024 ground investigation locations is provided below:

- BH301B – borehole to 8.0m bgl which provides information on ground conditions and soil and groundwater quality within the area.
- BH302 – borehole to 7.0m bgl which provides information on ground conditions and soil and groundwater quality within the area.
- BH303 – borehole to 8.0m bgl which provides information on ground conditions and soil and groundwater quality within the area.
- BH304 – deep borehole to 30.15m which provides information on ground conditions and soil and groundwater quality within the area.
- BH305 – borehole to 6.0m bgl which provides information on ground conditions and soil and groundwater quality within the area.
- BH306 – deep borehole to 29.70m bgl which provides information on ground conditions and soil and groundwater quality within the area.
- BH307 – borehole to 6.0m bgl which provides information on ground conditions and soil and groundwater quality within the area.
- BH308 – deep borehole to 30.0m bgl which provides information on ground conditions and soil and groundwater quality within the area.
- BH309 – deep borehole to 30.15m bgl which provides information on ground conditions and soil and groundwater quality within the area.
- BH310 – borehole to 6.0m bgl which provides information on ground conditions and soil and groundwater quality within the area.
- BH311 – borehole to 6.0m bgl which provides information on ground conditions and soil and groundwater quality within the area.
- BH312 – n/a
- BH313 – deep borehole to 30.15m bgl which provides information on ground conditions and soil and groundwater quality within the area.
- BH314 – deep borehole to 30.15 which provides information on ground conditions and soil and groundwater quality within the area.
- BH315 – borehole to 8.0m bgl which provides information on ground conditions and soil and groundwater quality within the area.
- BH316 – borehole to 8.0m bgl which provides information on ground conditions and soil and groundwater quality within the area.

- BH317 – borehole to 8.0m bgl which provides information on ground conditions and soil and groundwater quality within the area.
- BH318 – borehole to 8.0m bgl which provides information on ground conditions and soil and groundwater quality within the area.
- BH319 – borehole to 8.0m bgl which provides information on ground conditions and soil and groundwater quality within the area.
- BH320 – borehole to 8.0m bgl which provides information on ground conditions and soil and groundwater quality within the area.

Borehole cross sections for Area O are provided within Appendix 8-2 GQRA Report.

8.4.8 Site Specific Soils and Geology

The ground conditions indicated by the exploratory investigations are described in the exploratory hole logs presented in Appendix 8-2 and are briefly summarised below for each area of the site.

A summary of the ground types encountered in the exploratory holes is listed below, in approximate stratigraphic order:

- **Paved surface:** Bitmac, concrete and paving stones was encountered at ground level at almost every location across the site ranging in thickness from 60-200mm primarily, and 500mm at BH203. At some locations, paved surfacing was underlain by a second concrete/bitmac layer.
- **Topsoil:** encountered in 150mm thickness in BH112.
- **Made Ground (sub-base):** majority of locations which had a paved surface were underlain by granular fill of varying thicknesses.
- **Made Ground (fill):** reworked sandy gravelly clay/silt fill or sandy clayey gravel or gravelly clayey sand fill with varying amounts of concrete, red brick, timber, steel and glass fragments as well as varying amounts of wire, plastic, cloth, and ash was encountered across the site to a maximum depth of 15.80m in BH130. It should be noted that this location is through an existing caisson, and aside from this the maximum depth was 6.50m in BH120 in the south of the site, which is a former landfill area.
- **Marine beach deposits:** typically, medium dense to dense sands and gravels interspersed with layers of sandy gravelly clay frequently with shell fragments encountered across the site to a maximum depth of 20.10m in BH120 generally overlying Port Clay.
- **Port Clay:** Firm to stiff sandy silty clay often with laminations of silty sand encountered across the site to a maximum depth of 36.5m in BH217.
- **Glacial till/Fluvioglacial deposits:** very stiff sandy gravelly clay or very dense sandy clayey gravel generally encountered beneath Port Clay and overlying bedrock, encountered greatest in extent in the south of the site in BH124 to a depth of 40.00m.
- **Bedrock (Limestone and Mudstone):** Medium strong to strong limestone or mudstone was encountered at depths ranging from 24.50m in BH101 to 39.05 in BH217.

Table 8.4 summarises the ground types and maximum depth encountered within each Area.

Table 8.4 Summary of maximum strata depths encountered across the study area.

Strata	General summary of soil description	Maximum depth strata encountered (m bgl)
Hardstanding	Cobble stone pavement	0.07m at BH101
	Concrete	1.10m at BH126A
	Bitmac	0.10m at ST203
MADE GROUND	SAND – brownish grey, gravelly, silty fine to coarse sand. Gravel is rounded to subrounded fine to coarse. Occasional fragments of concrete at some locations.	1.50m at BH101 & BH103
	SAND – Medium dense brown slightly gravelly fine to coarse sand. Gravel is angular fine to medium.	3.50m at BH103
	SAND – Medium dense dark greyish brown silty SAND	18.40m at BH313
	GRAVEL – Grey sandy silty rounded fine to coarse gravel with medium cobble content and low boulder content, fragments of red brick and concrete. Sand fine to coarse. Cobbles and boulders are subangular.	6.80m at BH215
	GRAVEL – Medium dense (locally dense) grey SAND and GRAVEL	13.20m at BH306
	CLAY – Firm to stiff grey, sandy, gravelly clay. Low cobble content (occasionally with fragments of red brick, metal, concrete and timber). Sand is fine to coarse. Gravel is angular fine to medium.	4.00m at BH103
	CLAY – Firm dark grey silty CLAY.	25.50m at BH308

8.4.8.1 Made Ground

Made ground was identified at all ground investigation locations. A review of ground conditions found that the depth of made ground deeper in the north of the study area due to hard engineering structures such as caissons e.g. 15.80m bgl at BH130. Made ground was encountered within Area O to a maximum depth of 6.50m bgl at BH120, ranging in composition from grey slightly sandy, slightly silty, angular fine to coarse gravel, to firm to stiff grey slightly sandy gravelly clay with low cobble content and fragments of plastic, concrete and red brick. Sand is fine to coarse. Gravel is subangular fine to coarse. This was subsequently followed by made ground comprising loose to medium dense grey very sandy silty subangular fine to coarse gravel with low cobble content. Sand is fine to coarse. Cobbles are subrounded.

8.4.8.2 Sand & Gravel

Beneath the Made Ground layer at the site, raised marine deposits were encountered comprising medium, dense, slightly gravelly, silty, fine to coarse sand, interchanging with medium dense, grey, very sandy, slightly silty, rounded, fine gravel to a maximum depth of 20.10 bgl at BH120. This stratum is a result of the reclamation of land during the development of the wider port.

8.4.8.3 Clay

Firm to stiff, grey, sandy, silty clay which is known locally as Port Clay was encountered in deeper boreholes to a maximum depth of 36.50m bgl at BH217.

8.4.8.4 Gravel

A gravel layer was encountered at some locations above bedrock, comprising dense, dark grey, slightly sandy, slightly clayey, subangular gravel of dark grey limestone with low cobble content.

8.4.8.5 Bedrock

Bedrock was encountered in some of the deeper boreholes comprising mudstone of very stiff, brown, and light brownish-grey, slightly gravelly clay (highly to completely weathered) e.g. BH124 (40m bgl); and medium, strong, locally moderately weak, thickly laminated to thinly bedded dark grey limestone e.g. BH125 (36.50m bgl).

8.4.9 Groundwater

Groundwater strikes were recorded during the ground investigation; the measurements are presented in Tables 8.5 and 8.6.

Table 8.5 Groundwater Strikes during 2023 Investigation

Exploratory Hole	Groundwater	Strata
SPAR Bridge		
BH101	Water strike at 6.50m (rose to 6.20m after 20 mins)	Medium dense becoming dense very sandy slightly silty subangular fine to medium GRAVEL. Sand is fine to coarse.
	Water strike at 8.30m (rose to 1.90m after 20 mins)	
	Water strike at 9.70m	
Maritime Village		
BH102	Water strike at 2.40m	MADE GROUND: Firm becoming stiff greyish brown slightly sandy gravelly SILT with fragments of red brick, concrete, metal and timber. Sand is fine to coarse. Gravel is angular fine to coarse.
BH130	Water strike at 4.40m (rose to 3.00m after 20 mins)	MADE GROUND: Medium dense locally dense brown fine to coarse SAND and subangular fine to coarse GRAVEL with low cobble content and fragments of red brick. Cobbles are subangular.
	Water strike at 8.60m (rose to 2.10m after 20 mins)	
BH131	Water strike at 6.30m (rose to 1.70m after 20 mins)	MADE GROUND: Medium dense greyish brown sandy slightly silty subangular fine to coarse GRAVEL with low cobble content and fragments of red brick and concrete. Cobbles are subrounded.
Roads / Transport Routes		
BH112	Water strike at 4.00m (rose to 3.50m in 20 mins)	MADE GROUND: Loose dark greyish black very sandy silty angular fine to coarse GRAVEL with abundant fragments of red brick, concrete, glass and rootlets. Gravel is angular fine to medium. (Contamination encountered).
Area O		
BH119	Water strike at 0.25m	MADE GROUND: Light grey sandy very silty angular fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are angular
BH120	Water strike 5.00m (rose to 4.30m after 20 mins)	MADE GROUND: Loose to medium dense grey very sandy silty subangular fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subrounded.

BH121	Water strike at 3.10m (rose to 2.60m after 20 mins)	MADE GROUND: Medium dense greyish black sandy silty subrounded fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subrounded.
BH122	Slow seepage at 0.35m	MADE GROUND: Grey very sandy silty subangular fine to coarse GRAVEL with high cobble content. Sand is fine to coarse. Cobbles are subangular.
	Water strike at 4.30m (rose to 3.90m after 20 mins)	MADE GROUND: Firm to stiff grey sandy gravelly SILT with fragments of red brick, concrete, glass and wood. Sand is fine to coarse. Gravel is subangular fine to coarse.
	Water strike at 9.50m (rose to 3.60 after 20 mins)	Medium dense grey gravelly fine to coarse SAND. Gravel is subrounded fine to coarse.
BH123	Slow seepage at 0.30m	MADE GROUND: Dark greyish black very sandy slightly silty subangular fine to coarse GRAVEL with high cobble content and cobbles sized fragments of red brick. Sand is fine to coarse. Cobbles are angular.
	Slow seepage at 4.30m	Medium dense greyish gravelly fine to coarse SAND with shell fragments. Gravel is subangular to subrounded fine to coarse.
BH124	Seepage at 0.80m	MADE GROUND: Grey very sandy very clayey subrounded fine to coarse GRAVEL with high cobble content and cobbles sized fragments of red brick. Sand is fine to coarse. Cobbles are subangular.
BH125	Slow seepage at 4.70m	MADE GROUND: Stiff dark greyish black sandy gravelly SILT with fragments of wood, plastic and cloth. Sand is fine to coarse. Gravel is subrounded fine to coarse.
BH320	Strike at 3.60m	MADE GROUND: Firm to stiff brown sandy CLAY with fragments of glass, paper and wood. Sand is fine to coarse.
BH322	Strike at 3.30m	MADE GROUND: Soft dark brownish black slightly sandy gravelly CLAY with low cobble content and fragments of concrete, brick, plastic, rubber and household waste. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subangular.
Port Park		
BH315	Strike at 1.50m	MADE GROUND: Greyish black gravelly silty fine to coarse SAND with medium cobble content and brick fragments
BH316	Strike at 4.00m (rose to 2.00m after 20 mins)	MADE GROUND: Soft greyish black very gravelly silty CLAY with fragments of glass and wood, newpaper, and household waste. Gravel is subangular fine to coarse.

BH317	Strike at 3.40m	MADE GROUND: Firm black sandy gravelly silty CLAY with fragments of brick, glass, wood, and household waste. Sand is fine to coarse. Gravel is subangular fine to coarse.
BH127	Water strike at 3.00m (rose to 2.50m after 20 mins)	MADE GROUND: Medium dense grey very sandy silty subangular fine to coarse GRAVEL. Sand is fine to coarse.
BH128	Slow flow at 1.50m Seepage at 2.00m	MADE GROUND: Very stiff grey sandy gravelly CLAY with fragments of timber and glass. Sand is fine to coarse. Gravel is subangular fine to coarse.
Area N		
BH212	Sea water ingress at 1.85m	MADE GROUND: Light slightly gravelly slightly silty fine to coarse SAND. Gravel is rounded fine to medium.
	Water strike at 3.00m (rose to 1.50m after 10 mins)	Medium dense brown fine to coarse SAND and subrounded fine to coarse GRAVEL with shell fragments.
47A Hardstand Area / Turning Circle		
BH215	Strong seepage at 4.30m (rose to 2.10m after 20 mins)	MADE GROUND: Dense grey slightly sandy angular to subangular fine to coarse GRAVEL with medium cobble content. Sand is fine to coarse. Cobbles are angular.
BH216	Strong seepage at 13.00m (rose to 1.60m after 20 mins)	Medium dense brownish grey very sandy slightly sitly subangular fine to coarse GRAVEL. Sand is fine to coarse.
BH217	Water strike at 7.65m	Soft grey slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subrounded fine to medium.
Area L		
BH305	Strike at 4.80m	Grey fine to coarse SAND and fine to coarse subangular GRAVEL with cobbles and boulders. Cobbles and boulders are subangular.
BH309	Strike at 3.20m	Medium dense grey fine to medium SAND.
BH313	Strike at 6.00m	Medium dense (locally dense) brown SAND and GRAVEL with occasional cobbles and boulders.
BH314	Strike at 5.00m	Loose becoming medium dense brown gravelly fine to coarse SAND with low cobble content and shell fragments.

Table 8.6 Groundwater Strikes during 2024 Investigation

Exploratory Hole	Groundwater	Strata
Port Park		
BH315	Water Strike at 1.50m	Made Ground: Greyish black gravelly silty fine to coarse SAND woth medium cobble content and occasional brick fragemnts.
BH316	Water Strike at 4.00m (rose to 2.50m after 20mins)	Made Ground: Soft Greyish black very gravelly silty CLAY with fragments of glass, wood, newpaper, and household waste. Gravel is subangular fine to coarse.
BH317	Water Strike at 3.40m	Made Ground: Firm black sandy gravelly silty CLAY with fragments of brick, glass, wood and household waste. Sand is fine to coarse. Gravel is subangular fine to coarse.
Area L		
BH310	Water Strike at 6.00m	Made Ground : Grey sandy subangualr fine to coarse GRAVEL with occasional cobbles. Sand is fine to coarse.
Area O		
BH320	Water Strike at 3.60m	Made Ground : Firm to stiff brown sandy CLAY with fragments of glass, paper, and wood. Sand is fine to coarse.
BH322	Water Strike at 3.30m	Made Ground: Soft dark brownish black slighlty sandy gravelly CLAY with klow cobble content and fragments of concrete, brick, plastic, rubber and household waste. Sand is fine to coarse. Gravel is subangualr fine to coarse. Cobbles are subangular.

A single 50mm HDPE groundwater monitoring standpipe was installed in 33 no. boreholes. Table 8.7 and 8-8 provides a summary of standpipe installations.

Table 8.7 Summary of standpipe installations 2023 investigation

Borehole ID	Standpipe Diameter	Response Zone (m bgl)
BH102	50mm	0.50-2.40
BH103	50mm	0.50-3.70
BH105	50mm	0.50-2.20
BH112	50mm	0.50-3.40
BH120	50mm	6.50-20.00
BH121	50mm	0.50-5.50
BH122	50mm	0.50-5.00
BH123	50mm	4.50-6.50
BH124	50mm	0.50-1.50
BH125	50mm	0.50-5.00
BH126A	50mm	0.5-1.50
BH127	50mm	0.50-2.50
BH128	50mm	0.50-2.10

Table 8.8 Summary of Standpipe Installations 2024 Investigations

Borehole ID	Standpipe Diameter	Response Zone (m bgl)
BH301B	50mm	0.50-6.00
BH302	50mm	0.50-5.00
BH303	50mm	0.50-6.00
BH304	50mm	2.80-6.50
BH305	50mm	6.50-3.00
BH306	50mm	0.50-2.50
BH307	50mm	0.50-3.50
BH308	50mm	5.50-10.00
BH309	50mm	0.50-8.00
BH310	50mm	0.50-5.50
BH311	50mm	0.50-3.50
BH313	50mm	4.50-8.00
BH315	50mm	0.50-3.00
BH316	50mm	0.50-4.00
BH317	50mm	0.50-4.70

BH318	50mm	0.50-4.50
BH319	50mm	0.50-4.50
BH320	50mm	0.50-4.50
BH321	50mm	0.50-4.50
BH322	50mm	0.50-4.50

Details of the installations, including the depth range of the response zone, are provided in the GQRA Report (Appendix 8-2). The groundwater level measurements were recorded on a number of occasions; the results are presented in Table 8.9 for the 2023 boreholes. Groundwater is likely to be tidally influenced in proximity to the River Liffey and Dublin Bay.

Table 8.9 Groundwater Monitoring Levels 2023

Borehole	**Groundwater Level**					
	15.02.223	16.02.2023	23.03.2023	17.02.2023	07.04.2023	24.04.2023
Maritime Village						
BH102 3.05 mOD	-	-	DRY	DRY	-	-
BH103 3.52 mOD	No Access during monitoring					
BH105 3.55 mOD	No Access during monitoring					
Roads / Transport route						
BH112 4.23 mOD	DRY	-	-	0.98 mOD	DRY	DRY
Area O						
BH120	-	0.48 mOD	-	0.23 mOD	0.68 mOD	0.49 mOD

5.13mOD						
BH121 4.81 mOD	-	0.61 mOD	-	0.56 mOD	0.66 mOD	0.71 mOD
BH122 4.72 mOD	-	-	-	-	No Access	No Access
BH123 4.58 mOD	0.45 mOD	-	-	0.67 mOD	0.49 mOD	0.83 mOD
BH124 4.75 mOD	-	-	-	-	3.28 mOD	3.77 mOD
BH125 4.94 mOD	0.42 mOD	-	-	0.54 mOD	0.48 mOD	0.52 mOD
BH126A 4.89 mOD	DRY	-	-	DRY	DRY	No Access
BH127 4.65 mOD	DRY	-	-	DRY	DRY	No Access
BH128 4.71 mOD	3.11 mOD	-	-	3.76 mOD	3.07 mOD	No Access

Key:

(grey)	Screened across groundwater within MADE GROUND
(orange)	Screened across groundwater within GRAVELS
(light yellow)	Screened across groundwater within SANDS & GRAVELS

Standing groundwater levels within all installed boreholes within Area L were monitored on six occasions between 25th April 2024 and Tuesday 18th June 2024, using an acoustic dip-meter. The results of the monitoring are presented in Table 8.10.

Table 8.10 Groundwater Monitoring Levels 2024 (Area L)

Borehole ID	Groundwater Levels					
	25.04.24	08.05.24	06.06.24	13.06.24	14.06.24	18.06.24
BH301B 3.12 mOD	1.20mOD	0.36mOD	0.58mOD	0.27mOD	0.39mOD	0.30mOD
BH302 3.56 mOD	1.57mOD	1.41mOD	1.71mOD	1.19mOD	1.71mOD	1.13mOD
BH303 3.73 mOD	0.99mOD	DRY	DRY	DRY	DRY	DRY
BH304 3.49 mOD	0.30mOD	0.26mOD	0.30mOD	0.35mOD	0.24mOD	0.45mOD
BH305 3.41 mOD	1.10mOD	DRY	No Access	No Access	No Access	No Access
BH306 3.79 mOD	1.21mOD	1.14mOD	1.17mOD	DRY	1.27mOD	DRY
BH307 3.62 mOD	DRY	0.67mOD	DRY	DRY	No Access	DRY
BH308 3.76 mOD	0.77mOD	0.11mOD	0.84mOD	0.21mOD	0.89mOD	0.56mOD
BH309 3.92 mOD	0.61mOD	0.36mOD	0.64mOD	0.36mOD	No Access	0.52mOD
BH310 3.47 mOD	No Access	No Access	0.02mOD	0.03mOD	No Access	0.07mOD
BH311 3.44 mOD	No Access	No Access	No Access	No Access	No Access	No Access
BH313 3.86 mOD	0.88mOD	0.81mOD	0.89mOD	0.14mOD	-0.04mOD	0.16mOD
BH314 3.97 mOD	No Access	0.57mOD	0.70mOD	-	0.07mOD	-

Key:

(grey)	Screened across groundwater within MADE GROUND
(orange)	Screened across groundwater within GRAVELS
(yellow)	Screened across groundwater within SANDS

Two boreholes (BH103 & BH105) were not accessible during the monitoring. Groundwater was encountered in a total of twenty-seven (27) boreholes during the ground investigation in the form of groundwater strikes during the drilling process. Follow on weekly monitoring indicates that groundwater was present in twenty (20) of the boreholes.

The weekly monitoring data indicates that perched shallow groundwater within boreholes installed within the made ground strata was encountered between 0.03mOD and 3.76mOD. A review of the monitoring data suggests the perched groundwater is discontinuous and on a number of occasions these wells were noted to be dry.

Water strikes were observed during drilling noted within sands and gravels underlying made ground. Monitoring data from BH123, BH120, BH308, BH309, and BH313 which were installed into sand and gravel response zones suggests that a shallow groundwater body is present. The direction of groundwater flow is broadly eastern towards Dublin Bay.

Groundwater within boreholes installed across Port Park & Area O in 2024 were fitted with continuous groundwater level data loggers. The groundwater levels were monitored between 4th April and 5th May 2024 at 10-minute intervals. This data is included within Appendix 8-2 GQRA report.

8.4.10 Sub Soil Contamination

Environmental soil samples were taken at regular intervals throughout the length of the excavation of each test location across the site. The protocol observed during the recovery of samples followed the guidance set out in BS 10175:2011 the Code of Practice for the Investigation of Potentially Contaminated Sites. The borehole logs are contained within the GQRA Report (Appendix 8-2) and the test locations are highlighted within Figure 8.6.

8.4.10.1 Laboratory Analysis

A total of 32 no. soil samples were sent to Chemtest for analysis for the 2023 investigation. An additional 56 no. samples were sent to DETS for analysis for the 2024 investigation. Samples were analysed for; Asbestos identification, moisture content, pH, Boron (hot water soluble), Sulphate (2:1 water soluble) as SO4, Total Sulphur, Sulphur (Elemental), Cyanide (total), Iron (total), Arsenic, Beryllium, Cadmium, Chromium (total), Copper, Mercury, Nickel, Lead, Selenium, Vanadium, Zinc, Chromium (hexavalent), Organic matter, Total Petroleum Hydrocarbons (TPH-CWG C5 – C35 aromatic-aliphatic split), speciated Polycyclic Aromatic Hydrocarbons (PAHs), Volatile Organic Compounds (VOCs), Semi-volatile Organic Compounds (SVOCs), speciated Poly Chlorinated Biphenyls (PCBs) and Phenols (speciated HPLC).

A total of 14 no. soil samples were also analysed for Leachability Analysis between 2023 & 2024. As per the EA Remedial Targets Methodology, the Level 1 screen examines the potential for contaminants to leach from soil to soil pore water. The compliance point utilised is the soil pore space and as such, is the most conservative compliance point as it does not take into account attenuation and dilution within the aquifer.

Speciated TPH analysis was undertaken to provide a better understanding of the 'make up' of the hydrocarbon contamination in relation to the specific carbon banding, as suggested within the 'Total Petroleum Hydrocarbon Criteria Working Group' (TPH-CWG) literature and recommended by the Environment Agency document P5-080/TR3 'The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbon in Soil'.

8.4.10.2 Human Health Risk Assessment

As per the methodology outlined within Section 8.1.2, a human health risk assessment was undertaken on the risk posed by potential ground contamination to future site users. The soil results have been screened against the latest available LQM/CIEH S4ULs and CL:AIRE GAC for commercial end use. Soil laboratory analytical results from boreholes within the proposed Port Park area (BH315, BH316, BH317, BH126, BH127 and BH128) have been screened against a public open space near residential end use.

8.4.10.3 Soil Contamination

All soil samples were found to be below the generic assessment criteria for commercial end use. One soil sample from BH308 is on the threshold for the commercial end use of Benzo(a)pyrene in Area L and recorded a concentration of 35 mg/kg (S4UL Commercial is 35 mg/kg). All soil samples from the proposed Port Park area recorded concentrations below the public open space near residential end use screening values. Asbestos containing material (ACM) was identified in 4 soil samples, as demonstrated in Table 8.11.

Table 8.11 Presence of asbestos in soil samples

Investigation Location	Depth (m bgl)	Asbestos Identification	Asbestos Quantification (%)
BH119	1.00	Amosite	<0.004
BH120	0.50	Chrysotile	<0.002
BH112	1.50	Chrysotile	0.004
BH116	0.50	Chrysotile	0.004
BH317 (Area O)	0.50	Chrysotile	Not quantified
BH320 (Area O)	0.50	Chrysotile	Not quantified
BH322 (Area O)	0.50	Chrysotile	Not quantified
BH322 (Area O)	3.00	Chrysotile	Not quantified
BH305 (Area L)	2.00	Chrysotile/Amosite	Not quantified

8.4.11 Groundwater contamination

A groundwater screening table for the groundwater and surface water samples with laboratory analytical certificates is contained within EIAR Appendix 8.2 GQRA Report.

8.4.11.1 2023 Sampling

One round of groundwater and surface water sampling and analysis was undertaken on 7th March 2023. Five (5) groundwater samples were obtained for laboratory analysis, four of which were from shallow boreholes installed into made ground (BH120, BH121, BH125 & BH128), and one from a borehole installed within the natural sand strata (BH123).

Three (3) surface water samples were also collected for laboratory analysis from the adjacent River Liffey and Dublin Bay (SW01 – SW03). Sample SW01 was taken from the River Liffey adjacent to the Poolbeg Yacht Club. SW02 is considered to be representative of ‘mid-stream’ and was taken from the River Liffey adjacent to an area of vacant land known as the ‘47A hardstand’. Sample SW03 is considered to be representative of ‘downstream’ and was obtained from Dublin Bay i.e. where the River Liffey discharges into to Irish Sea, from the Great South Wall, prior to reaching Poolbeg Lighthouse.

8.4.11.2 2024 Sampling

Round 1 – April 2024

A round of groundwater sampling and analysis from eight (8) boreholes within Area O was undertaken on the 8th April 2024. Seven (7) of the samples were obtained from boreholes installed within the made ground strata (BH315, BH316, BH317, BH318, BH319, BH320 and BH322). One (1) sample was obtained from a borehole installed within the sand (BH321).

A round of groundwater sampling and analysis from six (6) boreholes within Area L was undertaken on the 25th April 2024. Four (4) of the samples were obtained from boreholes installed in the made ground strata (BH301B, BH302, BH313, BH314). Two (2) of the samples were obtained from boreholes installed in the natural sands (BH308, BH309).

Round 2 – May 2024

A further round of groundwater sampling and analysis from eight (8) boreholes within Area O was undertaken on the 8th May 2024. Six (6) of the samples were obtained from boreholes installed within the made ground strata (BH315, BH316, BH317, BH319, BH320 and BH322). One (1) sample was obtained from a borehole installed within the sand (BH321).

A further round of groundwater sampling and analysis was undertaken between 8th and 9th May 2024 targeting the boreholes in Area L.

All water samples were analysed for a range of potential contaminants including: Metals, Phenols, TPH-CWG, PAHs (16 USEPA Speciated), PCBs, SVOCs and VOCs.

8.4.11.3 Groundwater and Surface Water Contamination

As groundwater and surface water in the vicinity of the site is not used as a potable water supply, no risk to human health exists through ingestion and as such, drinking water standards were not considered as part of the assessment. The annual average environmental quality standards (AA-EQS) for other surface waters, and groundwater from the European Union Environmental Objectives (Amendment) Regulations 2015/2016 have been used as screening values for the purposes of the risk assessment.

Area O & Port Park

Heavy Metals

Concentrations of cadmium (BH128), lead (BH128 & SW01), and nickel (BH120, BH121, BH123, BH125, BH128) exceeded the EU Environmental Objectives values for surface water receptors, however, notably, these issues did not appear to be significant within the surface water samples obtained during the investigation. The concentration of zinc in groundwater sampled from BH128 exceeded the EU Environmental Objectives for groundwater. The source of these metals is likely to be the made ground/waste material beneath the site.

Total Petroleum Hydrocarbons

The concentrations of total petroleum hydrocarbons in groundwater samples obtained from the 2023 boreholes in Area O were all found to be below the Groundwater Amendment Regulations 2016 threshold value of 7.5 mg/kg.

Groundwater samples obtained from subsequent boreholes put down across Area O and Port Park as part of the 2024 site investigation works showed elevated concentrations of total petroleum hydrocarbons above the Groundwater Amendment Regulations.

Polycyclic Aromatic Hydrocarbons

The concentrations of PAHs in groundwater samples obtained from the 2023 boreholes in Area O were all found to be below the EQS values. The samples obtained in 2024 all recorded exceedances for a number of PAHs including Anthracene, Benzo(a)pyrene, Fluoranthene and Napthalene.

The source of the elevated Hydrocarbons and PAHs is likely to be the made ground/waste material beneath the site.

Area L

Heavy Metals

Groundwater samples were obtained from Area L on two (2) occasions; 25th April and 8-9th May 2024. Concentrations of heavy metals within Area L were found to be in excess of the appropriate screening values. Notably, there is a decrease in the concentrations of particular heavy metals such as Barium, Cadmium, and Manganese during the second round of sampling. Other parameters such as Boron increase in concentration during the second round of sampling. Overall, the concentrations of metals are generally higher in samples obtained from the natural sands and slightly lower within the made ground.

Total Petroleum Hydrocarbons

Groundwater samples obtained from both monitoring rounds showed elevated concentrations of total petroleum hydrocarbons above the Groundwater Amendment Regulations. In particular, a highly elevated concentration of 56,000 ug/L was noted in the sample from BH308 on 9th May.

Polycyclic Aromatic Hydrocarbons

The samples obtained from both monitoring rounds recorded exceedances for a number of PAHs including Anthracene, Benzo(a)pyrene, Fluoranthene and Napthalene.

The source of the elevated Hydrocarbons and PAHs is likely to be the made ground/waste material beneath the site. With regard to the elevated Hydrocarbons at BH308, it is noted that this borehole is located within the Hammond Lane metal recycling facility. Is it likely that a spill or leak of fuel or oil has occurred within the vicinity of the borehole.

8.4.12 Ground Gas

8.4.12.1 Introduction

The principal components of ground borne gas are Methane and Carbon dioxide, but other gases such as Hydrogen sulphide and Carbon monoxide can also be present. Ground borne gas can present a hazard to end users of a site and can enter buildings, thus presenting a toxic, asphyxiation or explosion hazard.

Guidance on gas risk assessment is set-out in the following documentation:

- The Local Authority Guide to Ground Gas (Chartered Institute of Environmental Health, September 2008)
- CIRIA Report C665 Assessing risks posed by hazardous ground gases to buildings (CIRIA, 2007)
- Guidance on investigation for ground gas – Permanent gases and Volatile Organic Compounds (VOCs) (British Standard 8576, 2013)

8.4.12.2 Gas Monitoring

The gas results from four rounds of monitoring undertaken between April 2023 and March 2023 have been used to assess the gas condition on the site. The maximum recorded gas volumes (Methane and Carbon dioxide) and flow rate results recorded at each borehole location are summarised in EIAR Appendix 8.2 GQRA Report.

The gas results from four rounds of monitoring undertaken throughout June 2024, have been used to assess the gas conditions within Area L. The maximum recorded gas volumes (Methane and Carbon dioxide) and flow rate results recorded at each borehole location are summarised in EIAR Appendix 8.2 GQRA Report.

8.4.12.3 Gas Monitoring Results

Area O

The lowest atmospheric pressure throughout the monitoring period was recorded as 994mb on 16th March 2023. The maximum recorded concentration (volume gas/volume air) within boreholes was 59.4 vol/vol% for Methane in BH120 and 16.4 vol/vol% for Carbon Dioxide in BH125. The maximum flow rate was recorded as 10.8 litres / hour in BH120.

Negative flow rates were also recorded within some boreholes during the first round of monitoring, which may be represent falling groundwater levels or a tidal influence.

Area L

The lowest atmospheric pressure throughout the 2024 Area L monitoring period was 991mb, recorded on the 14th of June 2024. The maximum recorded concentration (volume gas/volume air) within boreholes was 0.2 vol/vol% for Methane in BH302 and 6.3 vol/vol% for carbon dioxide in BH308. The maximum flow rate recorded was 0.2 litres / hour.

Maritime Village

BH102 provided the only location in which access was available to carry out four rounds of gas monitoring. The lowest atmospheric pressure throughout the monitoring period was recorded as 994mb on the first round on monitoring. The maximum recorded concentration (volume gas/volume air) within the borehole, which was installed within made ground was 0.3 vol/vol% for Carbon Dioxide and 0.1 vol/vol% for Methane. The maximum flow rate was recorded as 0.1 litres / hour.

8.4.12.4 Gas Screening Value (GSV)

Area O

In accordance with the guidance provided in CIRIA C665, the maximum gas concentration (59.4 vol/vol% for Methane at BH120) and flow rate (10.8 litres/hour at BH120) was used to calculate a GSV, which was calculated as 6.42 l/hr which is categorised as Characteristic Situation 4.

Area L

The maximum gas concentration in Area L (6.3 vol/vol% for carbon dioxide at BH308) and flow rate (0.2 litres / hour at BH310) was used to calculate a GSV. The GSV value was calculated as 0.0126 l/hr, however the carbon dioxide concentrations were >5% on 3 no. occasions which would result in a Characteristic Situation 2 classification.

Maritime Village

As the only borehole accessible throughout the gas monitoring, BH102 which was installed within made ground maximum gas concentration (0.3 vol/vol% for Carbon Dioxide) and flow rate (0.1 litres/hour at) was used to calculate a GSV representative of this area. This was calculated as 0.0003 l/hr which is a Characteristic Situation 1.

8.4.13 Capital Dredging

8.4.13.1 Sediment Chemistry

Capital dredging is required to create elements of the 3FM Project set out in Table 8.14 and Figure 8.7, described previously in Chapter 5 Project Description. The volume of marine sediments to be dredged is 1,259,000 m^3.

Table 8.14 Dredging Summary

Element of Work	Reference within EIAR	Dredged Depth	Volume
Area N – Proposed Lo-Lo Terminal	Chapter 5	-13.0m CD	533,000 m^3
		-3.0m CD	72,000 m^3
Area K – Proposed Ro-Ro Terminal	Chapter 5	Pocket for scour protection -12.5m CD	13,000 m^3
Turning Circle	Chapter 5	-10.0m CD	444,000 m^3
Maritime Village	Chapter 5	-3.0m CD	197,000 m^3
Total Volume to be dredged			**1,259,000 m^3**

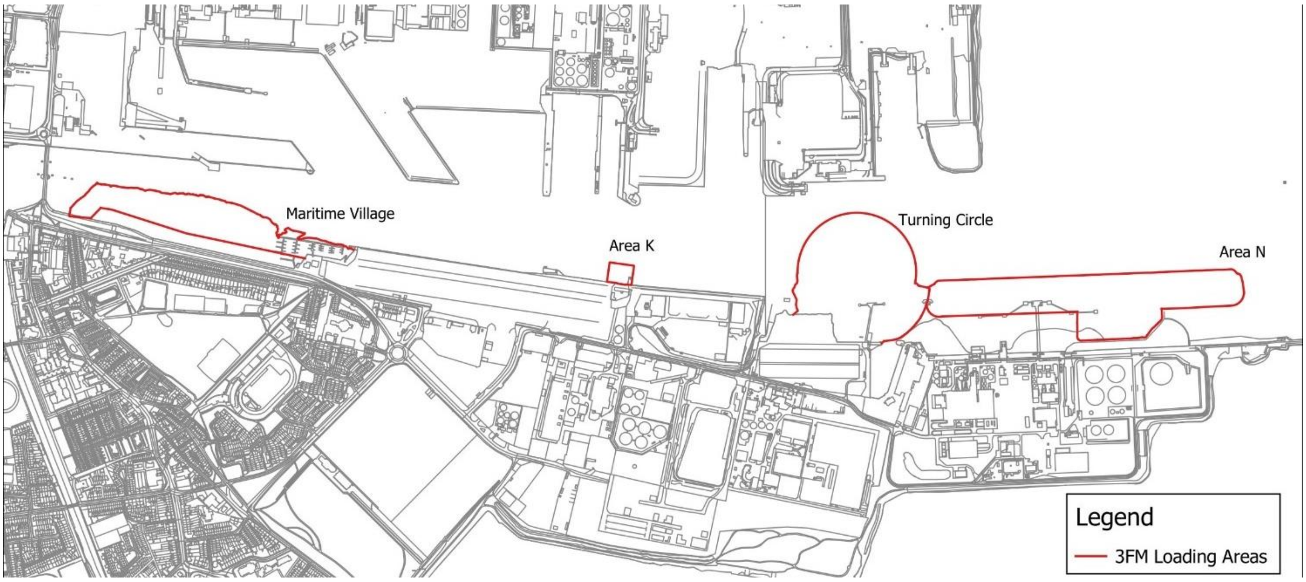


Figure 8.7 Location of dredging (loading) sites

In order to determine the suitability of the marine sediments for disposal at sea, the Marine Institute prepared Sampling and Analysis Plans (SAPs) specifying the sample locations, depths and contaminants to be tested.

The sediment chemistry sampling and analysis programme was carried out in two phases:

- Phase 1 Capital Dredging to facilitate permanent works; and
- Phase 2 Capital Dredging to facilitate the construction of Area N using marine plant.

Phase 1 Capital Dredging to facilitate permanent works

The capital dredging to facilitate permanent works comprises the following elements of work:

- Area N – Proposed Lo-Lo Terminal, Berthing Pocket dredged to -13.0m CD
- Area K – Proposed Ro-Ro Terminal, Pocket for scour protection dredged to -12.5m CD
- Turning Circle, dredged to -10.0m CD
- Maritime Village, dredged to -3.0m CD

A total of 44 samples were required to be tested at locations presented in Figure 8.12. Three sampling techniques were used related to the depth of sample required as presented in Table 8.15.

Table 8.15 Sediment Chemistry Sampling Programme

Sample Depth	Sample Collection Method	Specialist Site Investigation Contractor	Date of Sample Collection	Number of Samples Collected
Surface Samples	Grab	Aquatic Services Unit, UCC & Hydromaster Ltd	Oct' '22 and Feb' '23	26
Shallow depth samples (up to 4.5m)	Vibrocore	Hydromaster Ltd	Jan' '23	14
Deep samples (up to 11.0m)	Borehole	Fugro Geoservices Ltd	Nov' '22 and Jan' '23	4
Total Number of Samples Collected				**44**

In all cases, the sediment samples collected were sent to Socotec Laboratories in the UK for sediment chemistry analysis.

The marine sediments were classified by comparing the sediment chemistry results against the upper and lower action limits set in the *Marine Institute Guidelines for the Assessment of Dredge Material for Disposal in Irish Waters (2006)* as set out in Table 8.16 and Table 8.17.

The lower action levels for Arsenic and Nickel have recently been changed by the Marine Institute to take account of the natural background concentrations of these elements in Irish marine sediments. The most up to date lower action limits have been used in the analysis.

Table 8.16 Sediment Quality Classification (Marine Institute 2006)

Class	Description
Class 1	• Contaminant concentration less than the Level 1 Lower Level Values • Uncontaminated: no biological effects likely
Class 2	• Contaminant concentrations between Level 1 and Level 2 Values • Marginally contaminated; • Further sampling & analysis necessary to delineate problem area, if possible
Class 3	• Heavily contaminated; • Very likely to cause biological effects / toxicity to marine organisms. • Alternative management options to be considered

Table 8.17 Parameters and proposed guidance values for sediment quality (Marine Institute 2006)

Parameter	Units (Dry Wt)	Action Level 1 (Lower Level Value)	Action Level 2 (Upper Level Value)
Arsenic	mg kg^{-1}	20*	70
Cadmium	mg kg^{-1}	0.7	4.2
Chromium	mg kg^{-1}	120	370
Copper	mg kg^{-1}	40	110
Lead	mg kg^{-1}	60	218
Mercury	mg kg^{-1}	0.2	0.7
Nickel	mg kg^{-1}	40*	60
Zinc	mg kg^{-1}	160	410
Σ (TBT + DBT)	mg kg-1	0.1	0.5
g-HCH (Lindane)	µg kg^{-1}	0.3	1
PCB (individual congenerof ICES 7)	µg kg^{-1}	1	180
Σ (7 PCBs)	µg kg^{-1}	7	1260
Hexachlorobenzine	µg kg^{-1}	0.3	1
Σ (16 PAH)	µg kg^{-1}	4000	-
Total Extractable Hydrocarbons (TEH)	g kg^{-1}	1	
Note: * Revised Lower limits for Arsenic and Nickel Class 1 Sediments – Contaminant concentrations below the Level 1 Lower Level Values Class 2 Sediments – Contaminant concentrations between the Lower and Upper Level Values Class 3 Sediments – Contaminant concentrations above the Level 2 Upper Level Values			

The results of the Sediment Sampling and Analysis Plan, including comparison with Marine Institute Guidelines, are presented in Table 8.18 (surface samples), Table 8.19 (depth up to 4.5m) and Table 8.20 (depth up to 11m). Details of the full Laboratory Results including Quality Assurance Certificates are presented in Appendix 8-4.

The following observations can be made from the sediment chemistry results:

- None of the 44 samples have any parameter above the upper Marine Institute Guideline limit, that is, there is no Class 3 material present.
- The Surface Samples at locations 1-9 (Maritime Village) exhibit widespread levels of Class 2 material. The level of contamination significantly reduces with depth.
- The samples taken at the Turning Circle (sample locations 10 – 22) and Lo-Lo Terminal (Area N) Berthing Pocket (sample locations 23 – 42) are generally Class 1 (Uncontaminated: no biological effects likely) with localised, slightly elevated levels above the Marine Institute Lower Guideline limit.

The results are aligned with sediment chemistry trends recorded between 2006 – 2020 (Dublin Harbour Capital Dredging Project, EIAR, July 2021). This analysis demonstrated that a significant improvement in sediment chemistry has been witnessed within the Dublin Port navigation channel over time. The navigation channel at North Wall Quay Extension (upstream end of Dublin Port) was found to be the zone with highest initial contaminant levels and where downward trends are most evident. In an effort to summarise temporal trends with respect to the main contaminant groups, the mean annual concentrations of metals, PCBs and PAHs were indexed to the initial 2006 value. Subsequent years are expressed as a proportion of the 2006 concentration. Scaling in this manner allows a mean contaminant index to be computed based on these groups as shown in Figure 8.8. It indicates that the overall sediment contaminant load has reduced from 2006 to 2020, principally during the period from 2006 to 2019 and plateauing thereafter. The mean annual contaminant load in 2020 due to metals, PCBs and PAHs is less than half that measured in 2006.

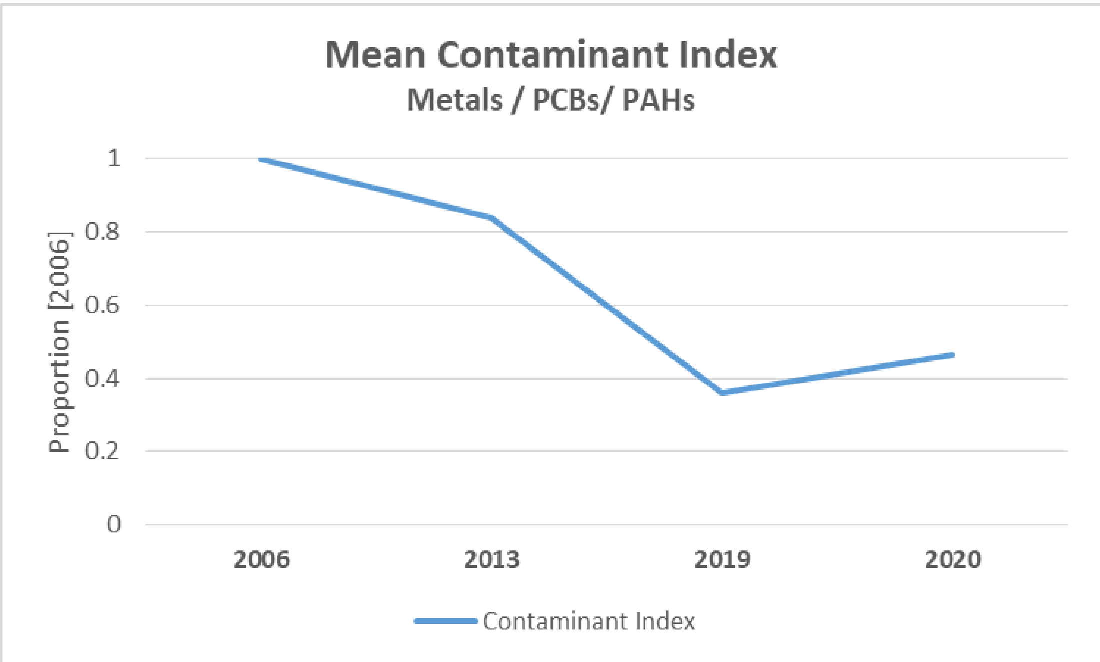


Figure 8.8 Annual index of combined sediment contaminant load over the period of record. Load is indexed to 2006 for each year.

The reasons for the significant improvement in sediment quality within the Dublin Port navigation channel over time is likely to be due to the following contributory factors:

- The construction of the Alexandra Basin Redevelopment (ABR) Project has now effectively removed the source of lead and zinc contamination within Alexandra Basin West which has likely migrated into the navigation channel. New ore loading facilities have been put in place which effectively eliminates the loss of lead and zinc ore to the receiving waters.
- The ship maintenance and repair facilities at Graving Dock #2 have now been removed and the graving dock closed-off from Alexandra Basin West and infilled. The potential source of contaminants from the shot-blasting of ship's hulls, notably copper and TBT, has therefore been eliminated.
- The legacy issue of contaminated sediments within Alexandra Basin West is being addressed through a process of removing the contaminated sediments, treatment and re-using the treated material for infill. This work is being undertaken in accordance with an Industrial Emissions Licence issued by the EPA.
- There has been a general improvement in water quality within the navigation channel as reported under the EU Water Framework Directive (WFD). Effective catchment management within the Liffey thereby appears to be yielding positive results with less pollutants now likely to be entering the Dublin Port navigation from the upstream catchment.

The Surface Samples at the Maritime Village which exhibit widespread levels of Class 2 material are located towards the upstream end of Dublin Port in an area which has not been subject to regular maintenance dredging. The level of contamination was therefore expected to be highest at this general location.

Table 8.18 Surface Sample Results - October 2022 (February 2023 for sample location S35)

Parameter	Units (Dry Wt)	Surface Samples				Guideline Values	
		S1	S3	S4	S5	Lower Level	Upper Level
		surface	surface	surface	surface		
Arsenic	mg kg-1	13.4	14.1	15.9	14.9	20	70
Cadmium	mg kg-1	1.12	1.16	1.45	1.20	0.7	4.2
Chromium	mg kg-1	69.3	65.8	71.9	68.5	120	370
Copper	mg kg-1	49.5	47.5	56.5	49.3	40	110
Lead	mg kg-1	70.3	71.2	74.6	59.0	60	218
Mercury	mg kg-1	0.25	0.25	0.26	0.29	0.2	0.7
Nickel	mg kg-1	32.5	33.6	34.2	31.3	40	60
Zinc	mg kg-1	222	245	265	226	160	410
(TBT + DBT)	mg kg-1	0.0208	0.0229	0.0358	<0.01	0.1	0.5
g-HCH (Lindane)	ug kg-1	<0.1	<0.1	<0.1	<0.1	0.3	1
PCB 028	ug kg-1	1.6000	2.2400	2.2200	1.7200	1	180
PCB 052	ug kg-1	0.8400	1.0700	1.0900	0.8900	1	180
PCB 101	ug kg-1	0.6700	0.7500	0.7900	0.8200	1	180
PCB 118	ug kg-1	0.9000	0.8300	1.0900	0.9300	1	180
PCB 138	ug kg-1	0.9000	0.9500	1.0800	0.5700	1	180
PCB 153	ug kg-1	0.7200	0.7700	0.9000	0.9800	1	180
PCB 180	ug kg-1	0.4100	0.4800	0.4400	0.4800	1	180
Σ (7 PCBs)	ug kg-1	6.0400	7.0900	7.6100	6.3900	7	1260
Hexachlorobenzine	ug kg-1	0.130	<0.1	0.130	0.130	0.3	1
Acenaphthene	ug kg-1	16.7	21.0	30.7	27.6	-	-
Acenaphthylene	ug kg-1	66.6	43.2	73.8	75.3	-	-
Anthracene	ug kg-1	88.4	78.6	140.0	99.6	-	-
Benzo (a) anthracene	ug kg-1	220.0	222.0	455.0	435.0	-	-
Benzo (a) pyrene	ug kg-1	350.0	338.0	635.0	629.0	-	-
Benzo (b) fluoranthene	ug kg-1	287.0	306.0	515.0	516.0	-	-
Benzo (ghi) perylene	ug kg-1	255.0	276.0	412.0	417.0	-	-
Benzo (k) fluoranthene	ug kg-1	296.0	288.0	492.0	499.0	-	-
Chrysene	ug kg-1	229.0	228.0	476.0	467.0	-	-
Dibenz (a,h) anthracene	ug kg-1	48.9	41.7	84.2	86.5	-	-
Flourene	ug kg-1	288.0	387.0	752.0	599.0	-	-
Fluoranthene	ug kg-1	44.1	45.6	72.5	63.6	-	-
Indeno (1,2,3–cd)	ug kg-1	238.0	243.0	410.0	411.0	-	-
Naphthalene	ug kg-1	50.4	47.1	62.8	62.5	-	-
Phenanthrene	ug kg-1	140.0	185.0	336.0	221.0	-	-
Pyrene	ug kg-1	378.0	493.0	839.0	722.0	-	-
Σ (16 PAH)	ug kg-1	2996.230	3243.200	5786.130	5331.230	4000	-
Total Extractable Hydrocarbons	g kg-1	0.586	0.517	0.632	0.657	1	

Table 8.18 cont'd Surface Samples October 2022 (February 2023 for sample location S35)

Parameter	Units (Dry Wt)	Surface Samples				Guideline Values	
		S6	S8	S11	S12	Lower Level	Upper Level
		surface	surface	surface	surface		
Arsenic	mg kg^{-1}	16.3	12.3	12.9	9.8	20	70
Cadmium	mg kg^{-1}	1.19	1.05	0.71	0.53	0.7	4.2
Chromium	mg kg^{-1}	73.0	65.5	61.2	53.2	120	370
Copper	mg kg^{-1}	65.0	59.6	50.4	31.8	40	110
Lead	mg kg^{-1}	64.7	54.5	32.6	31.3	60	218
Mercury	mg kg^{-1}	0.27	0.23	0.16	0.16	0.2	0.7
Nickel	mg kg^{-1}	31.4	28.1	27.9	23.9	40	60
Zinc	mg kg^{-1}	252	210	139	107	160	410
(TBT + DBT)	mg kg^{-1}	0.0536	0.0603	<0.01	<0.01	0.1	0.5
g-HCH (Lindane)	ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	0.3	1
PCB 028	ug kg^{-1}	1.6100	1.4700	0.3700	0.5100	1	180
PCB 052	ug kg^{-1}	0.8600	0.7400	0.2200	0.2400	1	180
PCB 101	ug kg^{-1}	0.7600	0.7000	0.1800	0.1900	1	180
PCB 118	ug kg^{-1}	0.9200	0.9400	0.2000	0.3300	1	180
PCB 138	ug kg^{-1}	1.0700	0.5700	0.1900	0.2000	1	180
PCB 153	ug kg^{-1}	0.8600	0.6600	0.2500	0.2700	1	180
PCB 180	ug kg^{-1}	0.4600	0.5900	0.0900	0.1600	1	180
Σ (7 PCBs)	ug kg^{-1}	6.5400	5.6700	1.5000	1.9000	7	1260
Hexachlorobenzine	ug kg^{-1}	0.160	0.120	<0.1	<0.1	0.3	1
Acenaphthene	ug kg^{-1}	18.1	16.1	8.4	11.3	-	-
Acenaphthylene	ug kg^{-1}	64.8	51.2	15.2	26.4	-	-
Anthracene	ug kg^{-1}	112.0	70.6	22.6	41.7	-	-
Benzo (a) anthracene	ug kg^{-1}	270.0	198.0	52.9	124.0	-	-
Benzo (a) pyrene	ug kg^{-1}	384.0	308.0	80.8	155.0	-	-
Benzo (b) fluoranthene	ug kg^{-1}	320.0	264.0	82.0	136.0	-	-
Benzo (ghi) perylene	ug kg^{-1}	266.0	232.0	77.7	121.0	-	-
Benzo (k) fluoranthene	ug kg^{-1}	299.0	252.0	72.2	139.0	-	-
Chrysene	ug kg^{-1}	271.0	216.0	68.5	135.0	-	-
Dibenz (a,h) anthracene	ug kg^{-1}	56.0	47.7	15.7	26.4	-	-
Flourene	ug kg^{-1}	385.0	258.0	72.3	204.0	-	-
Fluoranthene	ug kg^{-1}	58.0	49.7	21.0	25.2	-	-
Indeno (1,2,3–cd)	ug kg^{-1}	268.0	227.0	77.1	122.0	-	-
Naphthalene	ug kg^{-1}	56.6	54.9	27.9	33.1	-	-
Phenanthrene	ug kg^{-1}	206.0	135.0	59.3	103.0	-	-
Pyrene	ug kg^{-1}	436.0	349.0	105.0	225.0	-	-
Σ (16 PAH)	ug kg^{-1}	3470.660	2730.320	858.550	1628.100	4000	-
Total Extractable Hydrocarbons	g kg^{-1}	0.679	0.671	0.809	0.334	1	

Table 8.18 cont'd Surface Samples October 2022 (February 2023 for sample location S35)

Parameter	Units (Dry Wt)	Surface Samples				Guideline Values	
		S15	S17	S20	S21	Lower Level	Upper Level
		surface	surface	surface	surface		
Arsenic	mg kg^{-1}	10.6	8.9	9.9	11.5	20	70
Cadmium	mg kg^{-1}	0.57	0.51	0.58	0.61	0.7	4.2
Chromium	mg kg^{-1}	57.5	55.9	60.2	64.4	120	370
Copper	mg kg^{-1}	42.4	36.0	39.8	44.3	40	110
Lead	mg kg^{-1}	31.4	33.3	32.9	38.2	60	218
Mercury	mg kg^{-1}	0.15	0.22	0.15	0.17	0.2	0.7
Nickel	mg kg^{-1}	23.4	20.1	24.1	27.1	40	60
Zinc	mg kg^{-1}	121	123	118	138	160	410
(TBT + DBT)	mg kg^{-1}	<0.01	<0.01	<0.01	<0.01	0.1	0.5
g-HCH (Lindane)	ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	0.3	1
PCB 028	ug kg^{-1}	0.4000	0.4600	0.3900	0.4400	1	180
PCB 052	ug kg^{-1}	0.2600	0.6600	0.2200	0.2400	1	180
PCB 101	ug kg^{-1}	0.2400	0.5800	0.2400	0.2700	1	180
PCB 118	ug kg^{-1}	0.3500	0.3600	0.3800	0.4200	1	180
PCB 138	ug kg^{-1}	0.2800	0.4300	0.4900	0.5600	1	180
PCB 153	ug kg^{-1}	0.3200	0.4400	0.4100	0.5000	1	180
PCB 180	ug kg^{-1}	0.2100	0.2000	0.2700	0.5100	1	180
Σ (7 PCBs)	ug kg^{-1}	2.0600	3.1300	2.4000	2.9400	7	1260
Hexachlorobenzine	ug kg^{-1}	<0.1	<0.1	<0.1	0.110	0.3	1
Acenaphthene	ug kg^{-1}	13.5	34.9	17.9	16.1	-	-
Acenaphthylene	ug kg^{-1}	18.9	34.7	29.6	27.8	-	-
Anthracene	ug kg^{-1}	47.8	115.0	37.3	37.3	-	-
Benzo (a) anthracene	ug kg^{-1}	120.0	137.0	109.0	91.0	-	-
Benzo (a) pyrene	ug kg^{-1}	158.0	190.0	167.0	134.0	-	-
Benzo (b) fluoranthene	ug kg^{-1}	144.0	157.0	136.0	120.0	-	-
Benzo (ghi) perylene	ug kg^{-1}	115.0	122.0	120.0	103.0	-	-
Benzo (k) fluoranthene	ug kg^{-1}	127.0	154.0	143.0	110.0	-	-
Chrysene	ug kg^{-1}	138.0	153.0	125.0	104.0	-	-
Dibenz (a,h) anthracene	ug kg^{-1}	25.4	24.1	22.7	19.5	-	-
Flourene	ug kg^{-1}	199.0	50.5	27.4	31.1	-	-
Fluoranthene	ug kg^{-1}	25.2	282.0	162.0	139.0	-	-
Indeno (1,2,3–cd)	ug kg^{-1}	114.0	119.0	117.0	105.0	-	-
Naphthalene	ug kg^{-1}	28.2	66.8	35.2	53.8	-	-
Phenanthrene	ug kg^{-1}	119.0	182.0	111.0	101.0	-	-
Pyrene	ug kg^{-1}	217.0	389.0	183.0	166.0	-	-
Σ (16 PAH)	ug kg^{-1}	1610.000	2211.000	1543.100	1358.710	4000	-
Total Extractable Hydrocarbons	g kg^{-1}	0.378	0.293	0.484	0.403	1	

Table 8.18 cont'd Surface Samples October 2022 (February 2023 for sample location S35)

Parameter	Units (Dry Wt)	Surface Samples				Guideline Values	
		S23	S26	S28	S30	Lower Level	Upper Level
		surface	surface	surface	surface		
Arsenic	mg kg-1	9.7	15.1	11.7	11.0	20	70
Cadmium	mg kg-1	0.51	0.76	0.53	0.56	0.7	4.2
Chromium	mg kg-1	60.4	67.7	69.4	67.9	120	370
Copper	mg kg-1	35.1	67.1	43.4	47.1	40	110
Lead	mg kg-1	34.1	37.6	43.1	34.5	60	218
Mercury	mg kg-1	0.14	0.19	0.17	0.14	0.2	0.7
Nickel	mg kg-1	27.5	31.3	31.6	27.6	40	60
Zinc	mg kg-1	114	167	134	135	160	410
(TBT + DBT)	mg kg-1	<0.01	<0.01	<0.01	<0.01	0.1	0.5
g-HCH (Lindane)	ug kg-1	<0.1	<0.1	<0.1	<0.1	0.3	1
PCB 028	ug kg-1	0.5200	0.2600	0.3900	0.2900	1	180
PCB 052	ug kg-1	0.2900	0.1300	0.2100	0.1500	1	180
PCB 101	ug kg-1	0.2500	0.1600	0.2200	0.1700	1	180
PCB 118	ug kg-1	0.2900	0.2200	0.3200	0.2400	1	180
PCB 138	ug kg-1	0.3400	0.3300	0.3100	0.2400	1	180
PCB 153	ug kg-1	0.2400	0.2200	0.3100	0.2100	1	180
PCB 180	ug kg-1	0.1800	<0.08	0.1900	0.1300	1	180
Σ (7 PCBs)	ug kg-1	2.1100	1.3200	1.9500	1.4300	7	1260
Hexachlorobenzine	ug kg-1	<0.1	<0.1	<0.1	<0.1	0.3	1
Acenaphthene	ug kg-1	6.8	7.7	7.6	6.3	-	-
Acenaphthylene	ug kg-1	19.2	18.4	15.3	14.9	-	-
Anthracene	ug kg-1	25.5	25.8	18.7	19.8	-	-
Benzo (a) anthracene	ug kg-1	60.5	61.2	53.7	55.8	-	-
Benzo (a) pyrene	ug kg-1	84.0	87.4	77.5	84.0	-	-
Benzo (b) fluoranthene	ug kg-1	74.3	86.1	88.7	82.7	-	-
Benzo (ghi) perylene	ug kg-1	66.0	82.2	76.3	72.3	-	-
Benzo (k) fluoranthene	ug kg-1	75.6	101.0	74.1	69.9	-	-
Chrysene	ug kg-1	67.4	76.9	71.0	72.3	-	-
Dibenz (a,h) anthracene	ug kg-1	12.0	16.0	14.7	15.3	-	-
Flourene	ug kg-1	19.5	19.0	19.2	16.8	-	-
Fluoranthene	ug kg-1	78.3	91.4	82.5	86.4	-	-
Indeno (1,2,3–cd)	ug kg-1	65.0	80.7	76.5	69.9	-	-
Naphthalene	ug kg-1	26.4	25.4	26.0	24.1	-	-
Phenanthrene	ug kg-1	55.4	66.8	60.9	65.7	-	-
Pyrene	ug kg-1	116.0	114.0	95.0	101.0	-	-
Σ (16 PAH)	ug kg-1	851.900	959.950	857.710	857.660	4000	-
Total Extractable Hydrocarbons	g kg-1	0.275	0.660	0.417	0.513	1	

Table 8.18 cont'd Surface Samples October 2022 (February 2023 for sample location S35)

Parameter	Units (Dry Wt)	Surface Samples				Guideline Values	
		S31	S32	S34	S35	Lower Level	Upper Level
		surface	surface	surface	surface		
Arsenic	mg kg^{-1}	14.3	14.1	16.8	13.6	20	70
Cadmium	mg kg^{-1}	0.72	0.71	0.84	0.66	0.7	4.2
Chromium	mg kg^{-1}	70.9	74.2	68.9	74.3	120	370
Copper	mg kg^{-1}	68.3	55.3	84.0	69.4	40	110
Lead	mg kg^{-1}	39.4	45.9	42.4	43.7	60	218
Mercury	mg kg^{-1}	0.18	0.18	0.20	0.17	0.2	0.7
Nickel	mg kg^{-1}	31.5	33.5	31.1	32	40	60
Zinc	mg kg^{-1}	174	159	187	193	160	410
(TBT + DBT)	mg kg^{-1}	<0.01	<0.01	<0.01	<0.01	0.1	0.5
g-HCH (Lindane)	ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	0.3	1
PCB 028	ug kg^{-1}	0.3400	0.5300	0.5200	1.0400	1	180
PCB 052	ug kg^{-1}	0.2100	0.2600	0.3100	0.7400	1	180
PCB 101	ug kg^{-1}	0.1600	0.2400	0.2300	0.4500	1	180
PCB 118	ug kg^{-1}	0.2700	0.3200	0.3300	0.6300	1	180
PCB 138	ug kg^{-1}	0.2900	0.1900	0.3700	0.5600	1	180
PCB 153	ug kg^{-1}	0.2700	0.3300	0.3800	0.59000	1	180
PCB 180	ug kg^{-1}	0.1500	0.2400	0.2800	0.4500	1	180
Σ (7 PCBs)	ug kg^{-1}	1.6900	2.1100	2.4200	4.46	7	1260
Hexachlorobenzine	ug kg^{-1}	<0.1	<0.1	<0.1	0.11	0.3	1
Acenaphthene	ug kg^{-1}	10.7	11.9	12.0	5.00	-	-
Acenaphthylene	ug kg^{-1}	13.6	30.0	32.0	29.20	-	-
Anthracene	ug kg^{-1}	29.6	40.6	31.6	31.50	-	-
Benzo (a) anthracene	ug kg^{-1}	86.0	118.0	92.1	111.00	-	-
Benzo (a) pyrene	ug kg^{-1}	111.00	160.0	150.0	127.00	-	-
Benzo (b) fluoranthene	ug kg^{-1}	113.0	146.0	140.0	130.00	-	-
Benzo (ghi) perylene	ug kg^{-1}	100.0	122.0	138.0	107.00	-	-
Benzo (k) fluoranthene	ug kg^{-1}	88.6	138.0	134.0	125.00	-	-
Chrysene	ug kg^{-1}	105.0	138.0	123.0	136.00	-	-
Dibenz (a,h) anthracene	ug kg^{-1}	19.4	26.1	27.1	21.40	-	-
Flourene	ug kg^{-1}	23.3	30.8	32.7	32.90	-	-
Fluoranthene	ug kg^{-1}	147.0	152.0	132.0	173.00	-	-
Indeno (1,2,3–cd)	ug kg^{-1}	102.0	128.0	142.0	109.00	-	-
Naphthalene	ug kg^{-1}	47.4	34.0	45.1	37.00	-	-
Phenanthrene	ug kg^{-1}	92.4	93.0	93.3	105.00	-	-
Pyrene	ug kg^{-1}	168.0	220.0	166.0	224.00	-	-
Σ (16 PAH)	ug kg^{-1}	1257.000	1588.400	1490.900	1504.11	4000	-
Total Extractable Hydrocarbons	g kg^{-1}	0.738	0.443	1.220	0.905	1	

Table 8.18 cont'd Surface Samples October 2022 (February 2023 for sample location S35)

Parameter	Units (Dry Wt)	Surface Samples					Guideline Values	
		S37	S38	S39	S42	S43	Lower Level	Upper Level
		surface	surface	surface	surface	surface		
Arsenic	mg kg^{-1}	7.0	7.8	4.7	7.6	14.2	20	70
Cadmium	mg kg^{-1}	0.47	0.48	0.16	0.38	0.69	0.7	4.2
Chromium	mg kg^{-1}	43.5	53.4	36.6	41.7	55.8	120	370
Copper	mg kg^{-1}	36.1	27.2	11.1	36.6	100	40	110
Lead	mg kg^{-1}	29.1	32.2	24.4	38.4	38.3	60	218
Mercury	mg kg^{-1}	0.17	0.14	0.22	0.22	0.25	0.2	0.7
Nickel	mg kg^{-1}	22.3	26.3	14.3	18.4	24.0	40	60
Zinc	mg kg^{-1}	104	96.5	43.7	103	191	160	410
(TBT + DBT)	mg kg^{-1}	<0.01	<0.01	<0.01	0.0151	<0.01	0.1	0.5
g-HCH (Lindane)	ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	1
PCB 028	ug kg^{-1}	0.2600	0.3000	<0.08	0.5300	0.3700	1	180
PCB 052	ug kg^{-1}	0.1400	0.1600	<0.08	0.3100	0.2500	1	180
PCB 101	ug kg^{-1}	0.1500	0.1500	<0.08	0.2100	0.2100	1	180
PCB 118	ug kg^{-1}	0.1500	0.1500	<0.08	0.2000	0.2400	1	180
PCB 138	ug kg^{-1}	0.1900	0.2100	<0.08	0.1700	0.2100	1	180
PCB 153	ug kg^{-1}	0.1900	0.2000	<0.08	0.1900	0.3000	1	180
PCB 180	ug kg^{-1}	0.0900	<0.08	<0.08	0.1900	0.1300	1	180
Σ (7 PCBs)	ug kg^{-1}	1.1700	1.1700	0.0000	1.8000	1.7100	7	1260
Hexachlorobenzine	ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	0.120	0.3	1
Acenaphthene	ug kg^{-1}	11.5	7.2	1.8	29.1	41.8	-	-
Acenaphthylene	ug kg^{-1}	24.5	23.4	10.5	49.8	20.8	-	-
Anthracene	ug kg^{-1}	34.5	31.2	10.5	128.0	48.7	-	-
Benzo (a) anthracene	ug kg^{-1}	84.5	94.6	28.9	305.0	176.0	-	-
Benzo (a) pyrene	ug kg^{-1}	136.0	125.0	40.0	397.0	214.0	-	-
Benzo (b) fluoranthene	ug kg^{-1}	112.0	123.0	32.0	289.0	188.0	-	-
Benzo (ghi) perylene	ug kg^{-1}	101.0	99.9	24.8	223.0	145.0	-	-
Benzo (k) fluoranthene	ug kg^{-1}	118.0	113.0	35.3	314.0	181.0	-	-
Chrysene	ug kg^{-1}	93.3	104.0	31.6	328.0	212.0	-	-
Dibenz (a,h) anthracene	ug kg^{-1}	20.4	20.1	6.0	44.3	29.4	-	-
Flourene	ug kg^{-1}	27.4	24.0	6.6	70.5	35.0	-	-
Fluoranthene	ug kg^{-1}	106.0	138.0	36.5	495.0	434.0	-	-
Indeno (1,2,3–cd)	ug kg^{-1}	101.0	103.0	25.9	223.0	140.0	-	-
Naphthalene	ug kg^{-1}	42.6	25.8	8.5	55.5	26.4	-	-
Phenanthrene	ug kg^{-1}	74.9	63.6	17.6	292.0	316.0	-	-
Pyrene	ug kg^{-1}	164.0	160.0	69.5	659.0	451.0	-	-
Σ (16 PAH)	ug kg^{-1}	1251.600	1255.780	385.990	3902.200	2659.020	4000	-
Total Extractable Hydrocarbons	g kg^{-1}	0.755	0.327	0.085	0.536	0.871	1	

Table 8.19 Samples taken at shallow depth (up to 4.5m) using Vibrocore January 2023

Parameter	Units (Dry Wt)	Vibrocores				Guideline Values	
		S2	S7	S14	S16	Lower Level	Upper Level
		Depth -1.5m	Depth -2.5m	Depth -3.0m	Depth -3.8m		
Arsenic	mg kg^{-1}	12.3	12.9	7.3	8.6	20	70
Cadmium	mg kg^{-1}	0.95	1.14	0.26	0.61	0.7	4.2
Chromium	mg kg^{-1}	56.5	56.4	43.7	56.0	120	370
Copper	mg kg^{-1}	40.6	42.7	17.5	33.8	40	110
Lead	mg kg^{-1}	49.4	64.2	24.1	53.0	60	218
Mercury	mg kg^{-1}	0.17	0.22	0.07	0.21	0.2	0.7
Nickel	mg kg^{-1}	25.7	29.0	18.7	25.9	40	60
Zinc	mg kg^{-1}	177	207	74.5	153	160	410
(TBT + DBT)	mg kg^{-1}	0.0297	0.0331	0.01	0.0446	0.1	0.5
g-HCH (Lindane)	ug kg^{-1}	<0.1	<0.1	<0.1	0.16	0.3	1
PCB 028	ug kg^{-1}	1.56	2.09	0.38	1.64	1	180
PCB 052	ug kg^{-1}	0.95	1.17	0.21	0.90	1	180
PCB 101	ug kg^{-1}	0.82	0.90	0.19	0.76	1	180
PCB 118	ug kg^{-1}	0.85	1.19	0.28	1.02	1	180
PCB 138	ug kg^{-1}	0.99	0.83	0.16	0.81	1	180
PCB 153	ug kg^{-1}	0.87	1.02	0.18	0.95	1	180
PCB 180	ug kg^{-1}	0.51	0.58	<0.08	0.50	1	180
Σ (7 PCBs)	ug kg^{-1}	6.55	7.78	1.40	6.58	7	1260
Hexachlorobenzine	ug kg^{-1}	0.11	0.11	<0.1	<0.1	0.3	1
Acenaphthene	ug kg^{-1}	68.9	28.6	15.1	159	-	-
Acenaphthylene	ug kg^{-1}	123	112	29.3	93.7	-	-
Anthracene	ug kg^{-1}	197	145	57.1	278	-	-
Benzo (a) anthracene	ug kg^{-1}	534	364	118	440	-	-
Benzo (a) pyrene	ug kg^{-1}	784	567	176	507	-	-
Benzo (b) fluoranthene	ug kg^{-1}	631	445	156	402	-	-
Benzo (ghi) perylene	ug kg^{-1}	546	409	135	343	-	-
Benzo (k) fluoranthene	ug kg^{-1}	614	429	150	398	-	-
Chrysene	ug kg^{-1}	538	381	130	484	-	-
Dibenz (a,h) anthracene	ug kg^{-1}	121	91.0	30.7	79.3	-	-
Flourene	ug kg^{-1}	115	89.1	36.6	271	-	-
Fluoranthene	ug kg^{-1}	924	504	161	768	-	-
Indeno (1,2,3–cd)	ug kg^{-1}	577	418	142	363	-	-
Naphthalene	ug kg^{-1}	80.7	84.0	48.8	123	-	-
Phenanthrene	ug kg^{-1}	373	198	102	310	-	-
Pyrene	ug kg^{-1}	978	637	213	905	-	-
Σ (16 PAH)	ug kg^{-1}	7204.71	4901.81	1700.60	5924.00	4000	-
Total Extractable Hydrocarbons	g kg^{-1}	0.648	0.675	0.273	1.010	1	

Table 8.19 cont'd Samples taken at shallow depth (up to 4.5m) using Vibrocore January 2023

Parameter	Units (Dry Wt)	Vibrocores				Guideline Values	
		S18	S19	S22	S25	Lower Level	Upper Level
		Depth -4.5m	Depth -2.0m	Depth -2.5m	Depth -2.2m		
Arsenic	mg kg-1	13.3	8.7	7.6	12.1	20	70
Cadmium	mg kg-1	0.85	0.44	0.46	0.32	0.7	4.2
Chromium	mg kg-1	46.6	51.6	50.6	60.1	120	370
Copper	mg kg-1	32.1	29.5	25.9	23.4	40	110
Lead	mg kg-1	59.0	39.8	32.8	36.2	60	218
Mercury	mg kg-1	0.47	0.12	0.11	0.09	0.2	0.7
Nickel	mg kg-1	28.1	27.0	20.1	28.0	40	60
Zinc	mg kg-1	84.5	106	102	105	160	410
(TBT + DBT)	mg kg-1	0.01	0.01	0.01	0.01	0.1	0.5
g-HCH (Lindane)	ug kg-1	<0.1	<0.1	0.10	<0.1	0.3	1
PCB 028	ug kg-1	0.19	0.70	0.81	0.48	1	180
PCB 052	ug kg-1	<0.08	0.63	0.51	0.28	1	180
PCB 101	ug kg-1	<0.08	0.40	0.48	0.29	1	180
PCB 118	ug kg-1	<0.08	0.50	0.65	0.44	1	180
PCB 138	ug kg-1	<0.08	0.41	0.55	0.31	1	180
PCB 153	ug kg-1	<0.08	0.40	0.76	0.46	1	180
PCB 180	ug kg-1	<0.08	0.26	0.44	0.23	1	180
Σ (7 PCBs)	ug kg-1	0.19	3.30	4.20	2.49	7	1260
Hexachlorobenzine	ug kg-1	<0.1	<0.1	0.11	<0.1	0.3	1
Acenaphthene	ug kg-1	19.6	17.9	52.8	9.93	-	-
Acenaphthylene	ug kg-1	12.4	37.3	48.5	31.4	-	-
Anthracene	ug kg-1	61.4	66.5	91.8	36.1	-	-
Benzo (a) anthracene	ug kg-1	122	199	213	98.3	-	-
Benzo (a) pyrene	ug kg-1	117	253	293	148	-	-
Benzo (b) fluoranthene	ug kg-1	112	230	239	154	-	-
Benzo (ghi) perylene	ug kg-1	97	187	198	127	-	-
Benzo (k) fluoranthene	ug kg-1	114	216	238	134	-	-
Chrysene	ug kg-1	140	219	216	130	-	-
Dibenz (a,h) anthracene	ug kg-1	19.7	38.9	42.9	26.3	-	-
Flourene	ug kg-1	65.1	40.9	76.9	34.3	-	-
Fluoranthene	ug kg-1	162	336	349	148	-	-
Indeno (1,2,3–cd)	ug kg-1	75.8	199	200	134	-	-
Naphthalene	ug kg-1	39.7	39.5	67.1	35.9	-	-
Phenanthrene	ug kg-1	187	128	238	94.7	-	-
Pyrene	ug kg-1	179	350	416	163	-	-
Σ (16 PAH)	ug kg-1	1523.70	2558.00	2980.11	1504.93	4000	-
Total Extractable Hydrocarbons	g kg-1	0.321	0.303	0.364	0.372	1	

Table 8.19 cont'd Samples taken at shallow depth (up to 4.5m) using Vibrocore January 2023

Parameter	Units (Dry Wt)	Vibrocores			Guideline Values	
		S27	S29	S33	Lower Level	Upper Level
		Depth -3.0m	Depth -2.5m	Depth -1.5m		
Arsenic	mg kg^{-1}	10.6	11.2	10.2	20	70
Cadmium	mg kg^{-1}	0.48	0.75	0.35	0.7	4.2
Chromium	mg kg^{-1}	63.6	65.0	62.0	120	370
Copper	mg kg^{-1}	26.9	40.7	35.2	40	110
Lead	mg kg^{-1}	43.9	60.2	33.4	60	218
Mercury	mg kg^{-1}	0.14	0.26	0.09	0.2	0.7
Nickel	mg kg^{-1}	27.0	33.3	24.7	40	60
Zinc	mg kg^{-1}	114	149	108	160	410
(TBT + DBT)	mg kg^{-1}	0.0465	0.0262	0.0254	0.1	0.5
g-HCH (Lindane)	ug kg^{-1}	<0.1	0.15	<0.1	0.3	1
PCB 028	ug kg^{-1}	0.94	2.84	0.48	1	180
PCB 052	ug kg^{-1}	0.44	1.57	0.32	1	180
PCB 101	ug kg^{-1}	0.74	1.15	<0.08	1	180
PCB 118	ug kg^{-1}	0.71	1.47	0.37	1	180
PCB 138	ug kg^{-1}	2.27	1.11	0.33	1	180
PCB 153	ug kg^{-1}	2.61	1.54	0.44	1	180
PCB 180	ug kg^{-1}	2.27	1.02	0.18	1	180
Σ (7 PCBs)	ug kg^{-1}	9.98	10.70	2.12	7	1260
Hexachlorobenzine	ug kg^{-1}	<0.1	<0.1	<0.1	0.3	1
Acenaphthene	ug kg^{-1}	35.1	450	17.3	-	-
Acenaphthylene	ug kg^{-1}	38.6	482	33.1	-	-
Anthracene	ug kg^{-1}	78.9	1150	55.3	-	-
Benzo (a) anthracene	ug kg^{-1}	202	1930	131	-	-
Benzo (a) pyrene	ug kg^{-1}	247	2040	171	-	-
Benzo (b) fluoranthene	ug kg^{-1}	259	1470	173	-	-
Benzo (ghi) perylene	ug kg^{-1}	223	1330	146	-	-
Benzo (k) fluoranthene	ug kg^{-1}	247	1540	163	-	-
Chrysene	ug kg^{-1}	249	2050	160	-	-
Dibenz (a,h) anthracene	ug kg^{-1}	47.4	268	35.3	-	-
Flourene	ug kg^{-1}	64.7	728	44.1	-	-
Fluoranthene	ug kg^{-1}	330	3380	209	-	-
Indeno (1,2,3–cd)	ug kg^{-1}	232	1340	157	-	-
Naphthalene	ug kg^{-1}	55.7	336	38.0	-	-
Phenanthrene	ug kg^{-1}	238	3460	150	-	-
Pyrene	ug kg^{-1}	370	4170	249	-	-
Σ (16 PAH)	ug kg^{-1}	2917.40	26124.00	1932.10	4000	-
Total Extractable Hydrocarbons	g kg^{-1}	0.701	3.220	0.519	1	

Table 8.19 cont'd Samples taken at shallow depth (up to 4.5m) using Vibrocore January 2023

Parameter	Units (Dry Wt)	Vibrocores			Guideline Values	
		S36	S41	S44	Lower Level	Upper Level
		Depth -0.8m	Depth -1.5m	-Depth 4.5m		
Arsenic	mg kg^{-1}	7.8	7.8	10.0	20	70
Cadmium	mg kg^{-1}	0.47	1.95	0.40	0.7	4.2
Chromium	mg kg^{-1}	44.9	50.0	64.3	120	370
Copper	mg kg^{-1}	36.1	27.0	26.4	40	110
Lead	mg kg^{-1}	26.1	21.0	43.7	60	218
Mercury	mg kg^{-1}	0.11	0.06	0.12	0.2	0.7
Nickel	mg kg^{-1}	22.0	51.9	29.4	40	60
Zinc	mg kg^{-1}	97.7	92.0	118	160	410
(TBT + DBT)	mg kg^{-1}	0.01	0.01	0.01	0.1	0.5
g-HCH (Lindane)	ug kg^{-1}	<0.1	<0.1	<0.1	0.3	1
PCB 028	ug kg^{-1}	0.81	0.22	0.94	1	180
PCB 052	ug kg^{-1}	0.44	<0.08	0.49	1	180
PCB 101	ug kg^{-1}	0.24	<0.08	0.52	1	180
PCB 118	ug kg^{-1}	0.36	<0.08	0.74	1	180
PCB 138	ug kg^{-1}	0.31	<0.08	0.77	1	180
PCB 153	ug kg^{-1}	0.25	<0.08	0.74	1	180
PCB 180	ug kg^{-1}	0.24	<0.08	0.33	1	180
Σ (7 PCBs)	ug kg^{-1}	2.65	0.22	4.53	7	1260
Hexachlorobenzine	ug kg^{-1}	<0.1	<0.1	<0.1	0.3	1
Acenaphthene	ug kg^{-1}	<5	6.58	18.5	-	-
Acenaphthylene	ug kg^{-1}	29.6	<5	15.5	-	-
Anthracene	ug kg^{-1}	41.0	<5	40.0	-	-
Benzo (a) anthracene	ug kg^{-1}	108	<5	138	-	-
Benzo (a) pyrene	ug kg^{-1}	133	<5	164	-	-
Benzo (b) fluoranthene	ug kg^{-1}	102	22.5	210	-	-
Benzo (ghi) perylene	ug kg^{-1}	85.8	15.4	174	-	-
Benzo (k) fluoranthene	ug kg^{-1}	111	<5	190	-	-
Chrysene	ug kg^{-1}	119	50.2	190	-	-
Dibenz (a,h) anthracene	ug kg^{-1}	21.3	<5	36.8	-	-
Flourene	ug kg^{-1}	25.4	23.5	44.0	-	-
Fluoranthene	ug kg^{-1}	133	8.03	278	-	-
Indeno (1,2,3–cd)	ug kg^{-1}	91.8	<5	188	-	-
Naphthalene	ug kg^{-1}	23.6	11.0	53.4	-	-
Phenanthrene	ug kg^{-1}	72.5	67.4	175	-	-
Pyrene	ug kg^{-1}	196	18.6	252	-	-
Σ (16 PAH)	ug kg^{-1}	1293.00	223.21	2167.20	4000	-
Total Extractable Hydrocarbons	g kg^{-1}	0.921	0.033	0.559	1	

Table 8.20 Samples taken at depth (up to 11.0m) using Boreholes November 2022-January 2023

Parameter	Units (Dry Wt)	Boreholes				Guideline Values	
		S10 (BH-TC-05)	S13 (BH-TC-01)	S24 (BH-N-01)	S40 (BH-N-04)	Lower Level	Upper Level
		Depth -8m	Depth -10m	Depth -11m	Depth -10m		
Arsenic	mg kg^{-1}	4.9	5.2	3.7	4.3	20	70
Cadmium	mg kg^{-1}	0.48	0.58	0.7	0.82	0.7	4.2
Chromium	mg kg^{-1}	19.3	17.9	16.3	19.7	120	370
Copper	mg kg^{-1}	7	8	6.7	8.7	40	110
Lead	mg kg^{-1}	11.6	9.4	9.4	12.6	60	218
Mercury	mg kg^{-1}	0.02	<0.01	<0.01	<0.01	0.2	0.7
Nickel	mg kg^{-1}	15	18	14.6	17.8	40	60
Zinc	mg kg^{-1}	28	35	37.8	38	160	410
(TBT + DBT)	mg kg^{-1}	<0.002	<0.002	<0.002	<0.002	0.1	0.5
g-HCH (Lindane)	ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	0.3	1
PCB 028	ug kg^{-1}	0.1900	<0.08	<0.08	0.1200	1	180
PCB 052	ug kg^{-1}	0.4000	<0.08	<0.08	0.1600	1	180
PCB 101	ug kg^{-1}	0.5000	<0.08	<0.08	0.1700	1	180
PCB 118	ug kg^{-1}	0.3200	<0.08	<0.08	0.1300	1	180
PCB 138	ug kg^{-1}	0.4200	<0.08	<0.08	0.0900	1	180
PCB 153	ug kg^{-1}	0.7700	<0.08	<0.08	0.2000	1	180
PCB 180	ug kg^{-1}	0.6900	<0.08	<0.08	0.1400	1	180
Σ (7 PCBs)	ug kg^{-1}	3.29	<.08	<0.08	1.01	7	1260
Hexachlorobenzine	ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	0.3	1
Acenaphthene	ug kg^{-1}	<1	<1	<1	<1	-	-
Acenaphthylene	ug kg^{-1}	<1	<1	<1	<1	-	-
Anthracene	ug kg^{-1}	<1	<1	1.52	<1	-	-
Benzo (a) anthracene	ug kg^{-1}	<1	<1	<1	<1	-	-
Benzo (a) pyrene	ug kg^{-1}	<1	<1	<1	<1	-	-
Benzo (b) fluoranthene	ug kg^{-1}	1.37	1.52	2.15	1.91	-	-
Benzo (ghi) perylene	ug kg^{-1}	<1	<1	1.21	1.63	-	-
Benzo (k) fluoranthene	ug kg^{-1}	<1	<1	<1	<1	-	-
Chrysene	ug kg^{-1}	2.23	3.22	4.53	3.03	-	-
Dibenz (a,h) anthracene	ug kg^{-1}	<1	<1	<1	<1	-	-
Flourene	ug kg^{-1}	<1	<1	<1	<1	-	-
Fluoranthene	ug kg^{-1}	<1	<1	2.19	<1	-	-
Indeno (1,2,3–cd)	ug kg^{-1}	<1	<1	<1	<1	-	-
Naphthalene	ug kg^{-1}	<1	<1	1.38	<1	-	-
Phenanthrene	ug kg^{-1}	1.55	3.17	7.19	2.81	-	-
Pyrene	ug kg^{-1}	<1	<1	4.06	<1	-	-
Σ (16 PAH)	ug kg^{-1}	5.15	7.91	24.23	9.38	4000	-
Total Extractable Hydrocarbons	g kg^{-1}	0.002	0.002	0.004	0.004	1	

An additional SAP specifying the sample locations, depths and contaminants to be tested for Ro-Ro Terminal (Area K) was prepared by the Marine Institute at the request of DPC who were considering the deepening of the existing berthing pockets Berth 42-45 as part of the 3FM Project. This proposal was later removed from the scope of the 3FM Project because, as the project evolved, it emerged that the existing berths had sufficient depth for the Ro-Ro vessels envisaged. Localised capital dredging was however still required to facilitate scour protection to ESB's existing 220 kV cable crossing of the Liffey at the eastern end of Berth 45.

A total of nine additional samples were required to be tested at locations presented in Figure 8.12. The SAP required both Surface Samples and Vibrocores to collect the samples. The sediment samples were collected in January-February 2023 and sent to Socotec Laboratories in the UK for sediment chemistry analysis.

The results of the Sediment Sampling and Analysis Plan, including comparison with Marine Institute Guidelines, are presented in Table 8.21. Details of the full Laboratory Results including Quality Assurance Certificates are presented in Appendix 8-4.

Sample locations AC7, DP8 and AC9 are most relevant to the proposed capital dredging to facilitate scour protection. The following observations can be made from the sediment chemistry results:

- None of the samples have any parameter above the upper Marine Institute Guideline limit, that is, there is no Class 3 material present.
- Samples AC7, DP8 and AC9 are generally Class 1 (Uncontaminated: no biological effects likely) with only marginally elevated levels of Cadmium, Copper and Sum of PCB above the Marine Institute Lower Guideline limit.

Table 8.21 Surface Samples and Samples taken at shallow depth (up to 2.8m January 2023 (Area K)

Parameter	Units (Dry Wt)	Vibrocores and Surface Samples				Guideline Values	
		AC1	DP 02	AC3	DP 04	Lower Level	Upper Level
		1.8m under surface	surface	1m under surface	surface		
Arsenic	mg kg^{-1}	14.2	13.9	10.6	17.2	20	70
Cadmium	mg kg^{-1}	0.86	0.91	0.7	1.17	0.7	4.2
Chromium	mg kg^{-1}	66.7	67.6	58.2	81.2	120	370
Copper	mg kg^{-1}	38.4	42.2	17.4	56.5	40	110
Lead	mg kg^{-1}	52.5	49.3	20.9	55	60	218
Mercury	mg kg^{-1}	0.15	0.14	0.04	0.2	0.2	0.7
Nickel	mg kg^{-1}	32	32	32.1	37.4	40	60
Zinc	mg kg^{-1}	192	176	78.1	309	160	410
(TBT + DBT)	mg kg^{-1}	0.0194	0.0187	0.01	0.01	0.1	0.5
g-HCH (Lindane)	ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	0.3	1
PCB 028	ug kg^{-1}	1.4600	1.4200	<0.08	1.2800	1	180
PCB 052	ug kg^{-1}	0.8100	0.7200	<0.08	0.6900	1	180
PCB 101	ug kg^{-1}	0.6100	0.6100	<0.08	0.6400	1	180
PCB 118	ug kg^{-1}	0.7800	0.7400	<0.08	0.6700	1	180
PCB 138	ug kg^{-1}	0.8500	0.9600	<0.08	0.7200	1	180
PCB 153	ug kg^{-1}	0.9400	0.7100	<0.08	0.8300	1	180
PCB 180	ug kg^{-1}	0.5600	0.5300	<0.08	0.7300	1	180
Σ (7 PCBs)	ug kg^{-1}	6.0100	5.6900	0.5600	5.5600	7	1260
Hexachlorobenzine	ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	0.3	1
Acenaphthene	ug kg^{-1}	21.80	21.10	<5	31.10	-	-
Acenaphthylene	ug kg^{-1}	47.90	51.00	<5	35.20	-	-
Anthracene	ug kg^{-1}	71.30	73.50	<5	51.40	-	-
Benzo (a) anthracene	ug kg^{-1}	168.00	177.00	<5	136.00	-	-
Benzo (a) pyrene	ug kg^{-1}	260.00	273.00	<5	185.00	-	-
Benzo (b) fluoranthene	ug kg^{-1}	236.00	234.00	10.40	172.00	-	-
Benzo (ghi) perylene	ug kg^{-1}	200.00	197.00	7.18	144.00	-	-
Benzo (k) fluoranthene	ug kg^{-1}	212.00	225.00	<5	157.00	-	-
Chrysene	ug kg^{-1}	176.00	182.00	10.50	148.00	-	-
Dibenz (a,h) anthracene	ug kg^{-1}	35.00	42.90	<5	28.10	-	-
Flourene	ug kg^{-1}	46.30	48.20	<5	44.30	-	-
Fluoranthene	ug kg^{-1}	221.00	232.00	7.85	244.00	-	-
Indeno (1,2,3–cd)	ug kg^{-1}	208.00	208.00	<5	149.00	-	-
Naphthalene	ug kg^{-1}	57.50	59.70	<5	67.20	-	-
Phenanthrene	ug kg^{-1}	132.00	140.00	9.93	162.00	-	-
Pyrene	ug kg^{-1}	314.00	312.00	11.70	262.00	-	-
Σ (16 PAH)	ug kg^{-1}	2406.800	2476.400	57.560	2016.300	4000	-
Total Extractable Hydrocarbons	g kg^{-1}	0.392	0.359	0.038	0.421	1	

Table 8.21 cont'd Surface Samples and Samples taken at shallow depth (up to 2.8m January 2023 (Area K)

Parameter	Units (Dry Wt)	Vibrocores and Surface Samples					Guideline Values	
		AC5	DP 06	AC7	DP 08	AC9	Lower Level	Upper Level
		1m under surface	surface	2.8m under surface	surface	1.8m under surface		
Arsenic	$mg\ kg^{-1}$	11.6	12	10.6	12	13.1	20	70
Cadmium	$mg\ kg^{-1}$	0.81	1.7	1.38	0.74	0.74	0.7	4.2
Chromium	$mg\ kg^{-1}$	60.4	57.5	51.5	65.9	67.2	120	370
Copper	$mg\ kg^{-1}$	30.8	37.7	34.1	43.2	34.8	40	110
Lead	$mg\ kg^{-1}$	35.5	28.1	26	39.4	46.6	60	218
Mercury	$mg\ kg^{-1}$	0.11	0.09	0.08	0.12	0.15	0.2	0.7
Nickel	$mg\ kg^{-1}$	29.0	39.5	33.4	33.2	31.5	40	60
Zinc	$mg\ kg^{-1}$	119	136	124	144	142	160	410
(TBT + DBT)	$mg\ kg^{-1}$	0.01	0.01	0.01	0.01	0.0839	0.1	0.5
g-HCH (Lindane)	$ug\ kg^{-1}$	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	1
PCB 028	$ug\ kg^{-1}$	1.1700	0.8500	<0.08	0.5900	3.7400	1	180
PCB 052	$ug\ kg^{-1}$	0.6600	0.4100	<0.08	0.2900	2.0300	1	180
PCB 101	$ug\ kg^{-1}$	0.6300	0.4000	<0.08	0.3000	1.2400	1	180
PCB 118	$ug\ kg^{-1}$	0.7500	0.3700	<0.08	0.2000	1.3200	1	180
PCB 138	$ug\ kg^{-1}$	0.3800	0.4600	<0.08	0.2600	1.0100	1	180
PCB 153	$ug\ kg^{-1}$	0.5300	0.4900	<0.08	0.4000	1.2700	1	180
PCB 180	$ug\ kg^{-1}$	0.5400	0.2400	<0.08	0.1400	1.1500	1	180
Σ (7 PCBs)	$ug\ kg^{-1}$	4.6600	3.2200	0.5600	2.1800	11.7600	7	1260
Hexachlorobenzine	$ug\ kg^{-1}$	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	1
Acenaphthene	$ug\ kg^{-1}$	15.90	<5	7.15	13.10	26.4	-	-
Acenaphthylene	$ug\ kg^{-1}$	28.50	34.30	<5	47.30	24.6	-	-
Anthracene	$ug\ kg^{-1}$	49.90	47.60	<5	73.50	43.70	-	-
Benzo (a) anthracene	$ug\ kg^{-1}$	121.00	108.00	<5	189.00	135.00	-	-
Benzo (a) pyrene	$ug\ kg^{-1}$	171.00	154.00	<5	197.00	185.00	-	-
Benzo (b) fluoranthene	$ug\ kg^{-1}$	163.00	135.00	20.60	171.00	188.00	-	-
Benzo (ghi) perylene	$ug\ kg^{-1}$	132.00	120.00	10.00	132.00	148.00	-	-
Benzo (k) fluoranthene	$ug\ kg^{-1}$	148.00	125.00	<5	159.00	162.00	-	-
Chrysene	$ug\ kg^{-1}$	135.00	128.00	48.50	206.00	159.00	-	-
Dibenz (a,h) anthracene	$ug\ kg^{-1}$	27.10	22.20	<5	26.80	28.30	-	-
Flourene	$ug\ kg^{-1}$	33.70	32.50	28.50	37.80	41.50	-	-
Fluoranthene	$ug\ kg^{-1}$	183.00	148.00	6.48	256.00	240.00	-	-
Indeno (1,2,3–cd)	$ug\ kg^{-1}$	144.00	119.00	<5	133.00	152	-	-
Naphthalene	$ug\ kg^{-1}$	35.00	33.10	12.40	37.80	39.4	-	-
Phenanthrene	$ug\ kg^{-1}$	112.00	95.80	83.40	97.70	168	-	-
Pyrene	$ug\ kg^{-1}$	217.00	199.00	15.80	363.00	308	-	-
Σ (16 PAH)	$ug\ kg^{-1}$	1716.100	1501.500	232.830	2140.000	2048.900	4000	-
Total Extractable Hydrocarbons	$g\ kg^{-1}$	0.349	0.403	0.037	0.367	0.370	1	

Phase 2 Capital Dredging to facilitate the construction of Area N using marine plant

The capital dredging to facilitate the construction of Area N using marine plant comprises the following elements of work:

- Area N – Proposed Lo-Lo Terminal, area at eastern end of wharf, dredged to -3.0m CD

A total of 38 surface samples were initially tested in December 2023 at locations which would ultimately be located under the proposed open-piled Wharf N. The locations were selected by RPS using a regular grid system as presented in Figure 8.9. The surface sediment samples collected were sent to Socotec Laboratories in the UK for sediment chemistry analysis in accordance with standard Marine Institute laboratory analysis specifications.

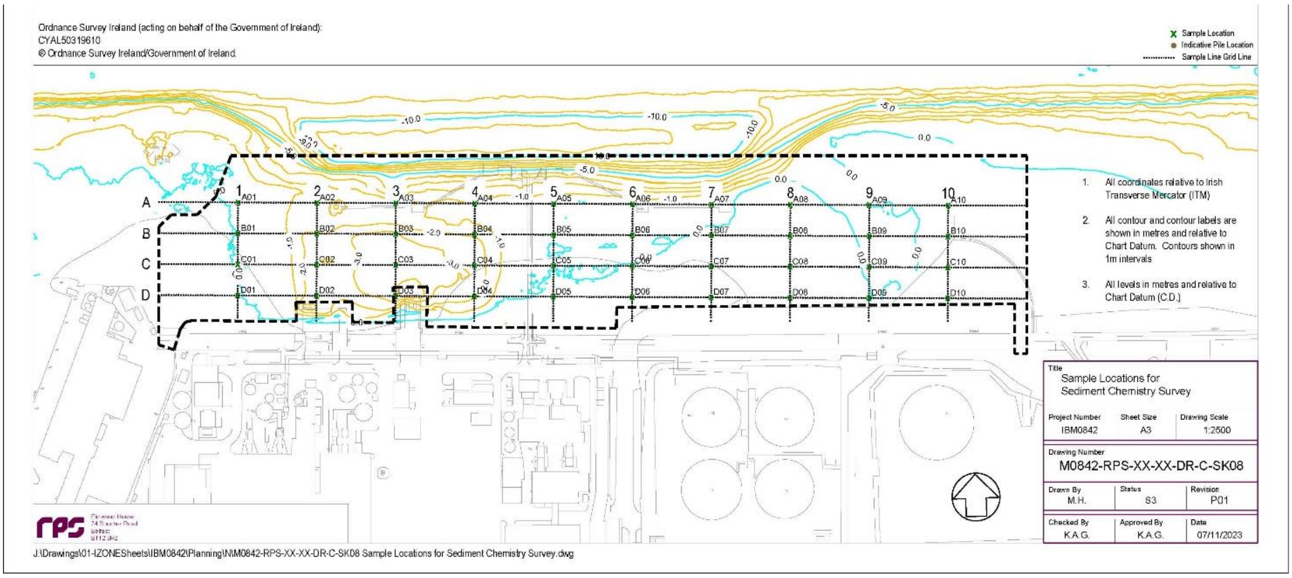


Figure 8.9 Surface Sediment Chemistry Sampling Locations at Wharf N

The results of the Sediment Chemistry analysis, including comparison with Marine Institute Guidelines, are presented in Table 8.22. Details of the full Laboratory Results including Quality Assurance Certificates are presented in Appendix 8-4.

The following observations can be made from the sediment chemistry results:

- Sample locations to the west and immediately landward of the Poolbeg Oil Jetty were found to be unsuitable for disposal at sea. One sample (A05) contained Class 3 Zinc and one sample (B06) contained Class 3 Lindane. There were also widespread Class 2 elements proximate to ESB's cooling water intakes, notably Copper.
- In contrast, sample locations to the east of the Poolbeg Oil Jetty contained generally Class 1 (Uncontaminated: no biological effects likely) with only one sample (A09) exhibiting Sum of PAH above the Marine Institute Lower Guideline limit.

The results of the surface sediment chemistry analysis were forwarded to the Marine Institute for their interpretation, in combination with other relevant data held by the Marine Institute.

The Marine Institute concurred that the sediments in the western portion of Wharf N were unsuitable for disposal at sea. The Marine Institute also confirmed that additional sediment sampling at depth using a Vibrocore would be required before they could reach a conclusion on the suitability of the sediments at the eastern portion of Wharf N for dumping at sea.

Further to the Marine Institute's interpretation of the surface sampling results, DPC requested that the Marine Institute issue a Sampling and Analysis Plan (SAP) for the required Vibrocore work at the eastern portion of Wharf N. The SAP was subsequently issued by the Marine Institute, the sample locations are presented in Figure 8.10.

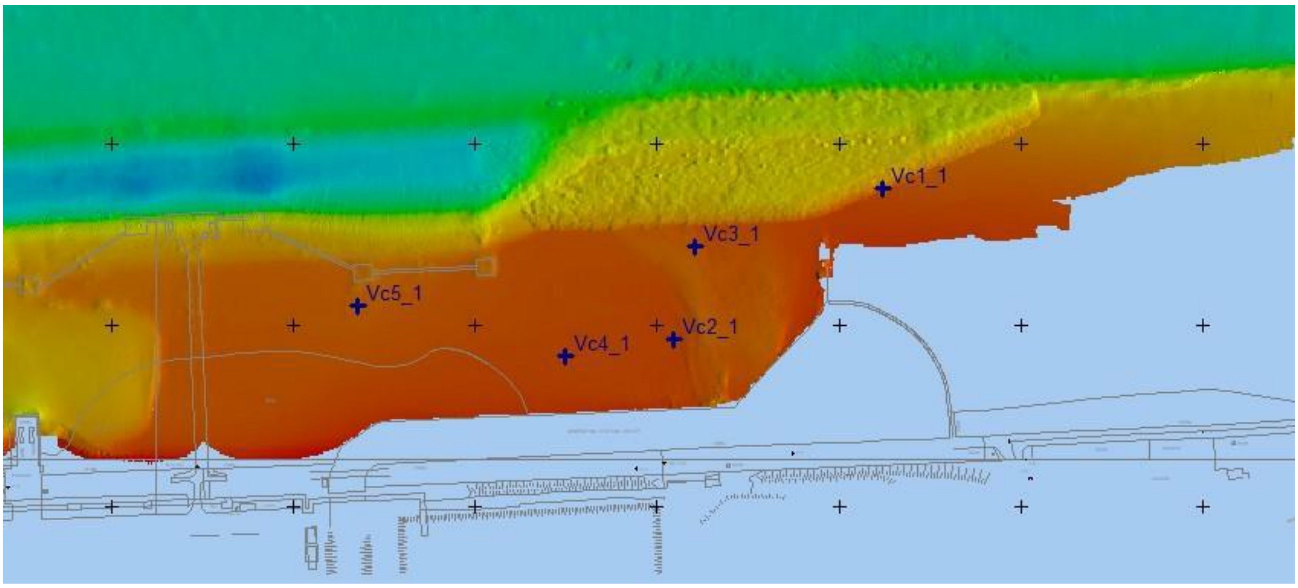


Figure 8.10 At-depth Sediment Chemistry Sampling Locations at Wharf N to the east of Poolbeg Oil Jetty

A total of 9 at-depth samples were tested in May 2024. The at-depth sediment samples collected were sent to Socotec Laboratories in the UK for sediment chemistry analysis in accordance with standard Marine Institute laboratory analysis specifications.

The results of the sediment sampling at depth using a Vibrocore, including comparison with Marine Institute Guidelines, are presented in Table 8.23. Details of the full Laboratory Results including Quality Assurance Certificates are presented in Appendix 8-4.

The following observations can be made from the sediment chemistry results:

- The samples taken at depth to the east of the Poolbeg Oil Jetty, within the area to be dredged, contained Class 1 (Uncontaminated: no biological effects likely).
- Sample (VC1.1) located to the north of the area to be dredged exhibited elements of Class 2 material, notably Mercury and Sum of PAH. This location is nevertheless within the side slope of the proposed Wharf N berthing pocket. The Vibrocore at this location refused at a depth of circa 1.0m when it encountered sandy gravel. The volume of dredged material containing low levels of contamination is therefore expected to be small with no significant environmental impact.

Table 8.22 Surface Samples at proposed Wharf N

Parameter	Units (Dry Wt)	Surface Samples 2023					Guideline Values	
		S1	S2	S3	S4	S5	Lower Level	Upper Level
		A01	A02	A03	A04	A05		
Arsenic	mg kg^{-1}	10.6	13.8	13.3	11.7	9.5	20	70
Cadmium	mg kg^{-1}	0.46	0.64	0.58	0.58	0.34	0.7	4.2
Chromium	mg kg^{-1}	57.6	75	74.2	68.1	50.3	120	370
Copper	mg kg^{-1}	34.5	49.3	38.3	44.7	39.6	40	110
Lead	mg kg^{-1}	33.8	40.1	39.7	44.6	48.9	60	218
Mercury	mg kg^{-1}	0.1	0.08	0.07	0.12	0.05	0.2	0.7
Nickel	mg kg^{-1}	24	32	31.4	29.6	15.8	40	60
Zinc	mg kg^{-1}	116	160	138	145	606	160	410
(TBT + DBT)	mg kg^{-1}	<.01	<.01	<.01	<.01	<.01	0.1	0.5
g-HCH (Lindane)	ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	1
PCB 028	ug kg^{-1}	0.4100	0.6600	0.6200	1.5700	0.2900	1	180
PCB 052	ug kg^{-1}	0.2900	0.3500	0.4200	1.0300	0.2100	1	180
PCB 101	ug kg^{-1}	0.2200	0.3400	0.4100	0.8400	0.2200	1	180
PCB 118	ug kg^{-1}	0.2800	0.4100	0.4000	0.9200	0.1900	1	180
PCB 138	ug kg^{-1}	0.2700	0.3700	0.4300	0.7400	0.1100	1	180
PCB 153	ug kg^{-1}	0.3300	0.4500	0.4600	1.0100	0.1900	1	180
PCB 180	ug kg^{-1}	0.2100	0.2900	0.2700	0.7500	0.1500	1	180
Σ (7 PCBs)	ug kg^{-1}	2.0100	2.8700	3.0100	6.8600	1.3600	7	1260
Hexachlorobenzine	ug kg^{-1}	0.2	0.42	0.17	0.14	<0.1	0.3	1
Acenaphthene	ug kg^{-1}	18.30	<5	15.70	34.40	17.60	-	-
Acenaphthylene	ug kg^{-1}	48.50	33.50	89.00	104.00	24.90	-	-
Anthracene	ug kg^{-1}	90.50	44.90	73.10	172.00	50.70	-	-
Benzo (a) anthracene	ug kg^{-1}	177.00	104.00	219.00	357.00	168.00	-	-
Benzo (a) pyrene	ug kg^{-1}	191.00	138.00	306.00	416.00	174.00	-	-
Benzo (b) fluoranthene	ug kg^{-1}	147.00	132.00	254.00	295.00	136.00	-	-
Benzo (ghi) perylene	ug kg^{-1}	107.00	100.00	196.00	217.00	80.30	-	-
Benzo (k) fluoranthene	ug kg^{-1}	165.00	127.00	256.00	334.00	148.00	-	-
Chrysene	ug kg^{-1}	163.00	121.00	211.00	343.00	155.00	-	-
Dibenz (a,h) anthracene	ug kg^{-1}	22.20	22.50	42.10	51.20	20.10	-	-
Flourene	ug kg^{-1}	49.00	36.70	58.90	92.60	28.90	-	-
Fluoranthene	ug kg^{-1}	228.00	145.00	252.00	414.00	281.00	-	-
Indeno (1,2,3–cd)	ug kg^{-1}	106.00	107.00	202.00	231.00	90.70	-	-
Naphthalene	ug kg^{-1}	46.40	43.80	51.30	81.30	20.30	-	-
Phenanthrene	ug kg^{-1}	113.00	88.40	116.00	234.00	142.00	-	-
Pyrene	ug kg^{-1}	515.00	177.00	389.00	690.00	307.00	-	-
Σ (16 PAH)	ug kg^{-1}	2187.100	1421.220	2731.270	4066.640	1844.500	4000	-
Total Extractable Hydrocarbons	g kg^{-1}	0	0.472	0.43	0.473	0.185	1	

Table 8.22 cont'd Surface Samples at proposed Wharf N

Parameter	Units (Dry Wt)	Surface Samples 2023					Guideline Values	
		S6	S7	S8	S9	S10	Lower Level	Upper Level
		A06	A07	A08	A09	A10		
Arsenic	mg kg^{-1}	9.2	9.1	7.1	9.7	7.9	20	70
Cadmium	mg kg^{-1}	0.47	0.32	0.18	0.4	0.19	0.7	4.2
Chromium	mg kg^{-1}	59.9	46	22.8	39.2	31.3	120	370
Copper	mg kg^{-1}	43.9	25.6	10	30.9	19	40	110
Lead	mg kg^{-1}	34.1	24.4	14.3	40.3	39.7	60	218
Mercury	mg kg^{-1}	0.04	0.01	<0.01	0.13	<0.01	0.2	0.7
Nickel	mg kg^{-1}	24.2	16.2	11.7	17.4	12.5	40	60
Zinc	mg kg^{-1}	140	82.2	48.2	90.4	60.5	160	410
(TBT + DBT)	mg kg^{-1}	<.01	<.01	<.01	<.01	<.01	0.1	0.5
g-HCH (Lindane)	ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	1
PCB 028	ug kg^{-1}	0.4000	0.2100	0.1100	0.4400	<0.08	1	180
PCB 052	ug kg^{-1}	0.3500	0.1300	0.0800	0.5000	<0.08	1	180
PCB 101	ug kg^{-1}	0.2100	0.1500	<0.08	0.8000	<0.08	1	180
PCB 118	ug kg^{-1}	0.2500	0.1900	<0.08	0.8000	<0.08	1	180
PCB 138	ug kg^{-1}	0.3000	0.1500	<0.08	1.1400	<0.08	1	180
PCB 153	ug kg^{-1}	0.3500	0.1500	0.1200	1.0000	<0.08	1	180
PCB 180	ug kg^{-1}	0.2100	0.0800	<0.08	0.8500	<0.08	1	180
Σ (7 PCBs)	ug kg^{-1}	2.0700	1.0600	0.6300	5.5300	<0.56	7	1260
Hexachlorobenzine	ug kg^{-1}	<0.1	<0.1	<0.1	0.1	<0.1	0.3	1
Acenaphthene	ug kg^{-1}	15.00	9.31	<5	45.4	<5	-	-
Acenaphthylene	ug kg^{-1}	49.30	21.30	9.81	388	26.80	-	-
Anthracene	ug kg^{-1}	96.00	47.90	22.60	344.00	57.70	-	-
Benzo (a) anthracene	ug kg^{-1}	289.00	143.00	41.60	1090.00	237.00	-	-
Benzo (a) pyrene	ug kg^{-1}	253.00	171.00	53.50	1560.00	271.00	-	-
Benzo (b) fluoranthene	ug kg^{-1}	191.00	130.00	36.30	811.00	191.00	-	-
Benzo (ghi) perylene	ug kg^{-1}	115.00	76.80	25.00	521.00	126.00	-	-
Benzo (k) fluoranthene	ug kg^{-1}	210.00	146.00	47.00	995.00	204.00	-	-
Chrysene	ug kg^{-1}	258.00	134.00	40.80	684.00	242.00	-	-
Dibenz (a,h) anthracene	ug kg^{-1}	26.10	18.40	<5	144.00	30.70	-	-
Flourene	ug kg^{-1}	62.30	26.20	14.60	85.80	13.70	-	-
Fluoranthene	ug kg^{-1}	331.00	263.00	56.20	569.00	323.00	-	-
Indeno (1,2,3–cd)	ug kg^{-1}	123.00	93.20	24.80	567	123.00	-	-
Naphthalene	ug kg^{-1}	40.50	21.70	16.90	126	18.80	-	-
Phenanthrene	ug kg^{-1}	179.00	89.60	47.00	380	89.00	-	-
Pyrene	ug kg^{-1}	565.00	334.00	88.00	3040	365.00	-	-
Σ (16 PAH)	ug kg^{-1}	2803.200	1725.410	524.110	11350.300	2318.700	4000	-
Total Extractable Hydrocarbons	g kg^{-1}	0.346	0.172	0.0953	0.314	0.116	1	

Table 8.22 cont'd Surface Samples at proposed Wharf N

Parameter	Units (Dry Wt)	Surface Samples 2023					Guideline Values	
		S11	S12	S13	S14	S15	Lower Level	Upper Level
		B01	B02	B03	B04	B05		
Arsenic	mg kg-1	8.3	13.6	14.2	12.7	11.4	20	70
Cadmium	mg kg-1	0.36	0.71	0.62	0.71	0.47	0.7	4.2
Chromium	mg kg-1	48.5	74.7	68.1	72	47.8	120	370
Copper	mg kg-1	26.6	51.8	43.5	55.4	38.1	40	110
Lead	mg kg-1	30.2	42.3	38.9	42.3	41.7	60	218
Mercury	mg kg-1	0.04	0.05	0.06	0.1	0.17	0.2	0.7
Nickel	mg kg-1	18.4	32.5	29.7	30.5	22.5	40	60
Zinc	mg kg-1	91	160	143	167	114	160	410
(TBT + DBT)	mg kg-1	<.01	<.01	<.01	<.01	<.01	0.1	0.5
g-HCH (Lindane)	ug kg-1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	1
PCB 028	ug kg-1	0.2600	0.6700	0.8800	0.8400	1.0300	1	180
PCB 052	ug kg-1	0.2000	0.3900	0.5200	0.4700	0.6600	1	180
PCB 101	ug kg-1	0.1700	0.3800	0.4100	0.4700	0.5700	1	180
PCB 118	ug kg-1	0.1600	0.3100	0.5500	0.5500	0.5000	1	180
PCB 138	ug kg-1	0.1300	0.4100	0.4500	0.4600	0.7600	1	180
PCB 153	ug kg-1	0.2800	0.6200	0.6600	0.7100	0.8600	1	180
PCB 180	ug kg-1	0.1400	0.2700	0.3800	0.4400	0.8400	1	180
Σ (7 PCBs)	ug kg-1	1.3400	3.0500	3.8500	3.9400	5.2200	7	1260
Hexachlorobenzine	ug kg-1	0.16	0.14	0.13	0.17	<0.1	0.3	1
Acenaphthene	ug kg-1	16.60	14.6	14.10	21.90	142	-	-
Acenaphthylene	ug kg-1	35.80	76.3	80.90	89.70	730	-	-
Anthracene	ug kg-1	58.30	68.20	77.30	94.10	877.00	-	-
Benzo (a) anthracene	ug kg-1	170.00	185.00	215.00	247.00	1800.00	-	-
Benzo (a) pyrene	ug kg-1	217.00	259.00	307.00	325.00	1950.00	-	-
Benzo (b) fluoranthene	ug kg-1	185.00	213.00	237.00	274.00	1190.00	-	-
Benzo (ghi) perylene	ug kg-1	123.00	157.00	191.00	193.00	752.00	-	-
Benzo (k) fluoranthene	ug kg-1	190.00	208.00	244.00	261.00	1460.00	-	-
Chrysene	ug kg-1	162.00	194.00	221.00	251.00	1750.00	-	-
Dibenz (a,h) anthracene	ug kg-1	29.60	35.50	44.20	40.90	157.00	-	-
Flourene	ug kg-1	34.40	55.70	53.30	67.60	281.00	-	-
Fluoranthene	ug kg-1	170.00	202.00	211.00	316.00	2590.00	-	-
Indeno (1,2,3–cd)	ug kg-1	121.00	159	191.00	192.00	724	-	-
Naphthalene	ug kg-1	31.90	44	50.50	55.10	273	-	-
Phenanthrene	ug kg-1	97.10	95.9	106.00	180.00	1300	-	-
Pyrene	ug kg-1	336.00	283	307.00	434.00	4450	-	-
Σ (16 PAH)	ug kg-1	1977.860	2250.340	2550.430	3042.470	20426.000	4000	-
Total Extractable Hydrocarbons	g kg-1	0.23	0.464	0.612	0.546	0.657	1	

Table 8.22 cont'd Surface Samples at proposed Wharf N

Parameter	Units (Dry Wt)	Surface Samples 2023					Guideline Values	
		S16	S17	S18	S19	S20	Lower Level	Upper Level
		B06	B07	B08	B09	C01		
Arsenic	mg kg^{-1}	10.4	9.3	6.3	11	11.6	20	70
Cadmium	mg kg^{-1}	0.39	0.2	0.19	0.36	0.4	0.7	4.2
Chromium	mg kg^{-1}	41.7	25.5	26.6	28.9	48.1	120	370
Copper	mg kg^{-1}	33.6	15.4	13.8	29.4	33.8	40	110
Lead	mg kg^{-1}	39.2	19.6	17.2	19.3	35.4	60	218
Mercury	mg kg^{-1}	0.15	0.01	<0.01	<0.01	0.12	0.2	0.7
Nickel	mg kg^{-1}	18.9	12.0	10.9	15.3	20.9	40	60
Zinc	mg kg^{-1}	100	55.5	50.6	77.2	108	160	410
(TBT + DBT)	mg kg^{-1}	<.01	<.01	<.01	<.01	<.01	0.1	0.5
g-HCH (Lindane)	ug kg^{-1}	2.95	<0.1	<0.1	<0.1	<0.1	0.3	1
PCB 028	ug kg^{-1}	0.3600	0.1600	0.1100	0.2000	0.3200	1	180
PCB 052	ug kg^{-1}	0.2100	<0.08	<0.08	0.1500	0.2100	1	180
PCB 101	ug kg^{-1}	0.1800	0.0900	<0.08	0.1400	0.1900	1	180
PCB 118	ug kg^{-1}	0.2300	0.0900	<0.08	0.1700	0.2500	1	180
PCB 138	ug kg^{-1}	0.2600	<0.08	0.1000	0.1400	0.3900	1	180
PCB 153	ug kg^{-1}	0.2200	0.1100	<0.08	0.1700	0.3100	1	180
PCB 180	ug kg^{-1}	0.1600	<0.08	0.1600	0.1500	0.1900	1	180
Σ (7 PCBs)	ug kg^{-1}	1.6200	0.6900	0.6900	1.1200	1.8600	7	1260
Hexachlorobenzine	ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	1
Acenaphthene	ug kg^{-1}	428.00	20.00	<5	11.9	22.4	-	-
Acenaphthylene	ug kg^{-1}	4820.00	107.00	45.2	37	53.6	-	-
Anthracene	ug kg^{-1}	2550.00	122.00	71.00	45.20	71.40	-	-
Benzo (a) anthracene	ug kg^{-1}	29900.00	251.00	309.00	128.00	259.00	-	-
Benzo (a) pyrene	ug kg^{-1}	21200.00	396.00	338.00	161.00	328.00	-	-
Benzo (b) fluoranthene	ug kg^{-1}	10700.00	302.00	251.00	121.00	301.00	-	-
Benzo (ghi) perylene	ug kg^{-1}	5720.00	171.00	168.00	81.50	199.00	-	-
Benzo (k) fluoranthene	ug kg^{-1}	14500.00	316.00	272.00	126.00	270.00	-	-
Chrysene	ug kg^{-1}	24600.00	254.00	299.00	110.00	252.00	-	-
Dibenz (a,h) anthracene	ug kg^{-1}	1480.00	44.70	47.70	21.40	45.50	-	-
Flourene	ug kg^{-1}	850.00	96.70	25.40	31.00	46.60	-	-
Fluoranthene	ug kg^{-1}	18000.00	424.00	293.00	137.00	350.00	-	-
Indeno (1,2,3–cd)	ug kg^{-1}	5700.00	177.00	184	85.1	201	-	-
Naphthalene	ug kg^{-1}	1520.00	73.50	37.6	43.6	54.1	-	-
Phenanthrene	ug kg^{-1}	2750.00	266.00	84.5	75.3	159	-	-
Pyrene	ug kg^{-1}	71500.00	645.00	388	281	515	-	-
Σ (16 PAH)	ug kg^{-1}	216218.000	3665.900	2813.400	1496.000	3127.600	4000	-
Total Extractable Hydrocarbons	g kg^{-1}	1.61	0.23	0.125	0.419	0.327	1	

Table 8.22 cont'd Surface Samples at proposed Wharf N

Parameter	Units (Dry Wt)	Surface Samples 2023					Guideline Values	
		S21	S22	S23	S24	S25	Lower Level	Upper Level
		C02	C03	C04	C05	C06		
Arsenic	mg kg^{-1}	18.3	18.6	18.6	10.2	10.9	20	70
Cadmium	mg kg^{-1}	0.77	0.75	0.8	0.22	0.23	0.7	4.2
Chromium	mg kg^{-1}	72.9	81.8	73	27.2	26.5	120	370
Copper	mg kg^{-1}	68.4	67.5	77.7	18.2	19.1	40	110
Lead	mg kg^{-1}	45.5	46.7	46.6	25.6	21.8	60	218
Mercury	mg kg^{-1}	0.14	0.1	0.12	<0.01	<0.01	0.2	0.7
Nickel	mg kg^{-1}	31.2	35.3	31.6	12.4	12.7	40	60
Zinc	mg kg^{-1}	201	197	213	61.2	61	160	410
(TBT + DBT)	mg kg^{-1}	<.01	<.01	<.01	<.01	<.01	0.1	0.5
g-HCH (Lindane)	ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	1
PCB 028	ug kg^{-1}	0.7400	0.8700	0.7300	0.1700	0.1100	1	180
PCB 052	ug kg^{-1}	0.4700	0.4700	0.4500	0.1100	<0.08	1	180
PCB 101	ug kg^{-1}	0.4500	0.4800	0.4300	0.0800	<0.08	1	180
PCB 118	ug kg^{-1}	0.4300	0.5700	0.4900	0.1100	0.0800	1	180
PCB 138	ug kg^{-1}	0.5800	0.8400	0.6700	0.1200	<0.08	1	180
PCB 153	ug kg^{-1}	0.6500	0.7000	0.7600	0.2000	0.1400	1	180
PCB 180	ug kg^{-1}	0.1900	0.4400	0.3300	<0.08	<0.08	1	180
Σ (7 PCBs)	ug kg^{-1}	3.5100	4.3700	3.8600	0.8700	0.6500	7	1260
Hexachlorobenzine	ug kg^{-1}	0.11	0.13	0.17	<0.1	<0.1	0.3	1
Acenaphthene	ug kg^{-1}	16.7	<5	9.79	11.3	17	-	-
Acenaphthylene	ug kg^{-1}	83.5	95.8	42.5	29.3	43	-	-
Anthracene	ug kg^{-1}	82.60	87.60	39.10	50.90	85.20	-	-
Benzo (a) anthracene	ug kg^{-1}	198.00	209.00	84.80	210.00	290.00	-	-
Benzo (a) pyrene	ug kg^{-1}	276.00	315.00	139.00	236.00	310.00	-	-
Benzo (b) fluoranthene	ug kg^{-1}	282.00	297.00	129.00	175.00	246.00	-	-
Benzo (ghi) perylene	ug kg^{-1}	191.00	218.00	99.30	124.00	148.00	-	-
Benzo (k) fluoranthene	ug kg^{-1}	227.00	283.00	116.00	184.00	250.00	-	-
Chrysene	ug kg^{-1}	216.00	235.00	101.00	207.00	273.00	-	-
Dibenz (a,h) anthracene	ug kg^{-1}	38.30	43.00	22.50	30.10	35.30	-	-
Flourene	ug kg^{-1}	55.90	56.10	27.60	23.70	37.50	-	-
Fluoranthene	ug kg^{-1}	212.00	236.00	109.00	336.00	504.00	-	-
Indeno (1,2,3–cd)	ug kg^{-1}	196	226	102	135	172	-	-
Naphthalene	ug kg^{-1}	53.9	71.4	28.7	30.6	25.4	-	-
Phenanthrene	ug kg^{-1}	119	143	62	114	144	-	-
Pyrene	ug kg^{-1}	303	309	157	396	536	-	-
Σ (16 PAH)	ug kg^{-1}	2551.010	2825.030	1269.460	2292.900	3116.400	4000	-
Total Extractable Hydrocarbons	g kg^{-1}	0.805	0.852	0.974	0.197	0.19	1	

Table 8.22 cont'd Surface Samples at proposed Wharf N

Parameter	Units (Dry Wt)	Surface Samples 2023					Guideline Values	
		S26	S27	S28	S29	S30	Lower Level	Upper Level
		C07	C08	C09	D01	D02		
Arsenic	mg kg-1	9.2	8.3	10.7	13.5	17.4	20	70
Cadmium	mg kg-1	0.16	0.14	0.19	0.55	0.76	0.7	4.2
Chromium	mg kg-1	28.7	22.1	18.1	63.4	71.6	120	370
Copper	mg kg-1	12.5	12.8	26.1	43.5	69.5	40	110
Lead	mg kg-1	22.5	16.3	18.6	41.4	46.3	60	218
Mercury	mg kg-1	<0.01	<0.01	<0.01	0.11	0.1	0.2	0.7
Nickel	mg kg-1	9.9	9.8	10.5	27.0	31.3	40	60
Zinc	mg kg-1	52.1	43	63.9	142	203	160	410
(TBT + DBT)	mg kg-1	<.01	<.01	<.01	<.01	<.01	0.1	0.5
g-HCH (Lindane)	ug kg-1	<0.1	<0.1	<0.1	<0.1	0.1	0.3	1
PCB 028	ug kg-1	<0.08	0.1000	<0.08	0.4800	0.8500	1	180
PCB 052	ug kg-1	<0.08	<0.08	<0.08	0.3300	0.6900	1	180
PCB 101	ug kg-1	<0.08	<0.08	<0.08	0.2900	0.6200	1	180
PCB 118	ug kg-1	<0.08	0.0800	<0.08	0.3300	0.7300	1	180
PCB 138	ug kg-1	<0.08	<0.08	<0.08	0.3000	0.9500	1	180
PCB 153	ug kg-1	<0.08	<0.08	<0.08	0.4900	0.9500	1	180
PCB 180	ug kg-1	<0.08	<0.08	<0.08	0.2800	0.6500	1	180
Σ (7 PCBs)	ug kg-1	<0.56	0.5800	<0.56	2.5000	5.4400	7	1260
Hexachlorobenzine	ug kg-1	<0.1	<0.1	<0.1	0.12	0.2	0.3	1
Acenaphthene	ug kg-1	38.2	21.3	<5	46.9	8.93	-	-
Acenaphthylene	ug kg-1	25.2	18	19.1	109	23.8	-	-
Anthracene	ug kg-1	107.00	63.80	23.30	144.00	18.20	-	-
Benzo (a) anthracene	ug kg-1	425.00	135.00	75.50	351.00	54.60	-	-
Benzo (a) pyrene	ug kg-1	486.00	149.00	103.00	474.00	76.40	-	-
Benzo (b) fluoranthene	ug kg-1	401.00	127.00	67.20	412.00	66.20	-	-
Benzo (ghi) perylene	ug kg-1	247.00	81.50	37.90	299.00	54.30	-	-
Benzo (k) fluoranthene	ug kg-1	362.00	125.00	81.20	376.00	65.50	-	-
Chrysene	ug kg-1	452.00	147.00	65.20	354.00	60.40	-	-
Dibenz (a,h) anthracene	ug kg-1	64.90	19.30	<5	69.20	9.93	-	-
Flourene	ug kg-1	41.40	26.70	16.30	90.20	16.70	-	-
Fluoranthene	ug kg-1	826.00	267.00	72.20	490.00	73.40	-	-
Indeno (1,2,3–cd)	ug kg-1	254	86.2	41.4	292	53	-	-
Naphthalene	ug kg-1	29.7	21.1	22.5	63.3	19	-	-
Phenanthrene	ug kg-1	433	175	40.1	285	41.6	-	-
Pyrene	ug kg-1	964	290	111	618	91.6	-	-
Σ (16 PAH)	ug kg-1	5156.400	1752.900	775.900	4473.720	733.760	4000	-
Total Extractable Hydrocarbons	g kg-1	0.131	0.148	0.164	0.426	0.7	1	

Table 8.22 cont'd Surface Samples at proposed Wharf N

Parameter	Units (Dry Wt)	Surface Samples 2023					Guideline Values	
		S31	S32	S33	S34	S35	Lower Level	Upper Level
		D03	D04	D05	D06	D07		
Arsenic	mg kg^{-1}	15.8	14.4	8.9	8.9	9.2	20	70
Cadmium	mg kg^{-1}	0.67	0.63	0.17	0.12	0.12	0.7	4.2
Chromium	mg kg^{-1}	76	68	23.1	24.4	18.7	120	370
Copper	mg kg^{-1}	50.1	57.4	15.1	8.6	9.2	40	110
Lead	mg kg^{-1}	47.1	41.1	19.2	17.1	20.4	60	218
Mercury	mg kg^{-1}	0.07	0.07	<0.01	<0.01	<0.01	0.2	0.7
Nickel	mg kg^{-1}	34.0	30.6	11.1	10.0	9.9	40	60
Zinc	mg kg^{-1}	173	176	52.4	37.4	37.5	160	410
(TBT + DBT)	mg kg^{-1}	<.01	<.01	<.01	<.01	<.01	0.1	0.5
g-HCH (Lindane)	ug kg^{-1}	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	1
PCB 028	ug kg^{-1}	0.8700	0.8800	0.1200	<0.08	<0.08	1	180
PCB 052	ug kg^{-1}	0.5600	0.6300	<0.08	<0.08	<0.08	1	180
PCB 101	ug kg^{-1}	0.5500	0.5300	<0.08	<0.08	<0.08	1	180
PCB 118	ug kg^{-1}	0.6200	0.7200	0.0900	<0.08	<0.08	1	180
PCB 138	ug kg^{-1}	0.4600	0.6800	0.1700	<0.08	<0.08	1	180
PCB 153	ug kg^{-1}	0.7700	0.8400	0.0900	<0.08	<0.08	1	180
PCB 180	ug kg^{-1}	0.4500	0.5000	0.0800	<0.08	<0.08	1	180
Σ (7 PCBs)	ug kg^{-1}	4.2800	4.7800	0.7100	<0.56	<0.56	7	1260
Hexachlorobenzine	ug kg^{-1}	0.14	<0.1	<0.1	<0.1	<0.1	0.3	1
Acenaphthene	ug kg^{-1}	18.9	14.9	<5	<5	<5	-	-
Acenaphthylene	ug kg^{-1}	70	68.4	14.4	<5	<5	-	-
Anthracene	ug kg^{-1}	80.60	74.80	28.70	<5	<5	-	-
Benzo (a) anthracene	ug kg^{-1}	191.00	184.00	31.70	14.60	11.00	-	-
Benzo (a) pyrene	ug kg^{-1}	247.00	260.00	35.00	18.40	14.20	-	-
Benzo (b) fluoranthene	ug kg^{-1}	218.00	228.00	26.80	14.40	11.40	-	-
Benzo (ghi) perylene	ug kg^{-1}	166.00	174.00	22.40	11.40	8.30	-	-
Benzo (k) fluoranthene	ug kg^{-1}	218.00	220.00	32.40	18.10	12.60	-	-
Chrysene	ug kg^{-1}	190.00	191.00	32.00	15.40	11.90	-	-
Dibenz (a,h) anthracene	ug kg^{-1}	37.30	39.00	<5	<5	<5	-	-
Flourene	ug kg^{-1}	58.60	52.70	20.10	<5	<5	-	-
Fluoranthene	ug kg^{-1}	233.00	241.00	56.50	15.10	14.00	-	-
Indeno (1,2,3–cd)	ug kg^{-1}	171	189	23.1	11.3	8	-	-
Naphthalene	ug kg^{-1}	47.8	48.4	15.5	<5	6.89	-	-
Phenanthrene	ug kg^{-1}	130	118	45.5	9.85	<5	-	-
Pyrene	ug kg^{-1}	348	311	74.9	31.4	27.9	-	-
Σ (16 PAH)	ug kg^{-1}	2425.340	2414.200	459.000	159.950	126.190	4000	-
Total Extractable Hydrocarbons	g kg^{-1}	0.454	0.655	0.146	0.0647	0.0363	1	

Table 8.22 cont'd Surface Samples at proposed Wharf N

Parameter	Units (Dry Wt)	Surface Samples 2023					Guideline Values	
		S36	S37	S38			Lower Level	Upper Level
		D08	D09	D10				
Arsenic	mg kg^{-1}	8.4	10.8	9.9			20	70
Cadmium	mg kg^{-1}	0.17	0.38	0.12			0.7	4.2
Chromium	mg kg^{-1}	23.5	49.4	24.6			120	370
Copper	mg kg^{-1}	14.8	14.7	10			40	110
Lead	mg kg^{-1}	17.4	16	34			60	218
Mercury	mg kg^{-1}	<0.01	<0.01	<0.01			0.2	0.7
Nickel	mg kg^{-1}	10.8	18.6	14.4			40	60
Zinc	mg kg^{-1}	48.9	55.4	38.1			160	410
(TBT + DBT)	mg kg^{-1}	<.01	<.01	<.01			0.1	0.5
g-HCH (Lindane)	ug kg^{-1}	<0.1	<0.1	<0.1			0.3	1
PCB 028	ug kg^{-1}	0.2000	<0.08	<0.08			1	180
PCB 052	ug kg^{-1}	0.0800	<0.08	<0.08			1	180
PCB 101	ug kg^{-1}	<0.08	<0.08	<0.08			1	180
PCB 118	ug kg^{-1}	<0.08	<0.08	<0.08			1	180
PCB 138	ug kg^{-1}	<0.08	<0.08	<0.08			1	180
PCB 153	ug kg^{-1}	0.1000	<0.08	<0.08			1	180
PCB 180	ug kg^{-1}	<0.08	<0.08	<0.08			1	180
Σ (7 PCBs)	ug kg^{-1}	0.7000	<0.56	<0.56			7	1260
Hexachlorobenzine	ug kg^{-1}	<0.1	<0.1	<0.1			0.3	1
Acenaphthene	ug kg^{-1}	<5	<5	<5			-	-
Acenaphthylene	ug kg^{-1}	28.9	9.54	<5			-	-
Anthracene	ug kg^{-1}	28.50	9.54	<5			-	-
Benzo (a) anthracene	ug kg^{-1}	80.10	15.50	11.40			-	-
Benzo (a) pyrene	ug kg^{-1}	95.50	27.40	16.00			-	-
Benzo (b) fluoranthene	ug kg^{-1}	73.00	17.70	10.30			-	-
Benzo (ghi) perylene	ug kg^{-1}	46.00	19.30	7.32			-	-
Benzo (k) fluoranthene	ug kg^{-1}	80.30	20.30	15.30			-	-
Chrysene	ug kg^{-1}	78.70	17.70	13.20			-	-
Dibenz (a,h) anthracene	ug kg^{-1}	11.60	<5	<5			-	-
Flourene	ug kg^{-1}	16.20	7.55	<5			-	-
Fluoranthene	ug kg^{-1}	103.00	20.60	18.70			-	-
Indeno (1,2,3–cd)	ug kg^{-1}	47.7	17.6	8.19			-	-
Naphthalene	ug kg^{-1}	14.9	9.42	<5			-	-
Phenanthrene	ug kg^{-1}	44.5	17.2	<5			-	-
Pyrene	ug kg^{-1}	125	34.8	31.6			-	-
Σ (16 PAH)	ug kg^{-1}	873.900	244.150	132.010			4000	-
Total Extractable Hydrocarbons	g kg^{-1}	0.171	0.113	0.0234			1	

Table 8.23 Vibrocore Samples at proposed Wharf N

Parameter	Units (Dry Wt)	Vibrocores at proposed Wharf N					Guideline Values	
		VC1.1	VC2.1	VC2.2	VC3.1	VC4.1	Lower Level	Upper Level
		-1	-1	-2	-1	-1		
Arsenic	mg kg^{-1}	10.3	7.7	7.2	10.2	7.5	20	70
Cadmium	mg kg^{-1}	0.72	0.14	0.11	0.16	0.12	0.7	4.2
Chromium	mg kg^{-1}	35.5	18.5	18.8	18.8	23.2	120	370
Copper	mg kg^{-1}	31.5	10.3	6.2	6	7.9	40	110
Lead	mg kg^{-1}	65.4	22	17.7	18	24.9	60	218
Mercury	mg kg^{-1}	0.43	0.06	0.03	0.09	0.05	0.2	0.7
Nickel	mg kg^{-1}	18.1	8.6	7.2	9.4	9.0	40	60
Zinc	mg kg^{-1}	119	49.1	68.7	30.6	41.7	160	410
(TBT + DBT)	mg kg^{-1}	<.01	<.01	<.01	<.01	<.01	0.1	0.5
g-HCH (Lindane)	ug kg^{-1}	0.13	<0.1	<0.1	<0.1	<0.1	0.3	1
PCB 028	ug kg^{-1}	20.7000	0.1000	<0.08	<0.08	0.0800	1	180
PCB 052	ug kg^{-1}	10.4000	<0.08	<0.08	<0.08	<0.08	1	180
PCB 101	ug kg^{-1}	4.5600	<0.08	<0.08	<0.08	<0.08	1	180
PCB 118	ug kg^{-1}	4.6100	<0.08	<0.08	<0.08	<0.08	1	180
PCB 138	ug kg^{-1}	6.9300	<0.08	<0.08	<0.08	<0.08	1	180
PCB 153	ug kg^{-1}	8.5000	<0.08	<0.08	<0.08	<0.08	1	180
PCB 180	ug kg^{-1}	6.7500	<0.08	<0.08	<0.08	<0.08	1	180
Σ (7 PCBs)	ug kg^{-1}	62.5800	<.58	<.56	<.56	<.56	7	1260
Hexachlorobenzine	ug kg^{-1}	0.13	<0.1	<0.1	<0.1	<0.1	0.3	1
Acenaphthene	ug kg^{-1}	77.20	3.33	6.76	7.57	1.34	-	-
Acenaphthylene	ug kg^{-1}	385.00	7.60	30.00	25.10	4.38	-	-
Anthracene	ug kg^{-1}	500.00	26.30	19.40	19.60	5.71	-	-
Benzo (a) anthracene	ug kg^{-1}	780.00	46.40	48.80	48.80	18.10	-	-
Benzo (a) pyrene	ug kg^{-1}	860.00	62.80	126.00	127.00	28.50	-	-
Benzo (b) fluoranthene	ug kg^{-1}	639.00	47.40	89.70	90.90	22.50	-	-
Benzo (ghi) perylene	ug kg^{-1}	473.00	32.80	83.70	84.80	17.40	-	-
Benzo (k) fluoranthene	ug kg^{-1}	677.00	46.40	81.90	82.10	22.10	-	-
Chrysene	ug kg^{-1}	725.00	42.10	50.60	51.40	16.00	-	-
Dibenz (a,h) anthracene	ug kg^{-1}	107.00	8.23	19.60	22.30	4.59	-	-
Flourene	ug kg^{-1}	383.00	10.50	14.90	14.40	3.16	-	-
Fluoranthene	ug kg^{-1}	1780.00	76.80	72.70	71.60	18.00	-	-
Indeno (1,2,3–cd)	ug kg^{-1}	475.00	37.50	94.60	95.10	21.00	-	-
Naphthalene	ug kg^{-1}	67.20	6.35	8.66	9.86	2.51	-	-
Phenanthrene	ug kg^{-1}	1770.00	36.80	45.60	43.90	5.73	-	-
Pyrene	ug kg^{-1}	1790.00	117.00	98.40	97.50	26.80	-	-
Σ (16 PAH)	ug kg^{-1}	11488.400	608.310	891.320	891.930	217.820	4000	-
Total Extractable Hydrocarbons	g kg^{-1}	0.585	0.0592	0.0398	0.0576	0.038	1	

Table 8.23 cont'd Vibrocore Samples at proposed Wharf N

Parameter	Units (Dry Wt)	Vibrocores at proposed Wharf N					Guideline Values	
		VC4.2	VC5.1	VC5.2			Lower Level	Upper Level
		-2	-1	-2				
Arsenic	mg kg-1	7.3	9.1	6.3			20	70
Cadmium	mg kg-1	0.09	0.17	0.19			0.7	4.2
Chromium	mg kg-1	16.5	18.5	23.7			120	370
Copper	mg kg-1	5.8	9.3	4.7			40	110
Lead	mg kg-1	16.9	16	7.3			60	218
Mercury	mg kg-1	0.04	0.04	0.06			0.2	0.7
Nickel	mg kg-1	8.2	11.4	8.7			40	60
Zinc	mg kg-1	28.9	50.7	21.7			160	410
(TBT + DBT)	mg kg-1	<.01	<.01	<.01			0.1	0.5
g-HCH (Lindane)	ug kg-1	<0.1	<0.1	<0.1			0.3	1
PCB 028	ug kg-1	<0.08	0.0800	<0.08			1	180
PCB 052	ug kg-1	<0.08	<0.08	<0.08			1	180
PCB 101	ug kg-1	<0.08	<0.08	<0.08			1	180
PCB 118	ug kg-1	<0.08	<0.08	<0.08			1	180
PCB 138	ug kg-1	<0.08	<0.08	<0.08			1	180
PCB 153	ug kg-1	<0.08	<0.08	<0.08			1	180
PCB 180	ug kg-1	<0.08	<0.08	<0.08			1	180
Σ (7 PCBs)	ug kg-1	<.56	<.56	<.56			7	1260
Hexachlorobenzine	ug kg-1	<0.1	<0.1	<0.1			0.3	1
Acenaphthene	ug kg-1	<1	2.94	<1			-	-
Acenaphthylene	ug kg-1	3.28	8.15	1.27			-	-
Anthracene	ug kg-1	5.04	16.90	1.38			-	-
Benzo (a) anthracene	ug kg-1	15.90	35.60	3.26			-	-
Benzo (a) pyrene	ug kg-1	22.20	64.30	6.67			-	-
Benzo (b) fluoranthene	ug kg-1	18.40	48.50	7.17			-	-
Benzo (ghi) perylene	ug kg-1	12.60	34.80	4.79			-	-
Benzo (k) fluoranthene	ug kg-1	16.60	48.60	5.09			-	-
Chrysene	ug kg-1	14.90	32.50	5.25			-	-
Dibenz (a,h) anthracene	ug kg-1	3.66	9.58	1.31			-	-
Flourene	ug kg-1	3.11	10.20	<1			-	-
Fluoranthene	ug kg-1	18.70	36.50	4.16			-	-
Indeno (1,2,3–cd)	ug kg-1	14.00	40.80	4.64			-	-
Naphthalene	ug kg-1	2.56	11.40	1.44			-	-
Phenanthrene	ug kg-1	9.03	25.00	5.18			-	-
Pyrene	ug kg-1	27.30	75.40	8.06			-	-
Σ (16 PAH)	ug kg-1	188.280	501.170	61.670			4000	-
Total Extractable Hydrocarbons	g kg-1	0.0179	0.0414	0.009			1	

Marine Institute's interpretation of sediment chemistry results

The full results of the sediment chemistry sampling and analysis were provided to the Marine Institute who examined the results in detail in combination with other relevant data held by the Marine Institute.

It was concluded that the following dredged sediments can be classified as Class 1 (Uncontaminated: no biological effects likely), subject to the formal approval of the Marine Institute, and are therefore suitable for disposal at sea in the absence of a more sustainable alternative.

- Area N – Proposed Lo-Lo Terminal, Berthing Pocket dredged to -13.0m CD
- Area N – Proposed Lo-Lo Terminal, area at eastern end of wharf, dredged to -3.0m CD
- Area K – Proposed Ro-Ro Terminal, Pocket for scour protection dredged to -12.5m CD
- Turning Circle, dredged to -10.0m CD

It was also concluded that the top 1.0m of material at the Maritime Village contained widespread levels of Class 2 material making it unsuitable for disposal at sea, equating to 70,000m^3 or 6% of the total volume required to be dredged. The underlying sediments can be classified as Class 1 (Uncontaminated: no biological effects likely), subject to the formal approval of the Marine Institute, and are therefore suitable for disposal at sea in the absence of a more sustainable alternative.

A summary of the capital dredge volumes and the suitability of the material for disposal at sea is summarised in Table 8.24.

Loading and Dumping of Dredged Material Suitable for Disposal at Sea

The capital dredging works will be carried out using a trailing suction hopper dredger and/or a backhoe dredger. Other ancillary equipment will include a survey vessel and a bed-leveller to remove peaks and troughs created by the dredger. All capital dredging works will take place within the period October to March.

It is proposed to dispose of the majority of the dredged material (1,189,000 m^3) at the licenced disposal site at the entrance to Dublin Bay located to the west of the Burford Bank, presented in Figure 8.11. Alternative options to disposal at sea were considered and are presented in Chapter 4 of this EIAR.

The loading and dumping of the dredged material will be subject to a separate Dumping at Sea Permit from the Environmental Protection Agency (EPA).

Table 8.24 Capital Dredging – Suitability of Dredged Material for Dumping at Sea

Location	Dredged Depth	Volume
Maritime Village	-3.0 m CD	197,000 m^3
Area K - Ro-Ro Terminal – Localised Scour Protection to 220 kV cables	-12.5 m CD	13,000 m^3
Turning Circle	-10.0m CD	444,000 m^3
Area N - Lo-Lo Terminal Berthing Pocket	-13.0 m CD	533,000 m^3
	-3.0m CD	72,000 m^3
Total Dredge Volume		**1,259,000 m^3**
Volume not suitable for disposal at sea (top 1.0m at Maritime Village)		**70,000 m^3**
Total Dredge Volume suitable for disposal at sea		**1,189,000 m^3**

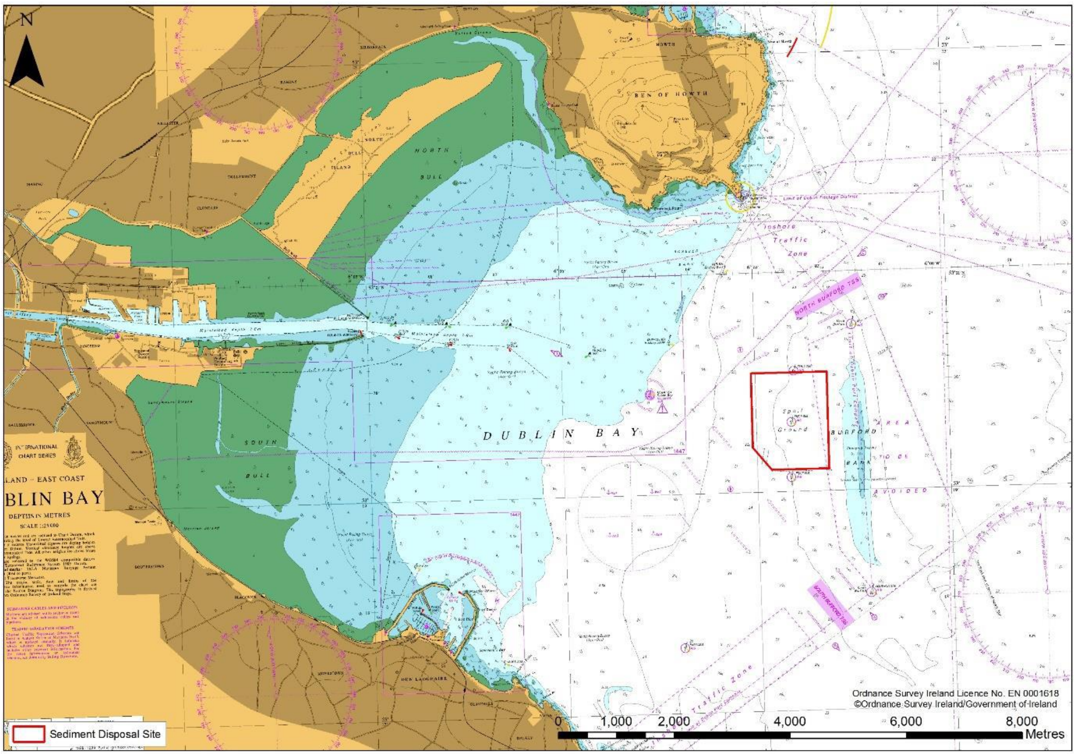


Figure 8.11 Location of licensed offshore disposal site

Consideration of options for removal of Class 2 Material at Maritime Village

The following options have been considered for dealing with the dredge sediments that are deemed unsuitable for disposal at sea. Set out below are some of the issues that affect the options considered.

Alexandra Basin Redevelopment (ABR) Project

The ABR Project was granted planning permission in 2015 and included for the treatment of approximately 470,000 m^3 of sediment that was unsuitable for disposal at sea. Graving dock no.2 and an area at berth 52/53 were identified as receptors for the sediments after undergoing stabilisation or solidification treatment. This activity was subject to an Industrial Emissions (IE) licence from the EPA which was granted in November 2016. Phase 1 of these works is completed and involved the dredging and stabilising of sediments for fill within the graving dock no.2 and storage at berth 52/53 for future placement into berth 52/53.

Phase 2 of the works will involve dredging, stabilisation, and placement of the remaining sediment from Alexandra basin at the berth 52/53 receptor. This can only be done after the construction of a new quay wall at berth 52/53. Based on the bulking factors experienced in the phase 1 works, the volume of bulked dredge remaining in Alexandra Basin is likely to be close to the receptor capacity at berth 52/53. Several factors influence the final receptor volume including design mixes of the stabilised material, design of the quay wall and the pavement design.

Waste Hierarchy

DPC recognise the waste hierarchy ranks waste management options in terms of sustainability and environmental impact. Prevention is given top priority as it aims to stabilise and reduce waste generation whilst disposal to landfill is the lowest priority. Recycling and recovery sit above disposal in the hierarchy. DPC endorses the principles of the waste hierarchy.

Maritime Village

Recovery of treated sediment within Dublin Port lands and specifically at the EPA licensed berth 52/53 site may not be feasible due to capacity as outlined above. It is acknowledged that if any contaminated sediments from outside of the ABR scope be placed at berth 52/53, then it would be subject to a revision of the IE licence which limits filling to sediment arising from the Alexandra basin. If capacity is available at berth 52/53 then it is proposed that the dredge sediment, or part thereof, will be treated and placed in the berth 52/53 receptor.

Off Site Options

In line with the waste hierarchy, the preference for any sediments to be removed off site is for the sediments to be recovered. There are several soil recovery facilities in Ireland which are authorised to accept uncontaminated soil and stone. In some cases, soil recovery facilities are also permitted to accept dredging spoil (EA Waste Code 17 05 06). If an operator proposes to accept dredging spoil at their facility, they must submit details of the source material and the proposed waste acceptance procedures on a case-by-case basis to the EPA or local authority for their consideration. Further testing would be required to confirm the suitability of the sediment for recovery at these facilities.

If receptor capacity is not available at berth 52/52 and if the sediment is not suitable for recovery at a soil recovery or a soil treatment facility in Ireland, then the dredge sediments would be sent to a suitable soil treatment facility outside of Ireland.

In these facilities contaminated soils and sediments are processed, treated and subsequently recovered/ re-used on development projects and/or reintroduced into the market as secondary raw materials for new projects. There are several such facilities close to ports in England and in northern Europe.

Summary

In summary, the disposal of the Class 2 element of dredged sediment from the Maritime Village will, in order of preference, be:

1. Filled to Berth 52/53 under a revised Industrial Emissions (IE) licence subject to availability of receptor capacity;
2. Recovered at a soil recovery or soil treatment facility in Ireland subject to testing of the sediments in line with the selected facility licence at the time of the works;
3. Recovered at a soil treatment facility in Great Britain or northern Europe; or
4. Disposed of at a licenced landfill facility in Ireland.

Radiological Testing

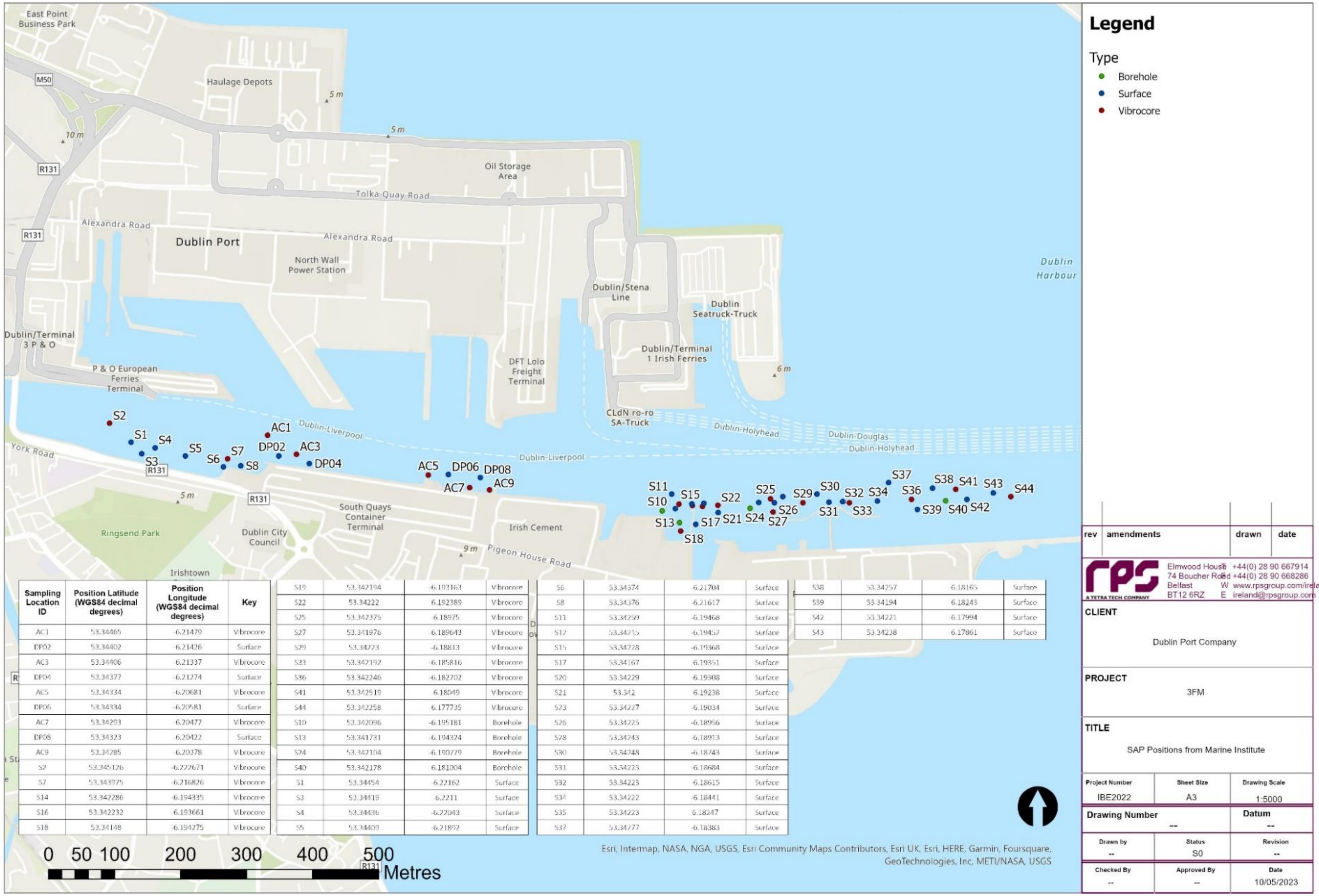
With regard to radioactivity, radiological analysis was carried out within Dublin Harbour in 2007, 2009 and 2018 in accordance with IAEA-TEC-DOC-1375, determining the suitability of materials for disposal at sea under the London Convention 1972 – a radiological assessment procedure. The results from these surveys indicated that the dumping of dredged material will not result in a radiological hazard.

DPC consulted the EPA's Office of Radiation Protection and Environmental Monitoring with regards the radiological testing of sediment in the areas to be dredged as part of the 3FM Project. EPA provided a specification of testing to be carried out based on the areas to be dredged and the proposed volumes of dredging.

In accordance with the instructions from EPA, 23 grab samples (Figure 8.12) were collected over a period of two dates in October 2022 (3rd and 24th). The sampling sites specified by the EPA are set out in Appendix 8-4. The samples were collected by Aquatic Services Unit and Hydromaster and were sent to the EPA Radiological Testing Laboratory at Clonskeagh, Dublin for analysis.

The 23 samples were consolidated into five composite samples for testing for radiological material. The results of the analysis are provided in Appendix 8-4 of this EIAR.

The EPA concluded that "*The results indicate that dumping of these materials at sea will not result in a radiological hazard*" (see Appendix 8-4).



Sampling Location ID	Position Latitude (WGS84 decimal degrees)	Position Longitude (WGS84 decimal degrees)	Key
AC1	53.34465	-6.21479	Vibrocore
DP02	53.34402	-6.21426	Surface
AC3	53.34406	6.21337	Vibrocore
DP04	53.34377	-6.21274	Surface
AC5	53.34334	-6.20681	Vibrocore
DP06	53.34334	-6.20581	Surface
AC7	53.34293	6.20477	Vibrocore
DP08	53.34323	6.20422	Surface
AC9	53.34285	6.20378	Vibrocore
S2	53.345126	-6.222671	Vibrocore
S7	53.343975	-6.216826	Vibrocore
S14	53.342286	-6.194335	Vibrocore
S16	53.342232	6.193661	Vibrocore
S18	53.34148	6.194275	Vibrocore
S19	53.342194	-6.193163	Vibrocore
S22	53.34222	6.192389	Vibrocore
S25	53.342375	6.18975	Vibrocore
S27	53.341976	-6.189643	Vibrocore
S29	53.34223	-6.18813	Vibrocore
S33	53.342192	-6.185816	Vibrocore
S36	53.342246	-6.182702	Vibrocore
S41	53.342519	6.18049	Vibrocore
S44	53.342258	6.177735	Vibrocore
S10	53.342096	-6.195181	Borehole
S13	53.341731	-6.194324	Borehole
S24	53.342104	-6.190779	Borehole
S40	53.342178	6.181004	Borehole
S1	53.34454	6.22162	Surface
S3	53.34419	6.2211	Surface
S4	53.34436	-6.22043	Surface
S5	53.34409	-6.21892	Surface
S6	53.34374	6.21704	Surface
S8	53.34376	-6.21617	Surface
S11	53.34259	-6.19468	Surface
S12	53.34215	-6.19452	Surface
S15	53.34228	-6.19368	Surface
S17	53.34167	6.19351	Surface
S20	53.34229	6.19308	Surface
S21	53.342	6.19238	Surface
S23	53.34227	6.19034	Surface
S26	53.34225	-6.18956	Surface
S28	53.34243	-6.18913	Surface
S30	53.34248	-6.18743	Surface
S31	53.34223	-6.18684	Surface
S32	53.34223	6.18615	Surface
S34	53.34222	6.18441	Surface
S35	53.34223	6.18247	Surface
S37	53.34277	-6.18383	Surface
S38	53.34257	-6.18165	Surface
S39	53.34194	6.18243	Surface
S42	53.34221	-6.17994	Surface
S43	53.34238	-6.17861	Surface

Figure 8.12 Marine Sediment Sampling locations

8.4.13.2 Compliance with National Marine Planning Framework (NMPF) Planning Policies

The National Marine Planning Framework (NMPF) was published on 30th June 2021 and brings together all marine-based human activities for the first time in a policy document, outlining the government's vision, objectives and marine planning policies for each marine activity.

The NMPF details how these marine activities will interact with each other in an ocean space that is under increasing spatial pressure, ensuring the sustainable use of our marine resources to 2040.

The NMPF is intended as the marine equivalent to the National Planning Framework. This approach will enable the Government to:

- set a clear direction for managing our seas
- clarify objectives and priorities
- direct decision makers, users and stakeholders towards strategic, plan-led, and efficient use of our marine resources

The Policy objectives for Ports, Harbours and Shipping is set out in Chapter 15 of the NMPF.

There are three planning policies (Policy 5, 8 & 9) which directly relate to the proposed Capital Dredging requirements for the 3FM Project. These policies and DPC's responses to demonstrate full compliance are set out below:

NMPF Policy 5 Proposals for capital dredging will be supported where it is necessary to safeguard national port capacity and Ireland's international connectivity, and where required compliance assessments associated with authorisations have been carried out and incorporated into subsequent competent authority decision(s).

As set out in Chapter 2 Need for the 3FM Project, the proposed 3FM Project is required to safeguard national port capacity and Ireland's international connectivity. This application is supported by this EIAR together with an Appropriate Assessment Screening Report and NIS (under separate cover). Capital dredging is an essential element of the 3FM Project.

NMPF Policy 8 Proposals that cause significant adverse impacts on licensed disposal areas should not be supported. Proposals that cannot avoid such impact must, in order of preference"
a) minimise,
b) mitigate, or
c) if it is not possible to mitigate the significant adverse impacts, proposals must set out the reasons for proceeding.

DPC intend to dispose of 1,189,000m^3 of dredged spoil arising from the 3FM Project which has been determined to be suitable for disposal at sea (Class 1 material: uncontaminated; no biological effects likely), subject to formal approval of the Marine Institute. It is proposed to dispose of the material at the licensed offshore disposal site located at the approaches to Dublin Bay, west of the Burford Bank.

Chapter 7 Biodiversity Flora & Fauna, sets out the environmental appraisals undertaken of the potential impact due to dumping operations at the disposal site in relation to benthic biodiversity and fisheries.

The licensed offshore disposal site lies within the Rockabill to Dalkey Island Special Area of Conservation (SAC) where the Qualifying Interests are Harbour Porpoise and Reefs. The NIS sets out the environmental appraisals undertaken of the potential impact due to dumping operations in relation to the Natura 2000 sites proximate to the disposal site.

Chapter 13 Material Assets - Coastal Processes, sets out a series of mitigation measures which will be fully implemented during the proposed dredging operations to ensure no significant impact at the disposal site.

NMPF Policy 9 Proposals for the management of dredged material must demonstrate that they have been assessed against the waste hierarchy.

An Assessment of Alternatives was undertaken for the 3FM Project capital dredging works which is set out in Chapter 4 Assessment of Alternatives.

A summary of the results of the Assessment of Alternatives is set out below:

At strategic level, the Masterplan identified that the 3FM Project is a key element of its implementation, underpinning the Masterplan's fundamental approach of providing capacity in Dublin Port for the 77.2m gross tonnes projected by 2040 by maximising the utilisation of Dublin Port's brownfield lands. The assessment process in support of the Masterplan identified that the development in this area of the port is the most sustainable approach and the desired approach from a strategic point of view.

The 3FM Project is concluded to be an essential step in achieving the port's ambitious throughput objective.

A number of alternative loading options were examined including the use of a range of mechanical and hydraulic dredgers. The preferred option identified was the use of a backhoe dredger and/or a Trailing Suction Hopper Dredger. No over-spill will be permitted whilst loading within the inner Liffey channel (Dublin Harbour). The quantity of dredged material entering the water column as a sediment plume is therefore expected to be similar for both types of dredger. Monitoring undertaken during the ABR Project has shown that loading operations within Dublin Harbour has had no significant impact on water quality.

A number of disposal options were also examined including: do nothing; beneficial re-use; disposal on land; incineration and disposal at sea. The preferred option identified was a combination of disposal at sea and re-use with computational modelling undertaken to determine appropriate method, rate, timing and location of these activities. A sediment chemistry sampling and analysis programme identified 1,117,000m^3 of dredge spoil material which was Class 1 (uncontaminated; no biological effects likely) and thereby suitable for the safe disposal at sea. No significant environmental impacts of this design choice were identified.

Conclusion

The overall objectives of the NMPF are overwhelmingly supportive of the objectives of the 3FM Project. The safeguards put in place by the NMPF to control capital dredging activity through dredging planning policies are fully met as set out above.

8.5 Construction Impacts

As outlined in Chapter 5 Project Description, the development will be phased over a number of years and will comprise both landside and marine works.

8.5.1 Land, Soils and Geology

8.5.1.1 Land-take

The 3FM Project will not require any temporary land-take during construction. The proposed construction works within areas of existing port infrastructure, commercial, and industrial operations, will be undertaken in a phased approach. The impact to land from construction work is considered to be **Neutral** as there will be no measurable impact.

8.5.1.2 Demolition Works

Demolition of the following will be undertaken as part of the 3FM Project; Turning Circle sludge jetty (including access viaduct, jetty head, walkway and mooring dolphins), Maritime Village (2no. buildings per Stella Maris Rowing Club, Poolbeg Yacht & Boat Club building), Area N ESB jetties (access viaduct, jetty head / T-head, walkway/footbridge, intermediate footbridge supports, breasting dolphins, mooring dolphins, miscalleneous quay furniture), Area N ESB weir (walkway structure), two existing dolphins at Tom Clark Bridge, MTL Terminal (including three warehouses and various combinations of portacabins and mobile offices, existing pier and existing ramp and caisson structures). No significant land-based earthworks will be required for these demolitions.

8.5.1.3 Earthworks

Turning Circle

The north-east portion of existing 47A Hardstand (Masterplan Area M) will be excavated to facilitate the proposed turning circle. Excavated material will be used for infill to an area between the turning circle and existing Harbour Wall directly to the south of the proposed Turning Circle. The 47A Hardstand will be used to support the Offshore Renewables Sector with the Land being used by Codling Wind Park (CWP) for a proposed Onshore Substation (subject to a separate planning application by CWP).

The loss of this portion of land will be **Neutral** as it predominantly involves the reuse of made ground deposits (the 47A Hardstand was constructed in the 2000s with fill material) as infill material.

The impact to land from the excavation the north-east portion of the 47A hardstand area (within the vicinity of boreholes BH215, BH216 and BH217), and reuse as infill material is considered to be **Neutral**. There will be no significant change of land use for this area.

Area O

Ground levels at Area O will be raised on average 500mm (with a maximum of 900mm) above the existing ground level across the site. The impact of clean imported material used to accommodate raising the ground levels in this area is considered to be **Beneficial** as there will be an improvement in the quality of upper soils.

Normal surface applied ground treatment techniques will be applied to improve ground conditions for geotechnical purposes and mitigate the risk of settlement in the upper soils. The appropriate techniques will be determined at detailed design stage of the proposal, and will be utilised to prepare the area prior to the construction of Area O. The impact of ground improvement techniques is considered to be **Neutral** as there will be no measurable impact soils and geology.

As soil pore to pore space is reduced during ground improvement techniques, there is a potential for a build-up of ground gases within Area O. It is considered that the potential impact of ground gas build-up on on-site and off-site commercial, light industrial buildings and infrastructure during the construction phase would be **Minor Adverse**.

Due to elevated ground gas concentrations observed within Area O, the impact of ground improvement techniques with regards to specific human health receptors i.e. construction workers within Area O is considered to be **temporary Minor Adverse** during the construction phase. Any gases released to the surface during construction will dissipate in open air, therefore the risk to human health of construction workers is negligible. The closest residential receptor / residential housing development is located to the south of the project area, c.500m south-west of Area O. The risk from ground gas as a result of ground improvement techniques to residential receptors during the construction phase from ground improvement techniques is considered to be **Neutral**.

If areas of soft ground are detected that are deemed unsuitable for ground treatment techniques, minor excavations to remove geotechnically unsuitable material may be required. In this instance, the loss of made ground deposits will be **Minor Adverse**.

Asbestos fibres were noted in soils at BH112, BH116, BH119, BH120, BH320, BH322 at 0.50m, BH305 at 2.00m and BH322 at 3.00m. A potential pathway may exist for construction workers during earth works for proposed roads and the proposed works within Area O. The appropriate use of PPE / RPE and dust suppression techniques can be employed to mitigate the risks to construction workers from the inhalation of asbestos fibres within these areas. In this instance, the human health risk to construction workers from asbestos fibres in soils is **Moderate Adverse**.

Roads & Active Travel Route

There will be minor earthworks associated with road and active travel rout improvements. These minor earthworks will be **Minor Adverse** as it predominantly involves the loss of made ground deposits.

Port Park

Asbestos fibres were noted at BH317 within the proposed Port Park & Wildflower Meadow. The removal of a small section of coastal berm and the implementation of soft landscaping in this area may result in a potential risk to the general public from a release of asbestos fibres. The human health risk is considered to be easily preventable during construction through the use of dust suppression measures and as such will be **Moderate Adverse**.

There is a requirement for minor cut and fill exercises to be undertaken to achieve proposed site levels. In this instance, the loss of made ground deposits will be **Minor Adverse**.

Area L

Asbestos fibres were identified within Area L at BH305. A potential pathway may exist for construction workers during earth works for proposed roads and the proposed works within Area L. The appropriate use of PPE / RPE and dust suppression measures can be employed to mitigate the risks to construction workers from the inhalation of asbestos fibres within these areas. In this instance, the human health risk to construction workers from asbestos fibres in soils is **Moderate Adverse**.

8.5.1.4 Construction

Area O

With regards to contaminated land, the construction of a new reinforced concrete slab for trailer handling and storage on top of the imported materials noted above, will remove any direct contact pathway with elevated contaminant concentrations in soils in this area. The impact of constructing this concrete slab is considered to be **Beneficial**.

Area L

With regards to contaminated land, the construction of a new reinforced concrete slab to provide for container handling and storage which will be tied into the existing quay levels. This slab will remove any direct contact pathways to soils in this area. The impact of constructing this concrete slab is considered to be **Beneficial**.

Off-site General Public

Due to the presence of asbestos in soils in Area O and Port Park & Wildflower Meadow, there is a potential risk to the general public along the adjacent public walkway and users of surrounding Port lands from asbestos fibre release during earthworks and landscaping in these areas during construction. The closest residential receptor / residential housing development is located to the south of the project area, c.500m south-west of Port Park and Area O which is a considerable distance. It is considered that these risks are easily preventable and as such the impact is considered to be **Moderate Adverse**.

8.5.1.5 Capital Dredging

Capital Dredging will be required for the 3FM Project as described in Chapter 5 Project Description. The capital dredging operations will be restricted to the winter seasons (October to March) over the duration of the project. It should be noted that the order of dredging activity may change depending on the priority required by the Harbour Master to ensure the safe navigation of vessels entering and leaving the port. The impact to land, soils and geology from dredging works is considered to be **Minor Adverse** due to the loss of small proportion of local high fertility sediments and high proportion of local low fertility sediments.

8.5.2 Hydrogeology

8.5.2.1 Demolition Works

The impact to hydrogeology from demolition work is considered to be **Neutral**.

8.5.2.2 Piling

Given that the piling will predominantly be undertaken in the marine environment, the potential for creating preferential pathways for contamination to migrate to deeper groundwater is minimal. In addition, no significant soil sources of contamination were identified within the GQRA (See Appendix 8-2).

8.5.2.3 Earthworks and Ground Improvement Works

Normal surface applied ground treatment techniques will be applied to improve ground conditions for geotechnical purposes and mitigate the risk of settlement in the upper soils. The appropriate techniques will be determined at detailed design stage of the proposal, and will be utilised to prepare the area prior to the construction of Area O. The impact of ground improvement techniques is considered to be **Minor Adverse** as any impact on shallow groundwater will be temporary in nature.

8.5.2.4 Capital Dredging

Dredging will occur in the marine environment and therefore the impact to hydrogeology is **Neutral.**

8.6 Operational Impacts

8.6.1 Land, Soils and Geology

The 3FM Project is designed to provide port infrastructure which will improve the efficiency of port operations and thereby increase the throughput of both cargo and passengers. The future land uses within the footprint of the 3FM Project will not significantly change, with the exception of the proposed Port Park which will result in a change of land use from commercial / industrial to public realm.

As part of the contamination assessment (EIAR Appendix 8-2), the Conceptual Site Model (CSM) did not identify any soil source-pathway-receptors linkages in relation to human health during the operational phase and therefore the risk to human health (future site workers and site users) from sub-soil contamination is considered to be negligible. In addition, the majority of the 3FM Project will be covered in concrete hardstanding which acts as a barrier to subsoils. The operational impact to land, soils and geology is considered to be **Neutral.**

An exception to this is Port Park which will comprise soft landscaping and public realm. Based on soil sampled from BH126, BH127 & BH128, BH315, BH316 and BH317, a soil source-pathway-receptor linkages in relation to human health has identified with regards to asbestos fibres at BH317. The operational use of Port Park & Wildflower Meadow is considered to be **Moderate Adverse**, as the risks from asbestos fibres in soils can be easily preventable. The operational impact to land within the proposed Port Park area is considered to be **Beneficial**.

A source-pathway-receptor linkage in relation to human health was identified with regards to ground gas within proposed buildings in Area O and L. The impact is considered to be **Moderate Adverse**. The risk from ground gas as a result of ground improvement works to residential receptors located a considerable distance from Area O is considered to be **Neutral**.

8.6.2 Hydrogeology

The operational phase of the development will not introduce significant new sources of potential groundwater contamination.

The overall hydrogeology impact from operation of the development is considered to be **Neutral.**

8.7 Remedial and Mitigation Measures

8.7.1 Construction Phase Mitigation Measures

8.7.1.1 Asbestos Mitigation Measures

The potential risk to construction workers from contaminants during the earthworks is low, with the exception of identified asbestos fibres at BH112, BH116, BH119, BH120, BH317, BH320, BH322 at 0.50m, BH305 at 2.00m and BH322 at 3.00m. The risk to construction workers via the inhalation of asbestos fibres during earth works / ground disturbance can be mitigated through the appropriate use of PPE / RPE. The use of dust suppression throughout earthworks / ground disturbance will mitigate the risk of asbestos fibre release impacting construction workers and the general public. The requirements for dust suppression and monitoring should be aligned with those noted in Chapter 10 Air Quality.

With regards to soft landscaping in Port Park & Wildflower Meadow, implementation of a clean cover barrier system of at least 600mm of clean imported soils will be required. All soft landscaping areas will incorporate the following mitigation measures;

- Installation of a clean cover barrier comprising clean, imported soil. In order to comply with required site levels, it will likely be required to remove the existing soils/hardstanding and replace with the 600mm of imported soil.
- The imported soil must be suitable for use i.e. public open space near residential housing. Validation samples of the imported soil will be collected and analysed for metals, TPH-CWG, speciated PAHs,

asbestos, VOCs, SVOCs and PCBs and the results will be screened against the LQM/CIEH S4Uls for a public open space near residential end use.

- The Contractor will be made aware of the presence of asbestos and will enact appropriate health and safety measures when removing the existing soil.
- The removed soil material will be disposed to an appropriately licensed facility.

8.7.1.2 Ground Gas Mitigation Measures

The construction phase will include the installation of ground gas protection measures within buildings in Area O and L.

Area O

To achieve the appropriate level of protection, consideration has been given to BS8485:2015+A1:2019 'Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings'. The building type has therefore been classified as a Type C building. This indicates, for a Characteristic 4, Type C building, the gas protection measures should provide a solution score total of 4.5.

Reference has then been made to BS8485:2015 which provides all of the protection elements/systems. A combination of elements have to be chosen and combined to achieve the required level of gas protection for all areas of the site. For the proposed development, the following is considered to be a potential solution:

Total Solution Score Required- 4.5

Table 5 (BS8485) – Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations – solution score of 1.5

Table 6 (BS8485) – Passive sub floor dispersal layer: good performance – solution score of 1.5

Table 7 (BS8485) – Gas resistant membrane – solution score of 2

<u>Total Solution Score – 4.5</u>

Area L

To achieve the appropriate level of protection, consideration has been given to BS8485:2015+A1:2019 'Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings'. The building type has therefore been classified as a Type C building. This indicates, for a Characteristic 2, Type C building, the gas protection measures should provide a solution score total of 2.5.

Reference has then been made to BS8485:2015 which provides all of the protection elements/systems. A combination of elements have to be chosen and combined to achieve the required level of gas protection for all areas of the site. For the proposed development, the following is considered to be a potential solution:

Total Solution Score Required- 2.5

Table 5 (BS8485) – Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations – solution score of 1.5

Table 7 (BS8485) – Gas resistant membrane – solution score of 2

Total Solution Score – 3.5

8.7.2 Operational Phase Mitigation Measures

No specific operational phase mitigation measures with regard to land, soils, geology and hydrogeology are required.

8.8 Residual Impacts

No residual impacts are predicted for either the construction or operational phase.

8.9 Cumulative Impacts

As described in Chapter 5 Project Description, there are a number of developments within the surrounding area which may interact with the 3FM Project. The Proposed Development has been considered, taking account of the location, scale and characteristics of those other projects, and assessed as to whether significant cumulative effects on soil and groundwater quality are likely to arise. Projects considered relevant to land, soils, geology and hydrogeology are set out in the table below (Table 8.25).

Table 8.25 Potential Cumulative Effects

Project	Potential Cumulative Effect
Open Cycle Gas Turbine (OCGT) and a generating plant. – Reg. Ref. PWSDZ3074/23 – done Q26	Potential for cumulative effects on groundwater quality due to the introduction of a contamination source (hydrocarbons).
Development that will be for mixed usage – Reg.Ref. PWSDZ3207/21	Potential for positive cumulative effects on groundwater quality and on-site ground gas regime due to the proposed basement and undercroft. This application will be accompanied by an Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement (NIS).
Development that will be for mixed usage – Reg.Ref. PWSDZ3406/22	Potential for positive cumulative effects on groundwater quality and on-site ground gas regime due to the proposed basement and undercroft.

The above developments will be required to fully comply with the current legislation, policies, plans and best practice guidance which seek to minimise the potential for contamination of soils and groundwater. As such, the likelihood of cumulative effects is considered to be low.

8.9.1 Inter-relationships

There are several anticipated interactions between land, soils, geology and hydrogeology, and other topic EIAR chapters, namely: Chapter 4 Noise and Vibration, Chapter 6 Water Quality, Chapter 9 Waste, Chapter 10 Air Quality, Chapter 13 Land Use & Material Assets.

8.10 Monitoring

8.10.1 Ground Gas, Groundwater and Surface Water Monitoring

Continuous, real-time ground gas monitoring during the construction phase of Area O works is recommended. The monitoring is recommended before enabling works, during construction including ground improvement works, and following the completion of works. Additional boreholes may be required within Area O and Port Park to facilitate monitoring works.

Monitoring and sampling of groundwater and surface water should be undertaken prior to any works commencing on Area O and then on a weekly basis during the ground improvement works to determine any change in contaminant concentrations as a result of works. It is advised that a monitoring round should be undertaken following the completion of all ground improvement and earth works, and again once all construction works are completed at Area O.

Further information on the proposed monitoring is contained within the Remedial Strategy Report in EIAR Appendix 8-3.

8.10.2 Dust & Fibre Monitoring

Dust and asbestos fibre monitoring during the earthworks associated with the development of Port Park and the removal of a small section of a coastal berm to the south of Port Park is recommended.

8.11 Conclusions

The assessment of land, soils, geology and hydrogeology was based on a desktop study of publicly available information such as geological maps, historical borehole logs and maps, a site walkover survey and an intrusive ground investigation.

With regards to land, all of the construction and operational phase land take is contained within the 3FM Project planning permission boundary. The environmental appraisals presented in the EIAR have taken into account the environmental implications of the land resource. There are no additional mitigation measures required as a result of the environmental appraisal of land to that already set out within the EIAR.

The investigation identified that the site is underlain by made ground, sands, gravels, clay and mudstone and limestone bedrock. The EIAR has concluded that there is no loss of high fertility soils as a result of the construction and operational phase of the 3FM Project, and as a result the impact of the project on soils is considered to be neutral. The 3FM Project proposes the inclusion of soft landscaping in lieu of current hard standing made ground. As such, the importation of virgin topsoil will be an enhancement to soil resources.

Hydrogeology is the study of groundwater, including its origin, occurrence, movement and quality. The site falls within an area of low groundwater vulnerability. Groundwater was encountered within the made ground deposits and within the underlying sand and gravel deposits.

The conceptual site model developed in the assessment has identified a relevant pollutant linkage for the site with regards to ground gas within Area O and L and future users within buildings in this area, which can be mitigated through the implementation of ground gas protection measures. Real-time continuous monitoring of ground gases before, during and after the construction phase will be used to determine any significant change in the ground gas regime. The presence of asbestos in soils is a relevant pollutant linkage for construction workers and the general public during construction, however, it is considered this can be mitigated through the appropriate use of PPE / RPE and appropriate dust suppression techniques. Furthermore, the inclusion of a clean cover barrier system within Port Park & Wildflower Meadow will remove any exposure pathway to future site users associated with disturbance of asbestos in soils.

The proposed development will not have any substantial, negative impacts on the land, soils, geology and hydrogeology of the area.

Sediment chemistry sampling and analysis of marine sediments to be dredged were provided to the Marine Institute who examined the results in detail in combination with other relevant data held by the Marine Institute.

It was concluded that the following dredged sediments can be classified as Class 1 (Uncontaminated: no biological effects likely), subject to the formal approval of the Marine Institute, and are therefore suitable for disposal at sea in the absence of a more sustainable alternative.

- Ro-Ro Terminal (Area K) – Localised Scour Protection to 220 kV cables;
- Turning Circle; and
- Lo-Lo Terminal (Area N) Berthing Pocket and an area towards the eastern end of the Wharf to enable construction using marine plant.

It was also concluded that the top 1.0m of material at the Maritime Village contained widespread levels of Class 2 material making it unsuitable for disposal at sea, equating to 70,000m^3 or 6% of the total volume required to be dredged. The underlying sediments can be classified as Class 1 (Uncontaminated: no biological effects likely), subject to the formal approval of the Marine Institute, and are therefore suitable for disposal at sea in the absence of a more sustainable alternative.

It is proposed to dispose of the Class 1 dredged material (1,189,000 m^3) at the licenced disposal site at the entrance to Dublin Bay located to the west of the Burford Bank, The loading and dumping of the dredged material will be subject to a separate Dumping at Sea Permit from the Environmental Protection Agency (EPA).

The options for disposal of the Class 2 dredged material (70,000 m^3) from the Maritime Village are, in order of preference:

1. Filled to berth 52/53 under a revised IE licence subject to availability of receptor capacity;
2. Recovered at a soil recovery or soil treatment facility in Ireland subject to testing of the sediments in line with the selected facility licence at the time of the works;

3. Recovered at a soil treatment facility in Great Britain or northern Europe;
4. Disposed of at a licenced landfill facility in Ireland.