Greater Dublin Drainage

Alternative Sites Assessment - Phase Two
Sites Assessment and Route Selection Report

Soils and Geology

May 2012

8 Soils and Geology

8.1 Introduction

This appendix concentrates on identifying constraints within the pipeline corridors, Wastewater Treatment Plant sites and marine outfall location for the Greater Dublin Drainage (GDD) scheme with regard to the soils and geology of the study area.

Within the study area there are seven possible pipeline routes, nine possible land-parcels to be assessed for the Wastewater Treatment Plant and two possible marine outfall locations.

This appendix comprises the soils and geology assessment for Phase Two of sub-stage (b): Alternative Sites Assessment (ASA) / Pipeline and Marine Routes Selection. It should be read in conjunction with Phase One of sub-stage (b): Alternative Sites Assessment (ASA) / Pipeline and Marine Routes Selection.

This ASA assessment, relating to the soils and geology has been prepared by Arup.

8.2 Methodology

The assessment methodology was developed in line with best practice and included a review of desk top data, wind shield surveys, consultations and a review of guidance. The basis for the assessment is discussed in the following sections.

8.2.1 Desktop Study

A desk top study was undertaken of all publically available relevant information and data gathered by the GDD and Arup project teams. The sources of information utilised in the assessment included:

- Site investigation data from previous Arup projects within the study area
- 1:100,000 Scale Bedrock Mapping (Geological Survey of Ireland) & associated memoir
- Karst Database (Geological Survey of Ireland)
- Quarternary Maps (Geological Survey of Ireland)
- Teagasc Subsoil Mapping (2004)
- Teagasc Soils Mapping (2007)
- Corine Land Cover datasets, (European Environment Agency, 2006)
- General Soil Map of Ireland (An Foras Talúntais, 2nd Edition,1980)
- The Peatlands of Ireland (An Foras Talúntais, 1981)
- Directory of Active Quarries, Pits and Mines in Ireland (Geological Survey of Ireland, 3rd Edition, 2001)
- Planning Departments of Local Authorities (Section 261,
- Pits and Quarries Planning and Development Act 2000)
- State Mining and Prospecting Facilities (published twice annually by Exploration and Mining Division of DCENR)
- Historic Mine Sites - Inventory and Risk Classification (EPA & GSI)
- Concrete Products Directory (Irish Concrete Federation)
- Proposed / Designated NHA Sites (Geological Survey of Ireland)

- National Parks and Wildlife Service
- County Geological Sites (Local Authority Planning Office/Heritage Officers) – Figure 4 of the ASA report contains this information
- Mining Heritage Trust of Ireland (old mining sites)
- Office of Licensing and Guidance, Environmental Protection Agency http://www.epa.ie/
- Local Authorities (Waste Management Section)
- Historical Maps (Ordnance Survey of Ireland / National Library of Ireland)
- National Landslide Database (Geological Survey of Ireland)
- Aerial Photographs (Geological Survey of Ireland / Ordnance Survey of Ireland)
- Atlas of Ireland (Royal Irish Academy)
- Exploration and Mining Division of the Department of Communications, Energy and Natural Resources (www.mineralsireland.ie)
- Fingal County Council Unregulated Landfill Data
- Eirgrid. Dublin North Fringe 220kV Reinforcement Project Site Selection Review of Constraints, April 2011

8.2.2 *Site Visits*

A windshield survey was undertaken by staff from Arup on 30th January 2012. Each route corridor, land parcel and marine outfall site were visited and features of interest were verified against the data collected during the desk study.

8.2.3 Consultations

Consultations have been undertaken with statutory consultees by the GDD project team and are described in the main report. Geological heritage data was gathered during Phase One of the ASA and was made available for this Phase Two report indicating that consultation with the Geological Survey of Ireland (GSI) was not required for the preparation of this assessment.

Due to the availability of data online, no further consultations were required with regard to the soils and geology assessment of this ASA.

8.2.4 Assessment Methodology

This ASA was prepared taking cognisance of the requirements of the NRA guidance for the preparation of route selection reports for geology, hydrology and hydrogeology ('Environmental Impact Assessment of National Road Schemes – Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes, NRA 2009'). While the proposed development is not a road, the liner nature of the pipeline route leads to similar impacts to those of a road scheme.

The guidelines also provide a useful methodology for assigning the level of impact relating to soils and geology, the principals of which can be applied to this proposed development. The importance of features identified is assigned in line with the criteria outlined in Table 8.1 and based on the scale and timescale of the impact, the level of impact can be assigned in line with Table 8.2. This is discussed in full in section 8.4.

Based on the level of impacts along each pipeline route, WwTP land parcels and marine outfall areas, an evaluation of the routes, land parcels and outfall areas was made. This is discussed in full in section 8.5.

The geological constraints along the proposed pipeline routes, land parcels and marine outfall areas were gathered and an importance assigned based on the criteria outlined in Table 8.1.

Table 8.1 – Greater Dublin Drainage Scheme Criteria for Rating Site Attributes (based on NRA Guidelines (2009); Box 4.1: Criteria for Rating Site Attributes)

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale Degree or extent of soil contamination is significant on a national or regional scale Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale	Geological feature rare on a regional or national scale (NHA) Large existing quarry or pit proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale Degree or extent of soil contamination is significant on a local scale Volume of peat and/or soft organic soil underlying route is significant on a local scale	Contaminated soil on site with previous heavy industrial usage Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site) Well drained and/or highly fertility soils
Medium	Attribute has a medium quality, significance or value on a local scale Degree or extent of soil contamination is moderate on a local scale Volume of peat and/or soft organic soil underlying route is moderate on a local scale	Contaminated soil on site with previous light industrial usage Small recent landfill site for mixed wastes Moderately drained and/or moderate fertility soils Small existing quarry or pit
Low	Attribute has a low quality, significance or value on a local scale Degree or extent of soil contamination is minor on a local scale Volume of peat and/or soft organic soil underlying route is small on a local scale*	Large historical and/or recent site for construction and demolition wastes Small historical and/or recent landfill site for construction and demolition wastes Poorly drained and/or low fertility soils Uneconomically extractable mineral resource

Table 8.2 Greater Dublin drainage Scheme criteria for rating impact significance at Route Selection Stage – Rating of Significant Environmental Impacts at Route Selection Stage (based on NRA Guidelines (2009); Box 4.4: Criteria for Rating Impact Significance at Route Selection Stage)

Impact Level	Attribute Importance				
	Extremely High	**Very High**	**High**	**Medium**	**Low**
Profound	Any permanent impact on attribute	Permanent impact on significant proportion of the attribute			
Significant	Temporary impact on significant proportion of attribute	Permanent impact on small proportion of attribute	Permanent impact on significant proportion of attribute		
Moderate	Temporary impact on small proportion of attribute	Temporary impact on significant proportion of attribute	Permanent impact on small proportion of attribute	Permanent impact on significant proportion of attribute	
Slight		Temporary impact on small proportion of the attribute	Temporary impact on significant proportion of attribute	Permanent impact on small proportion of attribute	Permanent impact on significant proportion of the attribute
Imperceptible			Temporary impact on small proportion of attribute	Temporary impact on significant proportion of attribute	Permanent impact on small proportion of attribute

8.3 Existing Environment

The existing environment of the study area in relation to soils and geology is described in the following sections. Sections 8.3.1.1 - 8.3.1.3 describes the regional soils and geology of the wider study area. The specific constraints within each pipeline corridor, land parcel and marine outfall have been summarised in sections 8.3.2.1 to 8.3.2.3 and are presented in Table 8.5 to Table 8.22.

The predicted geological constraints should the proposed scheme be constructed are proposed below. These constraints are discussed with regards to the interaction of main features of the development with the soils and geology of the scheme. These constraints may also relate to and interact with other disciplines within the route selection and ASA process where geotechnical and geological information has been provided to assist in impacts assessments e.g. construction strategy, noise, air quality, ecology, water and settlement.

8.3.1 Regional existing environment

8.3.1.1 Soils and geology

(a) Landscape, topography and landuse

The landscape of North County Dublin principally reflects the erosional and depositional legacy of the last period of glaciation, which ended some 10,000 years ago following the Devensian period. Glacial erosion of pre-existing topographic features and deposition of thick glacial drift deposits, mainly till (boulder clay) resulted in a rather subdued post-glacial topography. The post-glacial landscape also reflects the effects of fluvial processes that have altered the topography, albeit only to a small extent in this area, since the ice sheet retreat.

The topography of the study area ranges from approximately 80m above sea level, land to the south-west of the study area, to sea level as the route corridors connect to marine outfalls. The ground throughout the study area slopes towards the Irish Sea to the east.

The landscape in North County Dublin is a mixture of developed residential areas such as Swords, Clongriffin etc with large areas of agricultural land.

Landuse classifications for the study area have been obtained from the Corine Land Cover Data provided by the EEA (European Environment Agency). These datasets are available for the years 1990, 2000 and 2006 and provide a general indication of the landuse type in an area. The landuse classifications were confirmed during the windshield surveys where access was possible.

(b) Solid geology

This sub-section deals with bedrock underlying the area. Bedrock is defined as consolidated rock underlying the ground surface and any soils present. Above the bedrock is usually an area of broken and weathered unconsolidated rock in the basal subsoil. Sedimentary rock lies in beds or strata which may comprise of different rock types and which may be horizontal or inclined so that the rock encountered at the ground surface may change over a short distance.

The bedrock geology of the region, mapped by the Geological Survey of Ireland (GSI) is indicated on Sheet 13 of the 1:100,000 Bedrock Geology series. The geological aspect of the proposed scheme relative to its regional setting is discussed below and is discussed below and illustrated in Figure 8.3.

The solid (bedrock) geology of the region comprises a sequence of sedimentary rocks that are assigned to the Lower Carboniferous. These Lower Carboniferous strata range in age from Courceyan to Brigantian. Their stratigraphy is described in Table 8. 4 (Geological Memoir, sheet 13, GSI).

Table 8.4 Summary of General Stratigraphy in North Co. Dublin

Formation	Approximate thickness, m	Lithological description
Loughshinny Formation	<100-150	Laminated to thinly bedded, argillaceous, pyritic, locally cherty micrites and graded calcarenites, interbedded with dark grey to

Formation	Approximate thickness, m	Lithological description
		black shale
Naul Formation	0-100	Calcarenite and calcisiltite with minor chert and occasional thin shales
Lucan Formation	300-800	Dark grey, well bedded, cherty, graded limestones and calcareous shales
Holmpatrick Formation	90-200	Well bedded, bioclastic limestone, with oolite in the lower part
Smuggler's Cave Formation	40	Conglomerate and lithic sandstone; clasts mainly of Lower Palaeozoic greywacke
Lane Formation	>140	Argillaceous bioclastic limestone, with shales: pale grey, bioclastic limestone, sandier and more oolite towards the top, with pebbly horizons
Rush Conglomerate Formation	300	Graded quartz- and limestone-pebble conglomerates and lithic sandstones, interbedded with laminated shale and thin limestones
Tober Colleen Formation	<250 +	Dark grey calcareous mudstones and subordinate thin fine limestones (mapped previously as "Calp")
Waulsortian Limestones		Pale grey poorly bedded pure limestone (locally dolomitized) with distinctive cavity-filling structures. This limestone was deposited in "mudmounds" or "reefs". Thin shale interbeds are locally present, generally in off-bank limestone facies.
Malahide Formation	300-1200	Upper beds: Argillaceous limestones and nodular limestones and shales Fossiliferous limestones and shales with some oolitic limestones and sandstone Limestone (micrite) with thin limestone breccia horizons Lower beds: calcareous shales, siltstones and sandstones with occasional thin limestones
Portraine Volcanic Formation		Basalt to andesite sheets, tuffaceous sedimentary rocks, pebbly mudstone, limestone breccias and black shale

The geological sequence in this region was originally deposited in a marine sedimentary basin known as the Dublin Basin which opened during continental rifting in Lower Carboniferous times. Differences in the amount and rate of opening and deepening of this basin led to lateral facies variations so that rock type can change considerably within one stratigraphical horizon across the region. Within the basin the Carboniferous rocks are gently folded so that they form a series of

anticlines and synclines trending east-northeast west-southwest, with bedding dipping to approximately north-northwest or south-southwest.

The depth to bedrock will be a key component in determining the impact of the proposed scheme on the bedrock geology. The GSI have produced a 'depth to bedrock' map (available through Urbanviewer), however this map has been generated from computer data and does not take account of the geomorphology, topography etc of the area. It is also based on a limited data set primarily from cable percussive boreholes. As these boreholes may refuse before rock is encountered this dataset cannot solely be relied upon to provide depth to bedrock information.

The GSI Groundwater Vulnerability mapping also provides an indication of the depth to bedrock as the vulnerability is a function of permeability and overburden thickness. These maps have been generated using a larger dataset than the 'Depth to bedrock' maps and for this reason where an area is classified as 'Extremely vulnerable', it is a good indication that rock is shallow in those areas. Figure 8.4 shows the groundwater vulnerability for the study area.

These sources of information will be used to provide an initial indication of the depth to bedrock and to establish if the proposed scheme will impact on bedrock. However, site specific ground investigation data has been gathered where available from the GSI and from previous Arup projects within the study area. The site specific data will be used as the primary source of information for the depth to bedrock and general ground conditions information where available.

In summary, the GSI Bedrock Geology map of Dublin shows the bedrock lithologies in the study area to be dominated by limestones of varying ages and compositions. While, in the northern fringes of the study area volcanic and metasediments have been mapped.

(c) Superficial and soil deposits

This sub-section deals with essentially unconsolidated material overlying bedrock. In this area the soils include topsoil, made ground, and drift.

Drift is a general term applied to all mineral material (clay, sand, silt, boulders) transported by a glacier and deposited directly as till by or from the ice, or as fluvioglacial deposits by running water emanating from the glacier. It generally applies to deposits laid down during the Pleistocene glaciations. Drift can also be included under Quaternary deposits.

The drift geology of the area principally reflects 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 subglacially 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 were laid down in places by melt waters discharging from the front of the glacier.

The GSI Quaternary Geology map of Dublin shows the drift geology of the study area to comprise primarily of till derived from Lower Carboniferous limestone (Figure 8.2). To the west of the proposed pipelines tills derived from Namurian deposits are present.

Sands and gravels derived from Carboniferous material are mapped along the path of the Broadmeadow River and Made Ground is present in some parts of the study area, primarily around Dublin Airport and Swords town.

(d) Karst

Karst is the name given to a landscape characterised by remarkable surface and underground forms, created as the action of the water on the permeable limestones. Surface and underground features occur where fissures and fractures have been widened by dissolution to allow the passage of groundwater. As groundwater flows through fissures and fractures, the rock is dissolved to form caves and caverns of varying sizes that are referred to as 'solution features'.

As outlined in section (b) a significant portion of the study area is underlain by limestone rocks, however these limestone formations are typically not prone to karstification. To the north of the study area karstic limestones are encountered, however within the study area the extent of these are limited. Five karstic features are mapped within the study area and these are listed in Tables 8.5-8.22 and are shown on Figure 8.5.

8.3.1.2 Economic geology

(a) Mines and quarries

Historic maps from the OSI were examined to assess if pits and quarries were present within the study area historically. The database of the Exploration and Mining Division (EMD) of the Department of Communications, Energy and Natural Resources was searched for the presence of current mines, quarries or pits.

The presence of historic and current pits can be used to indicate:

(i) the economic viability of the bedrock or sand and gravel resources in the area if multiple pits are present, and
(ii) if contaminated land may be present, as old gravel pits were sometimes used as local dumping grounds.

The historic and current mines, quarries and pits in the study area are listed in Tables 8.5 – 8.22 and are shown on Figure 8.5.

(b) Landfill and contaminated land sites

There are a number of legacy landfills present in the study area and these are generally associated with historic pits and quarries as outlined above. These are listed in Tables 8.5 – 8.22 and are shown on Figure 8.5. The level of risk associated with each of these sites has been assessed by Fingal County Council and has been used in this assessment. The assessment behind this risk assessment is not available, however it is presumed that the risk level established refer to the risk to groundwater and human health.

A large historical unregulated landfill is located on IDA owned land in the Clonshaugh/Belcamp area. The IDA commissioned a ground investigation at this site which identified the following types of waste:

- Commercial waste from factories;
- Food waste from airline in-flight meals;
- Construction and demolition waste; and

- Waste from engine oil and glass vessels with blood.

The contaminated land on this site is believed to comprise an area of approximately 2.5 m by 250m and is approximately 2-5m thick, but the true extent is unknown. The Fingal County Council Unregulated landfill assessment has assigned this site a risk rating of 'Moderate' (as opposed to 'High') due to the remediation work which has been undertaken on the site.

There is one facility within the study area, Kilshane Cross Recycling Facility (Ref. W1), which has been granted a waste licence (W0223-01). This facility has been included in Tables 8.5-8.22 and is shown on Figure 8.5, however this facility has not been constructed to date.

Graveyards have also been highlighted as potentially areas where contaminated material may be encountered. Historic graveyards have been identified as part of this study, however it is unlikely contaminated material will be encountered in those areas as the by-products from burial have usually disappeared within 10 years. However, contaminated material and groundwater may be encountered in the vicinity of operational graveyards.

(c) Licensed industrial and agricultural facilities

Industrial sites may be the source of locally contaminated land due to site activities. However these sites operate with the EPA IPPC licence framework and due to the regulated nature of their activities, the risk of contamination is low. The IPPC licenced sites within the study area are listed in Table 8.5 and are shown on Figure 8.5.

Similarly, sites which have been granted a waste water discharge licence may be a source of contamination, however, these sites are also licenced by the EPA and as such the risk of contamination is low.

Agricultural lands may be both a source of contamination and also be a feature to be protected. Agricultural lands where fertiliser is used and animals are farmed may be a source of nitrate based pollutants.

8.3.1.3 Geological Heritage

The Geological Survey of Ireland (GSI) is in partnership with National Parks and Wildlife Service (NPWS - now part of Department of Arts, Heritage and the Gaeltacht) for the designation of Geological Heritage Areas (GHA) as Natural Heritage Areas (NHAs). The GSI is also working in partnership with local authorities to have sites of geological interest identified by panels of experts (through the Irish Geological Heritage Programme), included in development plans and protected as County Geological Sites (CGS), as per National Heritage Plan 2002.

An audit of County Geological Sites (CGS) in Co. Fingal was completed in 2007 and the CGSs within the study area are listed in Tables 8.5 – 8.22 and are shown on Figure 8.5.

8.3.2 Site Specific Existing Environment

8.3.2.1 Pipeline Corridors

(a) Route Corridor A

The geological constraints located within Route Corridor A and discussed in this section are shown on Figure 8.4 and are summarised in Table 8.5, where their predicted impacts are also assessed. References, such as Q1, L1 etc, given to features in this and subsequent sections identify these features in Table 8.5 – 8.22 and their locations in Figure 8.5.

The southern tip of the route includes land described as a green urban area. Agricultural lands are present in southern and northern parts of the route and accounts for a large proportion of the route corridor. A small proportion of a large industrial area is encountered along the western boundary of the route. Pasture land exists within the northern section of the route corridor. A proportion of a mineral extraction site which is situated next to a concrete plant also exists within the northern region of the route. There is also an area within the northern section of the route indicated as a construction site on the Corine mapping dataset that now is the location of Dublin Airport Logistics Park which is mainly comprised of warehouses.

The soil present along the length of the route is mainly grey brown podzolics/brown earths (deep well drained mineral derived from mainly calcareous parent materials) and surfacewater/groundwater gleys (deep poorly drained mineral derived from mainly calcareous parent materials). At the north of the route corridor there is quite a large area of Made Ground. Elsewhere scattered along the route in the areas of exposed bedrock is Renzinas/Lithosols (shallow well drained mineral derived from mainly calcareous parent materials). There is also a small area of alluvium along the banks of the Tolka River which passes through the southern section of the route.

Limestone till (carboniferous) underlies the brown earths and gleys which cover the majority of the route corridor. Other subsoils present in small pockets along the route include limestone sands and gravels (carboniferous) and undifferentiated alluvium.

The bedrock in Route A consists of the Tober Colleen Formation over the majority of the route, Waulsortion limestones to the south and the Boston Hill Formation to the north. The strata present are composed of argillaceous bioclastic limestone/shale, calcareous shale & subordinate limestones , nodular muddy limestone & shale and massive unbedded lime-mudstone. Within this section there are a number of faults trending north north west – south south east and these are more dense towards the north of the route.

The majority of the route is designated as an extreme or high vulnerability area according to GSI vulnerability mapping. The extreme vulnerability is in the locations of exposed bedrock in the northern and middle region of the route. This is a primary indication that depth of overburden may be shallow in this area.

The GSI Depth to Bedrock (DTB) map shows that in the northern part of the route corridor, the DTB is mainly 1m to 3m. In the southern part of the route, the DTB is a mixture of 0 to 1m and 1 to 3m DTB.

Site investigation data from Arup in house records for projects within Route A has been reviewed.

In the northern section of the route, borehole logs show approximately 3-6 m of glacial till overlying bedrock limestone. The boreholes located in the very south of the route show clay of approximately 4 – 5 m thick overlying limestones.

Where SI data is available it generally indicates that the overburden is thicker than the vulnerability and DTB maps indicate. However, it should be noted that an even spread of data is not available across the study area.

Made Ground was recorded in some boreholes; however no contaminated material has been identified in any of the ground investigation data available.

Two quarries exist within the study area for route A. There is a closed quarry (Ref C1) to the west of the N2. The majority of it is outside the study area for Route A, however part of it extends into the northern region of the route. GSI mineral mapping indicates that mineral reserves may still exist at this location. A second quarry (Ref C2) is located in the north east of the route and this is adjacent to the concrete plant at Huntstown.

Historically there appears to have been 5 no. sand/gravel pits and 7 no. quarries (Ref Q1) located within the route. The majority are focused in the northern region of the route with a few located further south.

There is a graveyard at Abbotstown (Ref G1)at the southern end of the route corridor.

Huntstown power plant (Ref I1) and Viridian Power Ltd (Ref I2) are IPPC Licensed facilities (P0483-03 and P0777-01 respectively) located within the northern section of Route Corridor A. The proposed Kilshane Cross Recycling Centre (Ref W1) is also located within the route corridor, however, this facility has not been constructed to date (application no. W0223-01).

There are two historical unregulated landfills present within the route corridor. These include Rockmount landfill (Ref L1), which is located on the same site as the quarry discussed above (Ref C1) . Also Blanchardstown Hospital landfill (Ref L2) is located at the very southern tip of the route corridor (Fingal County Council unregulated landfill study).

A number of unregulated landfills exist close to route corridor A, including Blanchardstown (low risk), Dunsink, North Park, Meakstown (high risk) and one landfill, Dunsoghly Quarry (low risk). However, these landfills are outside the study area and will not be considered further in this report.

(b) Route Corridor B

The geological constraints located within Route Corridor B and discussed in this section are shown on Figure 8.5 and are summarised in Table 8.6.

Agricultural land is present along the length of the route and accounts for a large proportion of the study area. Agricultural land used for pasture is present in the route corridor at the extreme east and west in Dubber and Middleton and also at two small areas to the south of Dublin airport.

There are sports and leisure grounds located in the western portion of the route (golf course) and to the south east of Dublin airport (pitches).

The soil present within the route corridor is mainly grey brown podzolics/ brown earths (deep well drained mineral derived from mainly calcareous parent materials) or surfacewater/groundwater gleys (deep poorly drained mineral derived from mainly calcareous parent materials). Small areas of Renzinas/Lithosols (shallow well drained mineral derived from mainly calcareous parent materials) are present at the western end of the route corridor. Gravelly alluvium is mapped along the banks of Santry River located in the west of the route corridor.

Limestone till (carboniferous) underlies the brown earths and gleys and therefore covers the majority of the route corridor. Other subsoils present in small pockets to the western end of the route corridor include limestone sands and gravels (carboniferous) and undifferentiated alluvium.

Made ground is present along the majority of the M50 route that forms a substantial part of the southern boundary of the route corridor. This material is anthropogenic in origin and has a heterogeneous composition.

The bedrock lithologies mapped in the route corridor are the Lucan Formation, Malahide Formation, Tober Colleen Formation and the Waulsortion Limestones. These lithologies are limestones and shales of various compositions (e.g. argillaceous bioclastic limestone/shale, calcareous shale etc). There are a number of faults mapped within the route corridor, particularly towards the western end of the route corridor.

The majority of the route corridor is designated by the GSI as a low vulnerability area. As outlined in section 8.3.1.1 this indicates that the overburden may be greater than 10 m thick in this area. However, the DTB (depth to bedrock) maps indicate that rock is generally between 3 – 5 mbgl and 5 – 10 mbgl across the majority of the route corridor. There are areas of shallower bedrock mapped in the west of the route corridor and to the north of the Clonshagh land parcel.

Site investigation data from Arup in house records for projects within Route B has been reviewed.

Information available from these indicates that the overburden is approximately 10m thick in this area which correlates with the groundwater vulnerability maps.

The Fingal County Council unregulated landfill register indicates that there are three historical unregulated landfills which may be a source of contamination located within the route corridor:

- Ballymun IRS (Ref L3): a high risk landfill at Ballymun-M50 junction
- Dardistown (Ref L4): a low risk landfill located next to M50-M1 junction; and
- Belcamp Lane (Ref L5): a moderate risk landfill located to the south of the Clonshagh land parcel.

Dardistown cemetery (Ref. G2) is located within the route just to the south-east of Dublin airport and is shown on Figure 8.5 and this may also be a source of contamination.

(c) Route Corridor C

The geological constraints located in Route Corridor C and discussed in this section are shown on Figure 8.5 and are summarised in Table 8.7.

The majority of the route corridor is classified as having an agricultural or pastural land use. Land defined as being used for complex cultivation patterns is present at the south of the route corridor.

The soil present within the route corridor is mainly grey brown podzolics/ brown earths (deep well drained mineral derived from mainly calcareous parent materials) or surfacewater/groundwater gleys (deep poorly drained mineral derived from mainly calcareous parent materials). To the north of Dublin Airport the ground is predominately Made Ground. Renzinas/Lithosols (shallow well drained mineral derived from mainly calcareous parent materials) have been mapped at various locations along the route corridor. Alluvium deposits associated with the Ward and Sluice Rivers have been mapped along those rivers within the route corridor.

The majority of the route corridor is underlain by limestone till (carboniferous) superficial deposits. Limestone sands and gravels of Carboniferous age and undifferentiated alluvium (as outlined previously) are also mapped in the route corridor along the banks of the Sluice and Ward Rivers.
The Tober Colleen and Malahide Formations are the main geological formations mapped in Route Corridor C, however there is also a small area of Waulsortion limestones present to the east of Dublin airport. There are very few faults mapped within the route corridor, and these tend to trend in a northeast – southwest direction.

A large area of exposed rock is located near Forest Great towards the middle of the route corridor. This outcrop spans the majority of the width of the route corridor at this location. For the rest of the route corridor the groundwater vulnerability and DTB mapping indicates that the depth to bedrock varies from 0 to greater than 10 mbgl.

Site investigation data along a section of Route Corridor C at Fosterstown South (north of Dublin airport) has been gathered from Metro North project. The data indicates that the overburden is approximately 16m to 24m thick in this area.

There are four historical quarries located within the route corridor as shown on Figure 8.5. These historical quarries (Ref Q2) are located in the middle and to the west of the route corridor.

Feltrim Hill Quarry and Geological heritage site (Ref H1) is located close to the northern boundary of the route corridor. However, this site is located outside Route Corridor C and will be dealt with within the discussion of Route Corridor D.

Potential sources of contamination in the route corridor include burial grounds (Refs G3, G4 and G5) and a single IPPC licenced facility (Ref I3).

There is a moderate risk historical unregulated landfill located outside the perimeter of southern boundary of the route corridor. However, no reference number has been assigned to this site and it will not be discussed further as it is outside the boundary of the route corridor.

(d) Route Corridor D

The geological constraints located in Route Corridor D and discussed in this section are shown on Figure 8.5 and are summarised in Table 8.8.

The landuse classifications across route corridor D vary across the area. The various landuses include: agricultural, sports and leisure, mineral extraction, complex cultivation patterns, industrial areas close to Swords town and discontinued urban fabric.

The soil type in the south of the route corridor, which is east of Swords and south of Malahide is predominantly of grey brown podzolics/ brown earths (deep well drained mineral derived from mainly calcareous parent materials) or surfacewater/groundwater gleys (deep poorly drained mineral derived from mainly calcareous parent materials). At Feltrim Hill quarry there is also a small area of soil described as lithosols/peats.

In the vicinity of Swords, the soils of route corridor are composed of made ground, estuarine sediments (silts/clays) and a small pocket of grey brown podzolics/ brown earths.

To the west of Swords, the soil types encountered in the route corridor are Renzinas/Lithosols and alluvium. In the area of Saucerstown, alluvium and gravels are mapped which is discussed further in section 8.3.2.2(h). At the northern extent of the route corridor the soil is dominated by grey brown podzolics/ brown earths and surface water/groundwater gleys again. Made Ground has also been mapped in this area.

The drift deposits of Route Corridor D are composed mainly of limestone till (Carboniferous age) with undifferentiated alluvium mapped in the northern part of the route corridor. In the vicinity of Swords, of estuarine sediments (silts/clays), gravelly alluvium, made ground, glaciofluvial limestone sands and gravels have also been mapped.

Similar to Route Corridor C, the Tober Colleen and Malahide Formations are the main geological formations present in within this route corridor, with a small area of Waulsortion limestones also present. These are comprised mainly of argillaceous bioclastic limestone/shale. At the southern end of the route there are two areas where massive unbedded lime-mudstone is encountered. There are 3 mapped faults in the study area, two of these are minor faults trending north east – south west and there is one major fault running almost west – east which intersects the route at one location.

The southern part of the route corridor is mapped as extreme and high vulnerability and as expected, these classification coincide with bedrock outcrops. To the south of Swords the groundwater is mapped as low vulnerability indicating overburden of greater than 10 m thick. To the north of Swords the vulnerability classifications are high, moderate and low indicating that the depth of overburden is variable in this area. This variability in depth to bedrock is confirmed by the GSI DTB mapping.

Site investigation data for a section of Route D at Balheary Demense, north of Swords town, has been gathered from the Metro North project. The data indicates that the overburden is approximately 3m to 6m thick in this area. However, this data does not cover a large area of the route and as outlined above, the depth to bedrock is variable in Route Corridor D.

Feltrim Hill quarry (H1) is located on the western boundary towards the south of the route corridor as shown on Figure 8.5. This quarry extracts limestone bedrock and the site is also a designated County Geological Site due to the quality of bedrock outcrops present.

Historical maps indicate that there was a sand pit (Ref P2) and quarry (Ref Q3) located within the route corridor. The locations of these are shown on Figure 8.5.

There are no historical unregulated landfills located within the route corridor. There is a low risk historical landfill at Trotting Track, however this is outside the boundary of the route corridor and will not be discussed further.

Other potential sources of contamination within Route Corridor D are Kinsaley church graveyard (G6) and the Swords Wastewater Treatment plan (D1). As outlined in section 8.3.1.2(c) the operations at the Swords Waste Water Treatment plant will be regulated through a discharge licence and will therefore have a low potential for contamination. The locations of these are shown on Figure 8.5.

(e) Route Corridor E:

The geological constraints located in Route E and discussed in this section are shown on Figure 8.5 and are summarised in Table 8.9.

Agriculture and pasture land is the dominant landuse along the route corridor. In the middle of the route corridor, the landuse is described as discontinuous urban fabric.

The soil present along the length of the route corridor is mainly grey brown podzolics/ brown earths (deep well drained mineral derived from mainly calcareous parent materials) or surfacewater/groundwater gleys (deep poorly drained mineral derived from mainly calcareous parent materials). Alluvium and Renzinas/Lithosols (shallow well drained mineral derived from mainly calcareous parent materials) have also been mapped.

Limestone till is the dominant drift deposit underlying the majority of Route Corridor E. Alluvium deposits and limestone sand and gravels have been mapped as shown in Figure 8.1. Lake sediments comprising undifferentiated, gravel derived from lower palaeozoic sandstone and shale have also been mapped in small areas of the route corridor to the north.

The Lucan Formation is the bedrock formation mapped over the majority of the route corridor. The Rush Conglomerate Formation and Tober Colleen Formation are also mapped to the very south.

Within the route there are three mapped faults as shown on Figure 8.3. Two of the faults towards the northern end of the route corridor trend south south west - north north east. These faults run parallel to the direction of the route corridor and as a result a considerable section of the faults are within the route corridor boundary.

Almost the entire route corridor is classified as having a low groundwater vulnerability classification indicating bedrock is greater than 10 m deep. There are, however, three small regions of the route classified as high or extreme vulnerability indicating bedrock will be shallower in these areas. These areas are at the very

south of the route, just to the east of where the M1 crosses the route and as the route passes directly north of Rogerstown estuary.

The GSI Depth to Bedrock (DTB) map shows that the route consists of DTB 3 to 5m or 5 to 10m along the length of the route. DTB 3 to 5m is slightly more dominant especially in the middle section and southern section of the route. This data indicates that the bedrock may be shallower than the vulnerability mapping indicates. However, there is no site investigation data available in this area to substantiate which of these is correct.

Historical maps and current registers indicate that no mines or quarries operated in this area. There is however, a historical record of the presence of a sand pit (Ref P3) as shown on Figure 8.5. This pit is no longer present.

Sources of contamination in Route E include an unregulated historic landfill site, Corduff (Ref L6) and the 0.66km section of the Dublin-Belfast Railway line (Ref T1) which crosses the route directly north of Rogerstown estuary. The Lusk Waste water Treatment Plant (Ref D2) is also located within the study area for Route corridor D. This site will have a low potential for contamination associated with it as it operates in line within the parameters of its discharge licence (D0122-01).

(f) Route Corridor F

The geological constraints located in Route F and discussed in this section are shown on Figure 8.5 and are summarised in Table 8.10.

Agricultural and pasture land is present along the majority of Route Corridor F. Other landuses present include complex cultivation pattern land at Greatcomman to the north of the route corridor and a golf course.

The mapped soil type over the majority of the route corridor is grey brown podzolics/brown earths (deep well drained mineral derived from mainly calcareous parent materials) or surfacewater / groundwater gleys (deep poorly drained mineral derived from mainly calcareous parent materials). Alluvium deposits, Renzinas/Lithosol soils and Made Ground have also been mapped as shown in Figure 8.2.

Limestone till is the dominant drift deposit underlying the majority of Route Corridor F. Alluvium deposits, made ground and limestone sand and gravels have been mapped in the route corridor as shown in Figure 8.1.

The bedrock geology is dominated by the Lucan Formation in the north of the route corridor and the Tober Colleen Formation in the south of the route corridor. To the very north of the route corridor there are small areas of Loughshinny and Naul Formations. The Rush Conglomerate, Malahide and Waulsortian Formations are also mapped in this route corridor, predominantly in the south. There are a number of bedrock faults trending north north west – south south east in the southern part of the route corridor as shown in Figure 8.3.

The majority of the route corridor in the north is mapped as having a low groundwater vulnerability classification. In the middle and south of the route corridor, the vulnerability is classified as extreme, high and moderate. The extreme areas coincide with bedrock outcrops. This indicates that in the northern part of the

route, the bedrock is greater than 10 m deep, while in the south the bedrock depth varies.

The GSI DTB mapping generally agrees with this, showing deeper bedrock to the north of the route area and shallower bedrock to the south. However, much of the northern area has bedrock mapped at 3-5 mbgl which differs from the groundwater vulnerability classification.

There is no site investigation data available for the northern part of Route F, however there a number of boreholes with results available from GSI located within the route corridor. Boreholes present within the 1 to 3m DTB areas shows overburden thicknesses of 10m, 12m and 9m etc. This indicates that the groundwater vulnerability mapping provides a more realistic indication of depth to bedrock.

There are two wells which are classified as karstic features in the northern part of the route corridor. These are the Tyrrelstown Little Karst Bog well (Ref K1) and Harlakes Karst well (Ref K2). These wells are located to the north of Lusk as shown on Figure 8.5.

There are no operating mines or quarries in the route corridor. Historic maps indicate that there are four old gravel pits Ref (P4) and three old quarries (Ref Q4) located within the route corridor. The locations of these can be seen on Figure 8.5.

Sites where contaminated land may be encountered within the route corridor include a 0.62 km section of the Dublin – Belfast railway line (Ref T1), 3 graveyards (Refs G7, G8 and G9) and one IPPC licenced site (Ref I4). As outlined previously, the potential for contamination associated with the IPPC licenced site is likely to be low due as its activities are regulated by the EPA.

(g) Route Corridor G:

The geological constraints located in Route G and discussed in this section are shown on Figure 8.5 and are summarised in Table 8.11.

The majority of the route corridor is classified as having an agricultural or pasture landuse. An area described as discontinuous urban fabric is present where Route G meets Route B, while the southern tip of the route takes in an area described as green urban area.

The soil deposits mapped in the route corridor are predominantly grey brown podzolics/ brown earths (deep well drained mineral derived from mainly calcareous parent materials) or surfacewater / groundwater gleys (deep poorly drained mineral derived from mainly calcareous parent materials). A small amount of alluvium has also been mapped.

Limestone till is the subsoil deposit underlying the majority of the route corridor. Small areas of gravelly alluvium and made ground have also been mapped. Limestone sands and gravels have been mapped in the northern part of the route corridor.

The bedrock underlying Route Corridor G is predominantly the Malahide Formation. There are small areas where the Waulsortian Formation have been mapped at the

northern extend of the route corridor. One bedrock fault has been mapped in this area as shown on Figure 8.3

The majority of the route corridor has been classified as having a low or medium vulnerability area. There is a small section of high and extreme vulnerability to the very north as Route Corridor G meets Route Corridor D. According to GSI Depth to Bedrock (DTB) mapping, the route consists of mainly 5 to 10m DTB or 3 to 5m DTB. At the very north of Route G where the route meets Route D there is ground with DTB indicated as 1 to 3m and 0 to 1m encountered. This generally agrees with the groundwater vulnerability mapping.

There is one historical unregulated landfill located within the route corridor as shown on Figure 8.5. The Baldoyle historical unregulated landfill (Ref L7) is a high risk landfill, part of which is located in the southern extent of the route corridor. However, it should be noted that the majority of this historic landfill is located outside the route corridor boundary.

An approximate 0.53km length section of the Dublin-Belfast Railway line (Ref T1) crosses the middle section of the route corridor and this may be a source of potential contamination.

8.3.2.2 Land parcels

Nine land parcels, where the proposed WwTP may be located, have been delineated across the study area. Within each of these land parcels, a smaller site has been designated where the WwTP is likely to be located. The smaller site was arrived at by preliminary screening carried out considering all the different disciplines. The geological constraints for the sites discussed in the following sections will be broadly similar to those for the land parcels. However, where differences occur these will be highlighted.

(a) Annsbrook

The geological constraints located in the Annsbrook land parcel and associated site are discussed in this section, are shown on Figure 8.5 and are also summarised in Table 8.12.

The Annsbrook land parcel slopes gently from west to east and the topography ranges between approximately 25m to 35mOD. The Annsbrook site is located in the western portion of the land parcel as shown in figure 8.5.

The land parcel is bounded to the north and south by streams, which are tributaries of the x river and eventually discharge into the Rogerstown Estuary. The land parcel is generally used for agriculture and the western part of the site is classified as pasture land.

Grey brown podzolics/ brown earths (deep well drained mineral derived from mainly calcareous parent materials) dominate the soil deposits within the land parcel. To the north and south of the land parcel, along the stream banks, surfacewater/groundwater gleys (deep poorly drained mineral derived from mainly calcareous parent materials) and alluvium have been mapped. The superficial deposits covering the majority of the land parcel are limestone till (carboniferous). Alluvium has been mapped along the stream boundaries, these are within the land parcel but outside the site boundaries.

The bedrock lithology mapped beneath the land parcel and site is the Lucan Formation. As outlined in section 8.3.1 this lithology is composed of dark grey, well bedded, cherty, graded limestones and calcareous shales. No faults have been mapped within the land parcel boundary, however a fault has been mapped to the north of the site which may extend into the land parcel and run parallel to the eastern boundary of the site.

The groundwater vulnerability of the land parcel is classified as low indicating that the overburden is greater than 10 m thick. The GSI DTB mapping assigns overburden thicknesses of 15-20 m and 20-25 m to the land parcel. These desk based sources indicate that bedrock is deep beneath this site.

Site investigation data has been gathered from the Dublin Landfill Siting Study 2004 in which a large site in the Annsbrook area was considered for the development of a landfill site. The Annsbrook land parcel for the GDD project forms a smaller section within that area which was considered in the siting study. Negatives mentioned in the siting study including reduced overburden and possible significant bedrock faulting in the northern section, all fall outside the boundaries of the Annsbrook land parcel considered for the GDD project.

There are no other geological features shown on Figure 8.5 within the Annsbrook land parcel.

(i) *Annsbrook site*

The Annsbrook site has the same ground conditions as those described above for the land parcel.

No alluvial deposits have been mapped within the site boundaries, however due to the proximity of streams to the northern and southern site boundaries, it is likely that some soft ground in the form of silts may be encountered.

As outlined above the depth to bedrock on the site is likely to be greater than 10 mbgl.

The absence of soft ground and the depth to bedrock should be confirmed by ground investigation.

(b) **Baldurgan**

The geological constraints located in the Baldurgan land parcel and associated site are discussed in this section, are shown on Figure 8.5 and are also summarised in Table 8.13.

The topography of the majority of the land parcel is generally flat, however the land rises to the south west towards a regional topographic high, which is outside the site boundary. Within the land parcel boundary, the topography ranges between approximately 20m to 30mOD. Streams bound the northern, western and southern boundaries of the land parcel and the main landuse is agricultural.

The soil types mapped on the site include: grey brown podzolics/ brown earths in the centre, acidic surfacewater / groundwater gleys in the southwest and basic surfacewater / groundwater gleys in the north east. The quaternary deposits underlying the site are limestone till of Carboniferous age. Alluvial deposits have been mapped on the northern and southern boundaries of the land parcel.

The bedrock underlying Baldurgan land parcel is the Lucan Formation which is described as dark grey, well bedded, cherty, graded limestones and calcareous shales. There is one mapped fault passing through the southern leg of the land parcel which trends north north-west to south south-east.

The land parcel is designated a low groundwater vulnerability area over the whole land parcel. This indicates that the bedrock is greater than 10 m below ground level. The GSI DTB indicates that the bedrock is shallower by classifying the whole site as having a depth to bedrock of 5m to 10m. No site investigation data is available to confirm which is correct.

There are no other geological features of interest within the Baldurgan land parcel.

(i) *Baldurgan site*

The Baldurgan site has the same ground conditions as those described above for the land parcel, including the presence of a fault running east – west through the site.

No alluvial deposits have been mapped within the site boundaries, however due to the proximity of streams to the northern, southern and western site boundaries, it is likely that some soft ground in the form of silts may be encountered.

As outlined above the depth to bedrock on the site is likely to be greater than 10 mbgl.

The absence of soft ground and the depth to bedrock should be confirmed by ground investigation.

(c) Clonshagh

The geological constraints located in the Clonshagh land parcel and associated site are discussed in this section, are shown on Figure 8.5 and are also summarised in Table 8.14.

The topography of the land parcel is generally flat and slopes from west to east, with a topographic range between approximately 40m to 50 mOD. The Mayne River is parallel to the northern boundary of the land parcel boundary. The land within the land parcel is used for agriculture. .

The soils present on the land parcel are grey brown podzolics/ brown earths to the south and surfacewater/groundwater gleys to the north. Limestone till deposits of Carboniferous age underlie the soils over the majority of the site however, gravels derived from limestone have been mapped in the north western corner. No alluvium deposits have been mapped within the land parcel boundaries however due to the presence of a river to the north, alluvium may be encountered here.

The Tober Colleen Formation is the bedrock lithology which underlies the majority of the site. The Lucan Formation, a dark grey, well bedded, cherty, graded limestone and calcareous shale has been mapped at the western extent of the land parcel.

The majority of the land parcel has been classified as having a low groundwater vulnerability indicating that bedrock is generally greater than 10 m deep. To the very east of the land parcel, the groundwater vulnerability classification is medium

indicating that the overburden may be thinner in this area. The GSI DTB mapping indicates the bedrock is 5-10 m deep across the whole site which is shallower than the groundwater vulnerability mapping. There is no site investigation data available to confirm which of these data sources is correct.

There are two historic unregulated landfills located close to the land parcel:

- Belcamp Lane landfill (Ref L5) is located approximately 150m outside the South-West boundary of the land parcel. This landfill has been assigned a moderate risk.
- Doolaghs Quarry Landfill (Ref L9) is located approximately 430m from the western boundary of the land parcel. This landfill has been classified as having a low risk.

(i) *Clonshagh site*

The Clonshagh site has the same ground conditions as those described above for the land parcel.

No alluvial deposits have been mapped within the site boundaries, however due to the proximity of streams to the northern site boundary, it is likely that some soft ground in the form of silts may be encountered.

As outlined above the depth to bedrock on the site is likely to be greater than 10 mbgl.

The absence of soft ground and the depth to bedrock should be confirmed by ground investigation.

Belcamp Lane Landfill (Ref L5) is approximately 400 m from the site boundary and Doolaghs Quarry Landfill (Ref L9) is approximately 850 m from the site boundary. This illustrates that these features are further from the site boundary, than from the land parcel boundaries discussed above.

(d) **Cookstown**

The geological constraints located in the Cookstown land parcel and associated site are discussed in this section, are shown on Figure 8.5 and are also summarised in Table 8.15.

The topography of the site is generally flat and slopes gently from west to east with a topographic range of approximately 30 – 20 mOD. A stream bounds the northern boundary of the land parcel and flows from west to east following the topography. The land use of the site is agricultural with some pasture land along the western boundary.

The soil types mapped on the site include: grey brown podzolics/ brown earths in the centre, acidic surfacewater / groundwater gleys in the northwest and basic surfacewater / groundwater gleys in the south east. The quaternary deposits underlying the site are limestone till of Carboniferous age. No alluvium deposits have been mapped within the land parcel boundaries however due to the presence of a river to the north, alluvium may be encountered here.

The Lucan Formation, a dark grey, well bedded, cherty, graded limestone and calcareous shale has been mapped as the bedrock lithology underlying the whole land parcel. There are no bedrock faults mapped within the land parcel.

The land parcel has been classified as having a low groundwater vulnerability indicating that bedrock is generally greater than 10 m deep. The GSI DTB mapping indicates the bedrock is 5-10 m deep across the majority of the site, with small areas of bedrock depth of 3 -5m. This mapping indicates rock is shallower than the groundwater vulnerability mapping does. There is no site investigation data available to confirm which of these data sources is correct.

There is a historic sand and gravel pit (Ref P4) located approximately 330m outside the boundary to the South-West of the land parcel.

(i) *Cookstown site*

The Cookstown site has the same ground conditions as those described above for the land parcel.

No alluvial deposits have been mapped within the site boundaries, however due to the proximity of streams to the northern site boundary, it is likely that some soft ground in the form of silts may be encountered.

As outlined above the depth to bedrock on the site is likely to be greater than 10 m deep over the majority of the site.

The absence of soft ground and the depth to bedrock should be confirmed by ground investigation.

The historic sand and gravel pit (Ref P4) located approximately 650 m outside the boundary to the South-West of the site.

(e) Cloghran

The geological constraints located in the Cloghran land parcel and associated site are discussed in this section, are shown on Figure 8.5 and are also summarised in Table 8.16.

The topography of the site is generally flat and slopes gently from west to east with a topographic range of approximately 40 – 30 mOD. The northern boundary of the land parcel is parallel to the Sluice River and the M1 motorway is parallel to the western boundary. The whole land parcel has been classified as having a land use of pasture land.

A variety of soil types have been mapped on the Cloghran land parcel as shown on Figure 8.1. These include: grey brown podzolics/ brown earths, basic surfacewater/groundwater gleys and renzinas/lithosols. Limestone till underlies the soil over the majority of the land parcel, however gravels derived from limestones are present to the north of the site near the Sluice River. Alluvium deposits have also been mapped adjacent to the Sluice River, however these are outside the land parcel boundaries. While, no alluvium deposits have been mapped within the land parcel boundaries, alluvium and soft ground may be encountered here.

The Tober Colleen Formation, a calcareous shale and limestone underlies the whole site. No bedrock faults have been mapped within the land parcel boundary.

The majority of the site has a low groundwater vulnerability classification indicating bedrock is greater than 10 m deep. The northern part of the land parcel has been classified as having a high vulnerability near the Sluice River. This is an indicator that the bedrock is shallower, however it is likely to be due to the presence of higher permeability gravels in this area. The GSI DTB mapping indicates that bedrock is 5 – 10 m deep over the majority of the site. This is slightly shallower than indicated by the groundwater vulnerability mapping, however there is no site investigation data available to confirm which is correct.

Feltrim Hill Quarry (Ref H1) which is a County Geological Site and active quarry is located approximately 550 m from the boundary of the Cloghran land parcel and site.

(i) *Cloghran site*

The Cloghran site has the same ground conditions as those described above for the land parcel.

No alluvial deposits have been mapped within the site boundaries, however due to the proximity of streams to the northern site boundary, it is likely that some soft ground in the form of silts may be encountered.

As outlined above the depth to bedrock on the site is likely to be greater than 10 m deep over the majority of the site. However, in the north of the site, the bedrock may be shallower and the depth to bedrock mapping indicates bedrock may be 5 -10 m deep.

The absence of soft ground and the depth to bedrock should be confirmed by ground investigation.

Feltrim Hill Quarry (Ref H1) which is a County Geological Site and active quarry is located approximately 550 m from the boundary of the Cloghran and site.

(f) **Newtowncorduff**

The geological constraints located in the Newtowncorduff land parcel and associated site are discussed in this section, are shown on Figure 8.5 and are also summarised in Table 8.17.

The southern boundary of the land parcel is a confluence point of two streams the topography of the site reflects this. The site is generally flat with a gentle slope to the south and a topographic range of 15 -25 mOD. The land parcel land use is classified as agricultural with the southern section specifically designated as pasture land.

The soils within the land parcel are mapped as grey brown podzolics/ brown earths in the centre and surfacewater / groundwater gleys around the eastern, southern and western boundaries. Limestone tills whose matrix has its origins from the Irish Sea Basin underlie the soils of the site. Alluvium deposits are mapped adjacent to the streams but these are outside the land parcel boundaries. While, no alluvium deposits have been mapped within the land parcel boundaries, alluvium and soft ground may be encountered here.

The Lucan Formation, a dark grey, well bedded, cherty, graded limestone and calcareous shale is mapped as the bedrock beneath the land parcel. There are no bedrock faults mapped within the land parcel however, a series of faults trending in a north east – south west direction parallel to the south of the land parcel boundary have been mapped and another fault related to these may be encountered beneath the land parcel.

The majority of the site has a low groundwater vulnerability classification indicating bedrock is greater than 10 m deep. The southern part of the land parcel has been classified as having a high and moderate vulnerability near the streams. This is an indicator that the bedrock is shallower, however it is likely to be due to the presence of higher permeability gravels in this area. The GSI DTB mapping indicates that bedrock is 5 – 10 m deep over the majority of the land parcel with some areas of 3-5 m mapped in the south. This is slightly shallower than indicated by the groundwater vulnerability mapping, however there is no site investigation data available to confirm which is correct.

There are no other geological features of interest within the Newtowncorduff land parcel.

(i) *Newtowncorduff site*

The Newtowncorduff site has the same ground conditions as those described above for the land parcel.

No alluvial deposits have been mapped within the site boundaries, however due to the proximity of streams to the southwestern and south eastern site boundary, it is likely that some soft ground in the form of silts may be encountered.

As outlined above the depth to bedrock on the site is likely to be greater than 10 m deep across the site.

The absence of soft ground and the depth to bedrock should be confirmed by ground investigation.

(g) **Rathartan**

The geological constraints located in the Rathartan land parcel and associated site are discussed in this section, are shown on Figure 8.5 and are also summarised in Table 8.18.

A stream flows parallel to the western boundary of the land parcel and a second stream runs parallel to the eastern boundary of the land parcel. The topography of the site is a reflection of this with the ground sloping gently towards both streams. The topographic range on the site is 15 -25 mOD. The land use on the site is classified as agricultural.
The soils within the land parcel are mapped as grey brown podzolics/ brown earths to the east and surfacewater / groundwater gleys to the west. Irish Sea till underlies the soils over the majority of the land parcel. Alluvium deposits are mapped adjacent to the streams, these are within the land parcel boundaries but these are outside the site boundaries.

The Lucan Formation, a dark grey, well bedded, cherty, graded limestone and calcareous shale underlie the majority of the site. The Rush Conglomerate

Formation, which is described as graded quartz- and limestone-pebble conglomerates and lithic sandstones, interbedded with laminated shale and thin limestones is mapped in the east of the land parcel. There is a mapped fault trending south south west - north north east through the South-East corner of the land parcel.

The groundwater vulnerability has been classified as low across the whole land parcel indicating bedrock is greater than 10 m deep. The GSI DTB mapping shows the majority of the land parcel to have an overburden thickness of 5 – 10 m with a small area on the western boundary of 3 – 5 m. No site investigation data is available for the land parcel, however GSI boreholes close to the show the depth to bedrock to be up to 35 mbgl.

Information has been gathered from the Fingal Alternative Landfill Study 1998 in which a large site in the Rathartan area was considered for the development of a landfill site. The Rathartan land parcel forms a smaller section within the overall area considered in the landfill study During this study the overburden was recorded as being in excess of 10 m thick of boulder clay according to the study with agrees with the results of the groundwater vulnerability classification above that bedrock on the site is relatively deep.

The main Dublin-Belfast railway line (Ref T1) runs close to the western boundary of the land parcel and this may be a potential source of contamination.

(i) *Rathartan site*

The Rathartan site has the same ground conditions as those described above for the land parcel.

No alluvial deposits have been mapped within the site boundaries, however due to the proximity of streams to the southwestern site boundary, it is likely that some soft ground in the form of silts may be encountered.

As outlined above the depth to bedrock on the site is likely to be greater than 10 m deep across the site.

The presence of soft ground and the depth to bedrock should be confirmed by ground investigation.

(h) **Saucerstown**

The geological constraints located in the Saucerstown land parcel and associated site are discussed in this section, are shown on Figure 8.5 and are also summarised in Table 8.19.

The topography of the land parcel is dominated by the presence of the Broad Meadow River along the northern boundary of the land parcel. The land slopes gently to the north towards the river and the topographic range between approximately 15 -25 mOD. Tributaries of the Broad Meadow River run through the site and the land parcel. The landuse classification for the site is agricultural.

Soils mapped on the land parcel include: renzinas/lithosols, of grey brown podzolics/ brown earths and surfacewater/groundwater gleys. The northern half of the land parcel is dominated by alluvial deposits associated with the Broad Meadow River. In the centre of the site the Quaternary deposits are composed of limestone gravels while in the south of the land parcel they are limestone tills.

The bedrock in the northern half of the land parcel has been mapped as the Tober Colleen Formation while the southern half of the site has been mapped as the Malahide Formation. There are no bedrock faults mapped in the area of the land parcel.

The majority of the land parcel has been classified has having a medium or high vulnerability. This is likely to be due to the permeability of the alluvium deposits in the land parcel area and as such doesn't give an indication as to the thickness of the overburden.

The GSI DTB mapping indicates that the bedrock is approximately 5 – 10 m deep over the majority of the site, however in the north east and south west corners of the land parcel there are areas where the bedrock is only 3 – 5 m deep.

There are no other geological features of interest within the Saucerstown land parcel.

(i) Saucerstown site

The Saucerstown site has the same ground conditions as those described above for the land parcel.

Alluvial deposits have been mapped in the northeastern portion of the site. Soft materials such as silts may be encountered in this area.

As outlined above the depth to bedrock is likely to vary on the site and may be shallow in some areas in the centre of the site.

The absence of soft ground and the depth to bedrock should be confirmed by ground investigation.

(i) Tyrrelstown Little

The geological constraints located in the Tyrrelstown Little land parcel and associated site are discussed in this section, are shown on Figure 8.5 and are also summarised in Table 8.20.

The land parcel is generally flat but slopes gently to the south east with a topographic range between approximately 40 – 30 mOD. The land use of the land parcel has been classified as agricultural.

The soils on the site have been mapped as grey brown podzolics/ brown earths and surfacewater/groundwater gleys. The Quaternary material underlying the site has been mapped as sandstone and shale till of a Lower Palaeozoic age with a matrix of Irish Sea Basin origin.

The Lucan Formation underlies the site and the southern part of the land parcel. The Naul Formation and the Loughshinny Formation underlie the northern part of the land parcel, however these are outside of the site boundary. There are a series of parallel faults trending to north – south to the north of the land parcel and these may extend into the land parcel.

The groundwater vulnerability has been classified as low across the whole land parcel indicating bedrock is greater than 10 m deep. The GSI DTB mapping shows the majority of the land parcel to have an overburden thickness of 3 – 5 m with a

small areas of 1 – 3 m and 5 – 10 m. These depths are shallower than those inferred from the groundwater vulnerability mapping.

Information has been gathered from the Fingal Alternative Landfill Study 1998 in which a large site in the Tyrrelstown area was considered for the development of a landfill site. The Tyrrelstown Little land parcel forms a smaller section within the overall area considered in the landfill study. The overburden was recorded as being in excess of 10m thick of boulder clay in this study and this is in line with the information inferred from the groundwater vulnerability mapping.

The main Dublin-Belfast railway line (Ref T1) runs close to the western boundary of the land parcel and this may be a potential source of contamination.

Harlakes Well (Ref K1) karst feature is located 650 m to the west of the land parcel boundary.

(i) *Tyrrelstown Little site*

The Tyrrelstown Little site has the same ground conditions as those described above for the land parcel.

No alluvial deposits have been mapped on the site, as such the potential for soft materials such as silts is unlikely to be encountered in this area.

As outlined above the depth to bedrock on the site is likely to be greater than 10 m deep across the site.

The absence of soft ground and the depth to bedrock should be confirmed by ground investigation.

8.3.2.3 Marine outfalls

(a) Northern Outfall

The geological constraints located in the Northern Outfall are discussed in this section, are shown on Figure 8.5 and are also summarised in Table 8.21.

The landuse within the Northern Outfall is, based on Corine mapping datasets. The middle section of the headland located within the outfall area has a large area of complex cultivation pattern land. Towards the north there is pasture ground and agricultural land. The southern part of the headland is mainly described as discontinuous urban fabric with a small area described as a construction site. It appears that a housing estate has been built here.

The main soil types in the Northern Outfall are well drained acid brown earths podzolics and surfacewater/groundwater gleys. Made ground has been mapped in the area of Rush town, undifferentiated aeolin deposits at the estuary entrance and beach deposits along the coast. The Quaternary material underlying the majority of the Northern Outfall has been mapped as sandstone and shale till of a Lower Palaeozoic age with a matrix of Irish Sea Basin origin underlie the majority of the Northern Outfall, however alluvial deposits are mapped along the rivers.

A number of bedrock lithologies have been mapped in the Northern Outfall. From north to south these are: the Holmpatrick Formation, the Smugglers Cave Formation, the Mudbank Limestone, the Lane Formation, the Loughshinny

Formation, the Naul Formation, the Lucan Formation, the Rush Conglomerate Formation and the Tober Colleen Formation. Several parallel faults trending almost east to west have been mapped in the centre of the Northern Outfall.

The groundwater vulnerability has been classified as low across the majority of the headland indicating that bedrock is greater than 10 m deep. The vulnerability along the coast varies between medium, high and extreme. The DTB mapping shows the bedrock is 1-3 m deep in the northern part of the Northern Outfall and 3-5 m deep in the southern part.

Based on Admiralty charts, along the coast the depth to sea bed drops quite sharply to 10m below sea level. There is a strip of high rock in the South-East of the outfall area known as Frazar Bank which comes out from Lambay island. Elsewhere the depth to sea bed ranges from 10m to 22m below sea level along the eastern boundary. No Infomar surveys have been carried out in the Northern Outfall.

Site investigation data in the area of the Northern Marine Outfall area has been gathered at Loughshinny from a previous Arup project carried out at this location. The data at Loughshinny shows possible made ground over clay and gravel underneath) to depth of 9 -12m to rock.

Within the Northern Outfall there are two Geological Heritage Areas (GHAs) or County Geological Sites (CGSs):

- Skerries to Rush Coastline (Ref H2) which extends along the coast
- Portaine Shore (Ref H3) located in the SW of Northern Outfall at the coastal cliffs and foreshore

Other GHAs present in the wider area are the Curkeen Hill Quarry, Shenicks Island and Lambay Island. However, these are outside the study area and as such will not be discussed further in this assessment.

There are three karst features within the Northern Outfall study area. These are St Catherine's well (Ref K3) and the Tobar Caillin well (Ref K4) and an area where karstified limestone is exposed at the surface (Ref K5) as shown on Figure 8.5. Portraine caves are also a karst feature, however these are located outside the Northern Outfall boundary and will not be dealt with further in this assessment.

There are a number of historical mines located within the outfall area:

- there are three copper mines (Ref M1) located close to one another just north of Loughshinny beach.
- in the north west of the Northern Outfall there is a dolomite mine (Ref M2).
- A jasper mine is located at the south west of the Northern Outfall area (Ref M3).

Potential sources of contamination in the Northern Outfall include:

- Rush Graveyard (Ref G10) which is in the north west of the Northern Outfall
- Brooks End historical unregulated landfill (Ref L8) which is located north of Rush

(b) Southern Outfall

The geological constraints located in the Southern Outfall are discussed in this section, are shown on Figure 8.5 and are also summarised in Table 8.22.

The landuse of Southern Outfall is mainly occupied by Portmarnock golf club as well as estuary and sea areas. There is a beach used for bathing located on Velvet Strand on the east of the peninsula.

The soils of the Southern Outfall are undifferentiated aeolin sediments and beach sands and gravels. These are underlain by of blown sand dunes and beach sands. The bedrock underlying the area is the Malahide Formation and a single fault has been mapped trending north east – south west in the Southern Outfall.

The southern outfall has been classified as having a high groundwater vulnerability area. This is likely to be a function of the permeability and as such does not provide an indication of the depth to bedrock. The GSI DTB mapping indicates that the bedrock is 3-5 m and 5-10 m thick. No site investigation data is available in this area.

There is a high risk unregulated historic landfill at Baldoyle (Ref L7) close to where Route G joins the outfall area.

The Admiralty maps indicate that along the coast the depth to sea bed drops less sharply to 10m below sea level then seen previously for the Northern Outfall area. Over half of the area is less than 10m below sea level. The remainder the narrow section ranges from 14m below sea level to 22m below sea level.

8.4 Predicted Impacts

The predicted impacts should the proposed scheme be constructed are outlined below. These impacts are discussed with regards to the impacts of main feature of the development on the soils and geology underlying and surrounding the scheme. These impacts may also relate to and interact with other disciplines within this ASA report where geotechnical and geological information has been provided to assist in impacts assessments. These are outlined below:

- Construction
- Noise
- Air quality
- Water (hydrology & hydrogeology)
- Ecology

8.4.1.1 Impact Assessment

The impact assessment methodology allows for the level of impact to be assigned based on the scale and duration of the impacts. At route selection stage it is acceptable for the impact assessment for both the construction and operational

impacts to be rated together to avoid confusion and the selection of the wrong route or site based on skewing of the results.

An example of this would be the presence of a high risk unregulated landfill along a route. During the construction stage this would be highlighted as a Significant or Profound Negative impact as a large volume of contaminated material may be encountered and have to be remediated or excavated but during the operational phase this would be rated as a positive impact as the site would have been remediated. However, during route selection stage, this profound impact should be avoided where possible.

As outlined in section 8.2.4 the level of impact is dependent upon the importance of the feature and the scale and duration of the impact on the feature.

Section 8.5 compiles these impacts into an evaluation matrix to allow land parcels to be compared to each other and to identify the routes and land parcels which will cause the least environmental impacts

8.4.1.2 Pipeline Routes

The constraints which may be encountered along each potential pipeline route have been outlined in section 8.3.2.1 and are summarised below. The assessment below indicates the potential level of impact which may occur to individual constraints if the pipe line were constructed along that route.

(a) Route A

Table 8.5 Predicted Impacts along Route A

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
A1	Agricultural Land (50% of Route)	High	Removal of fertile soil along route of pipeline over large proportion of the route. Possible impacts to the quality, drainage characteristics and uses of important agricultural land. No impact during operational phase	Temporary impact on significant proportion of attribute	Slight Negative
R1	Shallow Bedrock (95% of Route)	High	Rock may have to be excavated (e.g. through blasting) which will impact noise and dust generation.	Temporary impact on significant proportion of attribute	Slight Negative
S1	Alluvium Deposits (1% of Route)	Low	Alluvial deposits which may include soft silts mapped within the site. This indicates the potential for soft material to be removed	Temporary impact on small proportion of attribute	Imperceptible
Q1	Hist. Quarry (7)	Medium	Historical quarries may have been backfilled with contaminated material. This material may have to be excavated and disposed of appropriately	Permanent impact on significant proportion of attribute	Moderate Negative
P1	Hist. Sand & Gravel Pits (5)	Medium	Historical quarries may have been backfilled with contaminated material. This material may have to be	Permanent impact on significant proportion of	Moderate Negative

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
			excavated and disposed of appropriately	attribute	
G1	Abbotstown Graveyard	Medium	Study area passes through graveyard. Would require excavation of contaminated material (decomposed matter)	Permanent impact on significant proportion of attribute	Moderate Negative
I1	Huntstown Power Plant (IPPC Licence no P0483-03)	Low	IPPC licenced premises. Contaminated hotspots may be encountered and a small amount of material may have to be excavated. Potential for contamination is low as the site activities are regulated by the EPA.	Permanent impact on small proportion of attribute	Slight Negative
I2	Viridian Power Ltd. (IPPC Licence no: P0777-01)	Low	IPPC licenced premises. Contaminated hotspots may be encountered and a small amount of material may have to be excavated. Potential for contamination is low as the site activities are regulated by the EPA.	Permanent impact on small proportion of attribute	Slight Negative
W1	Proposed Kilshane Cross Recycling Centre (Waste licence application no W0223-01)	NA	This site has not been constructed to date	NA	NA
L1	Historical unregulated landfill.Rockmount Landfill (Low)	Low	Location of low risk historical unregulated landfill area at quarry thus threat of contaminated land. Contaminated material present within unregulated landfill, certain amount of material may have to be excavated.	Permanent impact on significant proportion of attribute	Slight Negative
L2	Historical unregulated landfill. Blanchardstown Hospital (Low)	Low	Location of low risk historical unregulated landfill area at quarry thus threat of contaminated land. Contaminated material present within unregulated landfill, certain amount of material may have to be excavated.	Permanent impact on small proportion of attribute	Imperceptible
C1	Huntstown Quarry	Very High	Large existing active quarry. Sterilisation of small proportion of future reserves at a large quarry site	Permanent impact on small proportion of attribute	Significant Negative
C2	Rockmount Quarry	High	Inactive quarry but possible location of mineral reserves due to previous extraction. Sterilisation of small proportion of future reserves at a quarry site	Permanent impact on significant proportion of attribute	Significant Negative

(b) Route B

Table 8.6 Predicted Impacts along Route B

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
A2	Agricultural Land (50%)	High	Removal of fertile soil along route of pipeline over large proportion of the route. Possible impacts to the quality, drainage characteristics and uses of important agricultural land	Temporary impact on significant proportion of attribute	Slight Negative
R2	Shallow Bedrock (5% of Route)	Low	Rock may have to be excavated (e.g. through blasting) which will impact noise and dust generation.	Temporary impact on small proportion of attribute	Imperceptible
S2	Alluvium Deposits (1% of Route)	Low	Alluvial deposits which may include soft silts mapped within the site. This indicates the potential for soft material to be removed	Temporary impact on small proportion of attribute	Imperceptible
L3	Historical unregulated landfill.. Ballymun IRS Site (High)	High	Location of high risk historical unregulated landfill area at quarry thus threat of contaminated land. Contaminated material present within unregulated landfill, certain amount of material may have to be excavated.	Permanent impact on significant proportion of attribute	Significant Negative
L4	Historical unregulated landfill. Dardistown (Low)	Low	Location of low risk historical unregulated landfill area at quarry thus threat of contaminated land. Contaminated material present within unregulated landfill, certain amount of material may have to be excavated.	Permanent impact on significant proportion of attribute	Slight Negative
L5	Historical unregulated landfill. Belcamp Lane (Moderate)	Medium	Location of moderate risk historical unregulated landfill area at quarry thus threat of contaminated land. Contaminated material present within unregulated landfill, certain amount of material may have to be excavated.	Permanent impact on small proportion of attribute	Slight Negative
G2	Dardistown Cemetery	Medium	Study area passes through graveyard. Would require excavation of contaminated material (decomposed matter)	Permanent impact on significant proportion of attribute	Moderate Negative

(c) Route C

Table 8.7 Predicted Impacts along Route C

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
A3	Agricultural Land (60%)	High	Removal of fertile soil along route of pipeline over large proportion of the route. Possible impacts to the quality, drainage characteristics and uses of important agricultural land	Temporary impact on significant proportion of attribute	Slight Negative
R3	Shallow Bedrock (65% of Route)	High	Rock may have to be excavated (e.g. through blasting) which will impact noise and dust generation.	Temporary impact on significant proportion of attribute	Slight Negative
S3	Alluvium Deposits (4% of Route)	Low	Alluvial deposits which may include soft silts mapped within the site. This indicates the potential for soft material to be removed	Temporary impact on small proportion of attribute	Imperceptible
Q2	Hist. Quarry (4)	Medium	Historical quarries may have been backfilled with contaminated material. This material may have to be excavated and disposed of appropriately	Permanent impact on significant proportion of attribute	Moderate Negative
G3	Westereave Burial Ground	Low	Study area passes through historic burial ground. May be some historical contamination remaining which would require excavation.	Permanent impact on significant proportion of attribute	Slight Negative
G4	Forest Great Burial Ground	Low	Study area passes through historic burial ground. May be some historical contamination remaining which would require excavation.	Permanent impact on significant proportion of attribute	Slight Negative
G5	Killeek Graveyard	Medium	Study area passes through graveyard. Would require excavation of contaminated material (decomposed matter)	Permanent impact on significant proportion of attribute	Moderate Negative
I3	Anglo Irish Beef Processors (IPPC Licensed)	Low	IPPC licenced premises. Contaminated hotspots may be encountered and a small amount of material may have to be excavated. Potential for contamination is low as the site activities are regulated by the EPA.	Permanent impact on small proportion of attribute	Slight Negative

(d) Route D

Table 8.8 Predicted Impacts along Route D

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
A4	Agricultural Land (60%)	High	Removal of fertile soil along route of pipeline over large proportion of the route. Possible impacts to the quality, drainage characteristics and uses of important agricultural land	Temporary impact on significant proportion of attribute	Slight Negative
R4	Shallow Bedrock (45% of Route)	High	Rock may have to be excavated (e.g. through blasting) which will impact noise and dust generation.	Temporary impact on significant proportion of attribute	Slight Negative
S4	Alluvium Deposits (10% of Route)	Low	Alluvial deposits which may include soft silts mapped within the site. This indicates the potential for soft material to be removed	Temporary impact on small proportion of attribute	Imperceptible
B1	Small area of Lithosols/Peats (Basic) at Feltrim Hill	Low	Peat mapped within the site. This indicates the potential for soft material to be removed	Temporary impact on small proportion of attribute	Imperceptible
H1	Feltrim Hill Quarry CGS & Active Quarry	Very High	Active Quarry. Sterilisation of small proportion of future reserves at a large quarry site Partial loss of GHA	Permanent impact on small proportion of attribute	Significant Negative
Q3	Hist. Quarry (1)	Medium	Historical quarries may have been backfilled with contaminated material. This material may have to be excavated and disposed of appropriately	Permanent impact on small proportion of attribute	Slight Negative
P2	Hist. Sand & Gravel Pits (1)	Low	Historical sand and gravel pits may have been backfilled with contaminated material. This material may have to be excavated and disposed of appropriately	Permanent impact on significant proportion of attribute	Slight Negative
G6	Kinsaley Graveyard	Low	Study area passes through historic burial ground. May be some historical contamination remaining which would require excavation.	Permanent impact on significant proportion of attribute	Slight Negative
D1	Swords Wastewater Treatment Plant (Waste water discharge licence application no D0024-01)	Low	An application for a wastewater discharge licence has been made to the EPA for this site		

(e) Route E:

Table 8.9 Predicted Impacts along Route E

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
A5	Agricultural Land (80%)	High	Removal of fertile soil along route of pipeline over large proportion of the route. Possible impacts to the quality, drainage characteristics and uses of important agricultural land	Temporary impact on significant proportion of attribute	Slight Negative
R5	Shallow Bedrock (10% of Route)	Low	Rock may have to be excavated (e.g. through blasting) which will impact noise and dust generation.	Temporary impact on small proportion of attribute	Imperceptible
S5	Alluvium Deposits (10% of Route)	Low	Alluvial deposits which may include soft silts mapped within the site. This indicates the potential for soft material to be removed	Temporary impact on small proportion of attribute	Imperceptible
T1	Train Railway Line (Length 0.66km)	Medium	Possible contamination due to presence of major railway line. In the event of contaminated land present, certain amount of material may have to be excavated.	Permanent impact on significant proportion of attribute	Moderate Negative
P3	Hist. Sand & Gravel Pits (1)	Low	Historical sand and gravel pits may have been backfilled with contaminated material. This material may have to be excavated and disposed of appropriately	Permanent impact on significant proportion of attribute	Slight Negative
L6	Historical unregulated landfill Corduff Landfill (Risk not identified	Medium	In the event of contaminated material present within unregulated landfill, certain amount of material may have to be excavated.	Permanent impact on significant proportion of attribute	Moderate Negative
D2	Lusk Waste water Treatment Plant (waste water discharge licence no D0122-01)	Low	This site is regulated by a waste water discharge licence and operates within that		

(f) Route F:

Table 8.10 Predicted Impacts along Route F

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
A6	Agricultural Land (80%)	High	Removal of fertile soil along route of pipeline over large proportion of the route. Possible impacts to the quality, drainage characteristics and uses of important agricultural land	Temporary impact on significant proportion of attribute	Slight Negative

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
R6	Shallow Bedrock (25% of Route)	Medium	Rock may have to be excavated (e.g. through blasting) which will impact noise and dust generation.	Temporary impact on significant proportion of attribute	Imperceptible
S6	Alluvium Deposits (5% of Route)	Low	Alluvial deposits which may include soft silts mapped within the site. This indicates the potential for soft material to be removed	Temporary impact on small proportion of attribute	Imperceptible
T1	Train Railway Line (Length 0.62km)	Medium	Possible contamination due to presence of major railway line. In the event of contaminated land present, certain amount of material may have to be excavated	Permanent impact on significant proportion of attribute	Moderate Negative
P4	Hist. Sand & Gravel Pits (4)	Medium	Historical sand and gravel pit may have been backfilled with contaminated material. This material may have to be excavated and disposed of appropriately	Permanent impact on significant proportion of attribute	Moderate Negative
Q4	Hist. Quarry (3)	Medium	Historical quarries may have been backfilled with contaminated material. This material may have to be excavated and disposed of appropriately	Permanent impact on significant proportion of attribute	Moderate Negative
G7	Historic Graveyard (1)	Low	Study area passes through historic graveyard. The level of contamination encountered is based on when the graveyard closed as the contamination reduces over time	Permanent impact on significant proportion of attribute	Slight Negative
G8	Common Graveyard	Low	Study area passes through historic burial ground. May be some historical contamination remaining which would require excavation.	Permanent impact on significant proportion of attribute	Slight Negative
G9	ChapelmidwayGraveyard	Medium	Study area passes through graveyard. Would require excavation of contaminated material	Permanent impact on significant proportion of attribute	Moderate Negative

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
			(decomposed matter)		
K1	Tyrrelstown Little Karst Bog Well	High	Karst feature may be destroyed during construction	Permanent impact on significant proportion of attribute	Significant Negative
K2	Harlakes Karst Well	High	Karst feature may be destroyed during construction	Permanent impact on significant proportion of attribute	Significant Negative
I4	Kelly Timber Frame Ltd. (IPPC Licensed)	Low	IPPC licenced premises. Contaminated hotspots may be encountered and a small amount of material may have to be excavated.	Permanent impact on small proportion of attribute	Slight Negative

(g) Route G:

Table 8.11 Predicted Impacts along Route G

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
A7	Agricultural Land (70%)	High	Removal of fertile soil along route of pipeline over large proportion of the route. Possible impacts to the quality, drainage characteristics and uses of important agricultural land	Temporary impact on significant proportion of attribute	Slight Negative
R7	Shallow Bedrock (5% of Route)	Low	Rock may have to be excavated (e.g. through blasting) which will impact noise and dust generation.	Temporary impact on small proportion of attribute	Imperceptible
S7	Alluvium Deposits (10% of Route)	Low	Alluvial deposits which may include soft silts mapped within the site. This indicates the potential for soft material to be removed	Temporary impact on small proportion of attribute	Imperceptible
T1	Train Railway Line (Length 0.53km)	Medium	Possible contamination due to presence of major railway line. In the event of contaminated land present, certain amount of material may have to be excavated	Permanent impact on significant proportion of attribute	Moderate Negative
L7	Historical unregulated landfill Baldoyle Landfill (High)	High	Location of high risk historical unregulated landfill area at quarry thus threat of contaminated land. Contaminated material present within unregulated landfill, certain amount of material may have to be excavated.	Permanent impact on significant proportion of attribute	Significant Negative

8.4.1.3 Land parcels:

The constraints which may be encountered in each land parcel have been outlined in section 8.3.2.2 and are summarised below. The assessment below indicates the potential level of impact which may occur to individual constraints if the WwTP were constructed on that site.

(a) Annsbrook

Table 8.12 Predicted Impacts at Annsbrook

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
A9	Agricultural Land (100%)	High	Removal of fertile soil on small site.	Permanent impact on significant proportion of attribute	Significant Negative
S10	Alluvium Deposits (1% of site)	Low	Alluvial deposits which may include soft silts mapped within the site. This indicates the potential for soft material to be removed	Permanent impact on significant proportion of attribute	Slight Negative

(b) Baldurgan

Table 8.13 Predicted Impacts at Baldurgan

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
A10	Agricultural Land (100%)	High	Removal of fertile soil on small site.	Permanent impact on significant proportion of attribute	Significant Negative

(c) Clonshagh

Table 8.14 Predicted Impacts at Clonshagh

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
A11	Agricultural Land (100%)	High	Removal of fertile soil on small site.	Permanent impact on significant proportion of attribute	Significant Negative
L5	Hist. Belcamp Lane Landfill (Moderate)	Low	Moderate risk historical unregulated landfill area located 150m from site. Implies potential for contaminated land. If any contaminated material is present on the it will have to be excavated	Permanent impact on small proportion of attribute	Imperceptible
L9	Hist. Doolaghs Quarry Landfill (Low)	Low	Low risk historical unregulated landfill area located 400m from site. Implies potential for threat of	Permanent impact on small proportion of	Imperceptible

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
			contaminated land. If any contaminated material is present on the it will have to be excavated	attribute	

(d) Cookstown

Table 8.15 Predicted Impacts at Cookstown

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
A12	Agricultural Land (100%)	High	Removal of fertile soil on small site.	Permanent impact on significant proportion of attribute	Significant Negative
P4	Hist. Sand & Gravel Pits (1)	Low	Historical gravel pit located 330m from site & may have been backfilled with contaminated material. This material may have to be excavated and disposed of appropriately	Permanent impact on small proportion of attribute	Imperceptible

(e) Cloghran

Table 8.16 Predicted Impacts at Cloghran

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
A13	Agricultural Land (100%)	High	Removal of fertile soil on small site.	Permanent impact on significant proportion of attribute	Significant Negative
R10	Shallow Bedrock (25% of Site)	Medium	Rock may have to be excavated (e.g. through blasting) which will impact noise and dust generation.	Temporary impact on small proportion of attribute	Imperceptible
H1	Feltrim Hill Quarry CGS & Active Quarry	High	Active Quarry and GHA located 500m from the site. Sterilisation of small proportion of future reserves at a large quarry site No impact to GHA	Permanent impact on small proportion of attribute	Moderate Negative

(f) Newtowncorduff

Table 8.17 Predicted Impacts at Newtowncorduff

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
A14	Agricultural Land (100%)	High	Removal of fertile soil on small site.	Permanent impact on significant	Significant Negative

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
				proportion of attribute	
R11	Shallow Bedrock (25% of Site)	Medium	Rock may have to be excavated (e.g. through blasting) which will impact noise and dust generation.	Temporary impact on small proportion of attribute	Imperceptible
T1	Train Railway Line	Low	Major railway line located <200m from site. In the event of contaminated land present, certain amount of material may have to be excavated	Permanent impact on small proportion of attribute	Imperceptible

(g) Rathartan

Table 8.18 Predicted Impacts at Rathartan

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
A15	Agricultural Land (100%)	High	Removal of fertile soil on small site.	Permanent impact on significant proportion of attribute	Significant Negative
T1	Train Railway Line	Low	Major railway line located <200m from site. In the event of contaminated land present, certain amount of material may have to be excavated	Permanent impact on small proportion of attribute	Imperceptible

(h) Saucerstown

Table 8.19 Predicted Impacts at Saucerstown

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
A16	Agricultural Land (100%)	High	Removal of fertile soil on small site.	Permanent impact on significant proportion of attribute	Significant Negative
R12	Shallow Bedrock (20% of Site)	Medium	Rock may have to be excavated (e.g. through blasting) which will impact noise and dust generation.	Temporary impact on small proportion of attribute	Imperceptible
S12	Alluvium Deposits (50% of Site)	Medium	Alluvial deposits which may include soft silts mapped within the site. This indicates the potential for soft material to be removed	Permanent impact on small proportion of attribute	Slight Negative

(i) Tyrrelstown Little

Table 8.20 Predicted Impacts at Tyrrelstown Little

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
A17	Agricultural Land (100%)	High	Removal of fertile soil on small site.	Permanent impact on significant proportion of attribute	Significant Negative

8.4.1.4 Marine outfall sites

(a) Northern Outfall

Table 8.21 Predicted Impacts at the Northern Outfall

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
A8	Agricultural Land (5%)	Low	Removal of fertile soil on small site.	Permanent impact on small proportion of attribute	Imperceptible
R8	Shallow Bedrock (5% of Site)	Low	Rock may have to be excavated (e.g. through blasting) which will impact noise and dust generation.	Permanent impact on small proportion of attribute	Imperceptible
S8	Alluvium Deposits (1% of Route)	Low	Alluvial deposits which may include soft silts mapped within the site. This indicates the potential for soft material to be removed	Permanent impact on small proportion of attribute	Imperceptible
P5	Hist. Sand & Gravel Pits (1)	Medium	Historical sand and gravel pits may have been backfilled with contaminated material. This material may have to be excavated and disposed of appropriately	Permanent impact on small proportion of attribute	Slight Negative
H2	Skerries to Rush Coastline CGS	Very High	Partial loss or alterations to county geological heritage site which lies entirely within outfall area.	Permanent impact on significant proportion of attribute	Profound Negative
H3	Portaine Shore CGS	Very High	Partial loss or alterations to county geological heritage site which lies entirely within outfall area.	Permanent impact on significant proportion of attribute	Profound Negative
K3	Karst St. Catherines Well	High	Loss of karst feature.	Permanent impact on significant proportion of attribute	Significant Negative
K4	Karst Tobair Caillin Well	High	Loss of karst feature.	Permanent impact on significant proportion of attribute	Significant Negative

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
K5	Karstified limestone bedrock at surface	High	Partial loss of karst feature.	Permanent impact on small proportion of attribute	Moderate negative
M1	Historic Copper Mines Loughshinny (3)	Medium	Historical mines may have been backfilled with contaminated material. This material may have to be excavated and disposed of appropriately	Permanent impact on significant proportion of attribute	Moderate
M2	Historic Dolomite Mine	Medium	Historical mines may have been backfilled with contaminated material. This material may have to be excavated and disposed of appropriately	Permanent impact on significant proportion of attribute	Moderate
M3	Historic Jasper Mine	Medium	Historical mines may have been backfilled with contaminated material. This material may have to be excavated and disposed of appropriately	Permanent impact on significant proportion of attribute	Moderate
G10	Rush Graveyard	Medium	Study area passes through graveyard. Would require excavation of contaminated material (decomposed matter)	Permanent impact on significant proportion of attribute	Moderate Negative
L8	Hist. Brooks End Landfill (Low)	Low	Low risk historical unregulated landfill area thus threat of contaminated land. If any contaminated material is present on the it will have to be excavated	Permanent impact on small proportion of attribute	Imperceptible

(b) Southern Outfall

Table 8.22 Predicted Impacts at the Southern Outfall

Ref	Feature	Importance	Impact Description	Scale and duration of impact	Level of impact
R9	Shallow Bedrock (15% of Site)	Low	Rock may have to be excavated (e.g. through blasting) which will impact noise and dust generation.	Permanent impact on small proportion of attribute	Imperceptible
S9	Alluvium Deposits (15% of Route)	Low	Alluvial deposits which may include soft silts mapped within the site. This indicates the potential for soft material to be removed	Permanent impact on small proportion of attribute	Imperceptible
L7	Hist. Baldoyle Landfill (High)	High	High risk historical unregulated landfill area thus threat of contaminated land. If any contaminated material is present on the it will have to be excavated	Permanent impact on significant proportion of attribute	Significant Negative

8.5 Evaluation

8.5.1 Evaluation of Land Parcels and Sites

Refer to land parcel and sites matrices below.

8.5.2 Evaluation of Route Options

Refer to pipeline routes matrix below.

8.5.3 Evaluation of Marine Outfall Location

Refer to marine outfall matrix below.

8.6 Mitigation Measures

The primary form of mitigation is avoidance of impacts where possible and this Route Selection and ASA report forms the basis for that. Once a pipeline route, land parcel and outfall location have been chosen, mitigations measures which may be employed to reduce residual impacts include:

- Locally re-align the pipeline route where possible to minimise construction over soft ground or areas of shallow bedrock. Confirmation of the site specific ground conditions are required for this
- Provide for the excavation and off-site disposal and/or recovery of unacceptable and/or contaminated soils in accordance with the Waste Management Act and associated regulations.
- Provide for in-situ remediation of soils if required
- Protection of geological resource during construction period
- Liaise with the GSI and Fingal County Council regarding the protection or preservation of County Geological Sites / Geological Heritage Areas

Phase 2 Alternative Sites Assessment - Environmental Criteria Evaluation Matrix
Stage 2 of Criteria Evaluation (landparcel)

Ref	Environmental Criteria	Annsbrook	Baldurgan	Newtowncorduff	Cookstown	Cloghran	Clonshagh	Rathartan	Saucerstown	Tyrrelstown Little
1.0	**Soils and Geology**	**Annsbrook**	**Baldurgan**	**Newtowncorduff**	**Cookstown**	**Cloghran**	**Clonshagh**	**Rathartan**	**Saucerstown**	**Tyrrelstown Little**
1.1	Potential to impact on Geological Heritage Sites	**Imperceptible:** 3.4km to Walshestown Stream Section (IGH 9), 3.7km to Nags Head Quarry (IGH 8), 8km to Feltrim Hill Quarry (IGH 8, 3)	**Imperceptible:** 4.8km to Nags Head Quarry (IGH 8), 5.2km to Walshestown Stream Section (IGH 9)	**Imperceptible:** 3.6km to Walshestown Stream Section (IGH 9), 4.7km to Nags Head Quarry (IGH 8)	**Imperceptible:** 5.5km to Nags Head Quarry (IGH 8), 6.1km to Walshestown Stream Section (IGH 9), 7.5km to Feltrim Hill Quarry (IGH 8, 3)	**Imperceptible:** 0.5km to Feltrim Hill Quarry (IGH 8, 3), 5.3km to Malahide Point (IGH 13), 5.0km Malahide Coast (IGH 3)	**Imperceptible:** 1.8km to Feltrim Quarry (IGH 8, 3)	**Imperceptible:** 1.8km to Skerries to Rush Coast (IGH 3, 8)	**Imperceptible:** 5.2km to Feltrim Hill Quarry (IGH 8, 3), 6.8km to Malahide Point (IGH 13)	**Imperceptible:** 1.4km Curkeen Hill Quarry (IGH 3, 8), 2.0km Milverton Quarry (IGH 8), 2.4km to Skerries to Rush Coast (IGH 3, 8)
1.2	Potential to interact with contaminated land	**Imperceptible:** No history of contamiantion identified. Agricultural land may be a source of nitrates.	**Imperceptible:** No history of contamiantion identified. Agricultural land may be a source of nitrates.	**Imperceptible:** No history of contamiantion identified. Agricultural land may be a source of nitrates.	**Imperceptible:** Sand & Gravel Pit - approx 330m to landparcel	**Imperceptible:** No history of contamiantion identified. Agricultural land may be a source of nitrates.	**Imperceptible:** Belcamp Lane (Moderate) - approx 150m to site, St. Doolaghs Quarries (Low) - approx 400m to site	**Imperceptible:** Train line 75m from land parcel. Agricultural land may be a source of nitrates.	**Imperceptible:** No history of contamiantion identified. Agricultural land may be a source of nitrates.	**Imperceptible:** Train line approx. 125m from site. Agricultural land may be a source of nitrates.
1.3	Potential to sterilise mineral resource	**Imperceptible:** No known mineral resources or registered quarries nearby	**Imperceptible:** No known mineral resources or registered quarries nearby	**Imperceptible**	**Imperceptible:** No known mineral resources or registered quarries nearby	**Imperceptible:** 500m to Feltrim Hill Quarry	**Imperceptible:** No known mineral resources or registered quarries nearby	**Imperceptible**	**Imperceptible**	**Imperceptible**
1.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc)	**Imperceptible -** Limited data, however it does indicate that bedrock is at least 10 mbgl across the site. Confirm using ground investigation (rotary coring)	**Imperceptible -** confirm using ground investigation (rotary coring)	**Imperceptible -** 5% Shallow Bedrock in south of landparcel. Confirm using ground investigation (rotary coring)	**Imperceptible -** confirm using ground investigation (rotary coring)	**Slight negative -** confirm using ground investigation (rotary coring)	**Imperceptible -** confirm using ground investigation (rotary coring)	**Imperceptible -** confirm using ground investigation (rotary coring)	**Slight negative:** 20% Shallow Bedrock . Confirm using ground investigation (rotary coring)	**Imperceptible -** confirm using ground investigation (rotary coring)
1.5	Potential impact on karst features	**Imperceptible:** No karst features identified	**Imperceptible:** No karst features identified	**Imperceptible:** No karst features identified	**Imperceptible:** No karst features identified	**Imperceptible:** No karst features identified	**Imperceptible:** No karst features identified	**Imperceptible:** No karst features identified	**Imperceptible:** No karst features identified	**Imperceptible:** 650m to Harlakes Well Karst Feature
1.6	Potential to encounter soft ground	**Imperceptible:** Alluvial deposits which may include soft silts mapped on the northern and southern fringes of the landparcel	**Imperceptible:** Alluvial deposits which may include soft silts mapped on the northern and southern fringes of the landparcel	**Imperceptible:** No alluvial deposits mapped within the landparcel. Presence of rivers may indicate alluvium (including soft silts) along the southern boundary	**Imperceptible:** No alluvial deposits mapped within the land parcel boundary. Presence of a river near the north east and north west corners indicate alluvium (including soft silts) may be present.	**Imperceptible:** No alluvial deposits mapped within land parcel boundaries however proximity to river indicates soft silts may be present in the north of the land parcel. Ground investigation to confirm	**Imperceptible:** No alluvial deposits mapped within land parcel boundaries however proximity to river indicates soft silts may be present in the north of the land parcel. Ground investigation to confirm	**Imperceptible:** No alluvial deposits mapped within land parcel boundaries however proximity to river indicates soft silts may be present in the south west and north east of the land parcel. Ground investigation to confirm	**Slight negative:** 50% Alluvium Deposits. Potential for soft ground in north of land parcel.	**Imperceptible:** No alluvial deposits mapped

Phase 2 Alternative Sites Assessment - Environmental Criteria Evaluation Matrix
Stage 2 of Criteria Evaluation (Sites)

Ref	Environmental Criteria	Annsbrook	Baldurgan	Newtowncorduff	Cookstown	Cloghran	Clonshagh	Rathartan	Saucerstown	Tyrrelstown Little
1.0	**Soils and Geology**	**Annsbrook**	**Baldurgan**	**Newtowncorduff**	**Cookstown**	**Cloghran**	**Clonshagh**	**Rathartan**	**Saucerstown**	**Tyrrelstown Little**
1.1	Potential to impact on Geological Heritage Sites	**Imperceptible:** 3.4km to Walshestown Stream Section (IGH 9), 3.7km to Nags Head Quarry (IGH 8), 8km to Feltrim Hill Quarry (IGH 8, 3)	**Imperceptible:** 4.8km to Nags Head Quarry (IGH 8), 5.2km to Walshestown Stream Section (IGH 9)	**Imperceptible:** 3.6km to Walshestown Stream Section (IGH 9), 4.7km to Nags Head Quarry (IGH 8)	**Imperceptible:** 5.5km to Nags Head Quarry (IGH 8), 6.1km to Walshestown Stream Section (IGH 9), 7.5km to Feltrim Hill Quarry (IGH 8, 3)	**Imperceptible:** 0.5km to Feltrim Hill Quarry (IGH 8, 3), 5.3km to Malahide Point (IGH 13), 5.0km Malahide Coast (IGH 3)	**Imperceptible:** 1.8km to Feltrim Quarry (IGH 8, 3)	**Imperceptible:** 1.8km to Skerries to Rush Coast (IGH 3, 8)	**Imperceptible:** 5.2km to Feltrim Hill Quarry (IGH 8, 3), 6.8km to Malahide Point (IGH 13)	**Imperceptible:** 1.4km Curkeen Hill Quarry (IGH 3, 8), 2.0km Milverton Quarry (IGH 8), 2.4km to Skerries to Rush Coast (IGH 3, 8)
1.2	Potential to interact with contaminated land	**Imperceptible:** No history of contamiantion identified. Agricultural land may be a source of nitrates.	**Imperceptible:** No history of contamiantion identified. Agricultural land may be a source of nitrates.	**Imperceptible:** No history of contamiantion identified. Agricultural land may be a source of nitrates.	**Imperceptible:** Sand & Gravel Pit - approx 650m to site	**Imperceptible:** No history of contamiantion identified. Agricultural land may be a source of nitrates.	**Imperceptible:** Belcamp Lane (Moderate) - approx 400m to site, St. Doolaghs Quarries (Low) - approx 850m to site	**Imperceptible:** Train line 100m from site. Agricultural land may be a source of nitrates.	**Imperceptible:** No history of contamiantion identified. Agricultural land may be a source of nitrates.	**Imperceptible:** Train line approx. 500m from site. Agricultural land may be a source of nitrates.
1.3	Potential to sterilise mineral resource	**Imperceptible:** No known mineral resources or registered quarries nearby	**Imperceptible:** No known mineral resources or registered quarries nearby	**Imperceptible**	**Imperceptible:** No known mineral resources or registered quarries nearby	**Imperceptible:** 500m to Feltrim Hill Quarry	**Imperceptible:** No known mineral resources or registered quarries nearby	**Imperceptible**	**Imperceptible**	**Imperceptible**
1.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc)	**Imperceptible -** Limited data, however it does indicate that bedrock is at least 10 mbgl across the site. Confirm using ground investigation (rotary coring)	**Imperceptible -** confirm using ground investigation (rotary coring)	**Imperceptible:** Confirm using ground investigation (rotary coring)	**Imperceptible -** confirm using ground investigation (rotary coring)	**Slight negative -** confirm using ground investigation (rotary coring)	**Imperceptible -** confirm using ground investigation (rotary coring)	**Imperceptible -** confirm using ground investigation (rotary coring)	**Slight negative: 3**0% Shallow Bedrock . Confirm using ground investigation (rotary coring)	**Imperceptible -** confirm using ground investigation (rotary coring)
1.5	Potential impact on karst features	**Imperceptible:** No karst features identified	**Imperceptible:** No karst features identified	**Imperceptible:** No karst features identified	**Imperceptible:** No karst features identified	**Imperceptible:** No karst features identified	**Imperceptible:** No karst features identified	**Imperceptible:** No karst features identified	**Imperceptible:** No karst features identified	**Imperceptible:** 770m to Harlakes Well Karst Feature
1.6	Potential to encounter soft ground	**Imperceptible:** No alluvial deposits mapped within site boundaries however proximity to river indicates soft silts may be present in the northern and southeastern part of the site. Ground investigation to confirm	**Imperceptible:** No alluvial deposits mapped within site boundaries however proximity to river indicates soft silts may be present in the north, south and west of the site. Ground investigation to confirm	**Imperceptible:** No alluvial deposits mapped within the site boundary. Presence of a river near the south east and south west corners indicate alluvium (including soft silts) may be present. Ground investigation to confirm	**Imperceptible:** No alluvial deposits mapped within the site boundary. Presence of a river along the northern boundary indicates alluvium (including soft silts) may be present. Ground investigation to confirm	**Imperceptible:** No alluvial deposits mapped within site boundaries however proximity to river indicates soft silts may be present in the north of the site. Ground investigation to confirm	**Imperceptible:** No alluvial deposits mapped within site boundaries however proximity to river indicates soft silts may be present in the north of the site. Ground investigation to confirm	**Imperceptible:** No alluvial deposits mapped within site boundaries however proximity to river indicates soft silts may be present in the south west of the site. Ground investigation to confirm	**Slight negative: 25**% Alluvium Deposits. Potential for soft ground in northeastern corner. Ground investigation to confirm	**Imperceptible:** No alluvial deposits mapped. Soft ground unlikely to be encountered.

Phase 2 Alternative Sites Assessment - Environmental Criteria Evaluation Matrix
Stage 1 of Criteria Evaluation (Pipeline Routes)

Ref	Environmental Criteria	Route Section A	Route Section B	Route Section C	Route Section D	Route Section E	Route Section F	Route Section G
1.0	**Soils and Geology**	**Route Section A**	**Route Section B**	**Route Section C**	**Route Section D**	**Route Section E**	**Route Section F**	**Route Section G**
1.1	Potential to impact on Geological Heritage Sites				Feltrim Hill Quarry (IGH 8, 3)			
1.2	Potential to interact with contaminated land	Abbotstown Graveyard, Huntstown Power Plant, Viridian Power Ltd., Kilshane Recycling Centre, Rockmount Hist. Unreg. Landfill (Low), Blanchardstown Hist. Unreg. Landfill (Low), Hist. Quarry (7), Hist. Sand & Gravel Pits (5)	Ballymun IRS Hist. Unreg. Landfill (High), Dardstown Hist. Unreg. Landfill (Low), Belcamp Lane Hist. Unreg. Landfill (Moderate), Dardstown Cementary	Westereave Hist. Burial Ground, Forest Great Hist. Burial Ground, Killeek Graveyard, Anglo Irish Beef Processors, Hist. Quarry (4)	Kinsaley Church Graveyard, Swords Wastewater Treatment Plant, Hist. Quarry (1), Hist. Sand & Gravel Pits (1)	Corduff Hist. Unreg. Landfill, Hist. Sand & Gravel Pits (1), 0.66km Railway Line	Common Graveyard, Chapelmidway Graveyard, Hist. Graveyard, Kelly Timber Frame Ltd., Hist. Quarry (4), Hist. Sand & Gravel Pits (3), 0.62km Railway Line	Baldoyle Hist. Unreg. Landfill (High), 0.53km Railway Line
1.3	Potential to sterilise mineral resource	Huntstown Quarry, Rockmount Quarry			Feltrim Hill Quarry			
1.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc)	95% Shallow Bedrock (15% Bedrock at Surface)	5% Shallow Bedrock (0% Bedrock at Surface)	65% Shallow Bedrock (5% Bedrock at Surface)	45% Shallow Bedrock (5% Bedrock at Surface)	10% Shallow Bedrock (1% Bedrock at Surface)	25% Shallow Bedrock (1% Bedrock at Surface)	5% Shallow Bedrock (0% Bedrock at Surface)
1.5	Potential impact on karst features						Tyrrelstown Little Karst Bog Well, Harlakes Karst Well	
1.6	Potential to encounter soft ground	1% Alluvium Deposits	1% Alluvium Deposits	4% Alluvium Deposits	Small area of Lithosols/Peats (Basic), 10% Alluvium Deposits	10% Alluvium Deposits	5% Alluvium Deposits	10% Alluvium Deposits

Phase 2 Alternative Sites Assessment - Environmental Criteria Evaluation Matrix
Stage 1 of Criteria Evaluation (Marine Outfall)

Ref	Environmental Criteria	Northern Outfall Study Area	Southern Outfall Study Area
1.0	**Soils and Geology**	**Northern Outfall Study Area**	**Southern Outfall Study Area**
1.1	Potential to impact on Geological Heritage Sites	Skerries to Rush Coastline, Portraine Shore	
1.2	Potential to interact with contaminated land	Brooks End Hist. Unreg. Landfill (Low), Rush Graveyard, Passage Tomb, Hist. Jasper Mine, Hist. Dolomite Mine, Hist. Copper Mines (3), Hist. Sand & Gravel Pit (1)	Baldoyle Hist. Unreg. Landfill (High)
1.3	Potential to sterilise mineral resource		
1.4	Potential to encounter shallow bedrock during construction (interactions with other disciples during construction - noise, dust etc)	5% Shallow Bedrock (2% Bedrock at Surface)	15% Shallow Bedrock
1.5	Potential impact on karst features	St. Catherines Karst Well, Tobair Caillin Karst Well, Karstified limestone bedrock at surface	
1.6	Potential to encounter soft ground	1% Alluvium	15% Alluvium

Legend

- Final Proposed Sites
- Final Proposed Land Parcels
- Outfall Study Areas
- Potential Pipeline Corridors

Soil Type

- AeoUND - Aeolian Undifferentiated
- AlluvMIN - Mineral Alluvium
- AminDW - Acid Brown earths/Brown Podzolics
- AminPD - Surface/Ground water gleys, Acidic
- AminSP - Shallow Surface/Ground water Gleys, Acidic
- AminSW - Lithosols/Regosols, Acidic
- BminDW - Grey Brown Podzolics/Brown Earths, Basic
- BminPD - Surface/Ground water Gleys, Basic
- BminSP - Shallow Surface/Ground water Gleys
- BminSRPT - Lithosols/Peats, Basic
- BminSW - Renzinas/Lithosols, Basic
- Cut
- Lac - Alluvium, Lacustrine type soil
- Made
- MarSands - Beach sand & gravel
- MarSed - Marine/Estaurine Sediments
- Scree
- Water

Northern Outfall Area

Southern Outfall Area

Tyrrelstown Little

Rathartan

Annsbrook

Newtowncorduff

Baldurgan

Cookstown

Saucerstown

Cloghran

Clonshagh

F

E

F

C

D

B

G

A

AminDW

AminSP

AminPD

AlluvMIN

MarSed

MarSands

BminSP

BminDW

BminPD

BminSW

BminSRPT

AminSRPT

AminSW

AeoUND

Made

Water

BALBRIGGAN
Baile Brigín

SKERRIES
Na Sceiri

Lambay Island

ASHBOURNE
Cill Dhéaglain

DUBLIN HARBOUR

IRISH SEA
Muir Éireann

Greater Dublin Drainage

Drawing Title

ASA: PHASE TWO
SITES ASSESSMENT AND ROUTE SELECTION REPORT

SOILS MAP

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
D01	26/01/12	DRAFT	BL	—	—	—

N W E S

0 1 2 3
Kilometres

JACOBS TOBIN Patrick J. Tobin & Co. Ltd. ARUP

Drawing Status	DRAFT
Scale @ A3	1:100,000 — DO NOT SCALE
Job No.	218525-00
Drawing No.	FIGURE 8.1

Legend

- Final Proposed Sites
- Final Proposed Land Parcels
- Outfall Study Areas
- Potential Pipeline Corridors

Quaternary

TYPE

- Aeolian
- Alluvium
- Drift
- Glaciofluvial sands and gravels
- Glaciolacustrine deposits
- Marine deposits
- Other unsorted deposits
- Peat
- Tills
- Water

Water

Glaciofluvial sands and gravels

Northern Outfall Area

Tyrrelstown Little

F

Rathartan

Annsbrook

Newtowncorduff

Alluvium

E

Baldurgan

Cookstown

Saucerstown

F

C

D

Cloghran

B

Southern Outfall Area

Clonshagh

G

A

Marine deposits

Aeolian

Other unsorted deposits

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
D01	26/01/12	DRAFT	BL	—	—	—

Kilometres

Drawing Title

ASA: PHASE TWO
SITES ASSESSMENT AND ROUTE SELECTION REPORT

QUATERNARY MAP

Drawing Status	DRAFT
Scale @ A3	1:100,000 DO NOT SCALE
Job No.	218525-00
Drawing No.	FIGURE 8.2

Legend

- Final Proposed Sites
- Final Proposed Land Parcels
- Outfall Study Areas
- Potential Pipeline Corridors
- Faults
- Strike and Dip of Bedding

Bedrock Geology 100k

- BYG - BRAY GROUP
- GG - Balbriggan Formation
- BA - Ballysteen Formation
- BC - Balrickard Formation
- BP - Belcamp Formation
- BN - Boston Hill Formation
- CP - Calp
- CF - Clashford House Formation
- CW - Clatterstown Formation
- DD - Denhamstown Formation
- DE - Donabate Formation
- DK - Drumleck Formation
- EL - Elsinore Formation
- FK - Fournocks Formation
- GK - Gaskins Leap Formation
- HB - Herbertstown Formation
- HH - Hippy Hole Formation
- HO - Holmpatrick Formation
- KT - Kennetstown Formation
- LM - Lambay Volcanic Formation
- LE - Lane Formation
- LO - Loughshinny Formation
- LU - Lucan Formation
- ML - Malahide Formation
- MK - Mudbank limestone
- MF - Mullaghfin Formation
- NA - Naul Formation
- PP - Pipers Gut Formation
- PL - Portrane Limestone Formation
- PV - Portrane Volcanic Formation
- RU - Rush Conglomerate Formation
- SI - Shenicks Island Formation
- SS - Skerries Formation
- SR - Smugglers Cave Formation
- SW - Snowtown Formation
- TC - Tober Colleen Formation
- WL - Walshestown Formation
- WA - Waulsortian Limestones

Northern Outfall Area

Southern Outfall Area

Tyrrelstown Little

Rathartan

Annsbrook

Newtowncorduff

Baldurgan

Cookstown

Saucerstown

Cloghran

Clonshagh

A

B

C

D

E

F

G

IRISH Muir Éireann SEA

DUBLIN HARBOUR

Lambay Island

SKERRIES Na Sceirí

BALBRIGGAN Baile Brigín

PHOENIX PARK Páirc an Fhionnuisce

Greater Dublin Drainage

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
D02	26/01/12	Inculsion of new proposed site boundaries	BL	__	__	
D01	23/11/11	DRAFT	BL	__	__	__

N W E S

0 1 2 3

Kilometres

JACOBS TOBIN Patrick J. Tobin & Co. Ltd. ARUP

Drawing Title

ASA: PHASE TWO
SITES ASSESSMENT AND ROUTE SELECTION REPORT

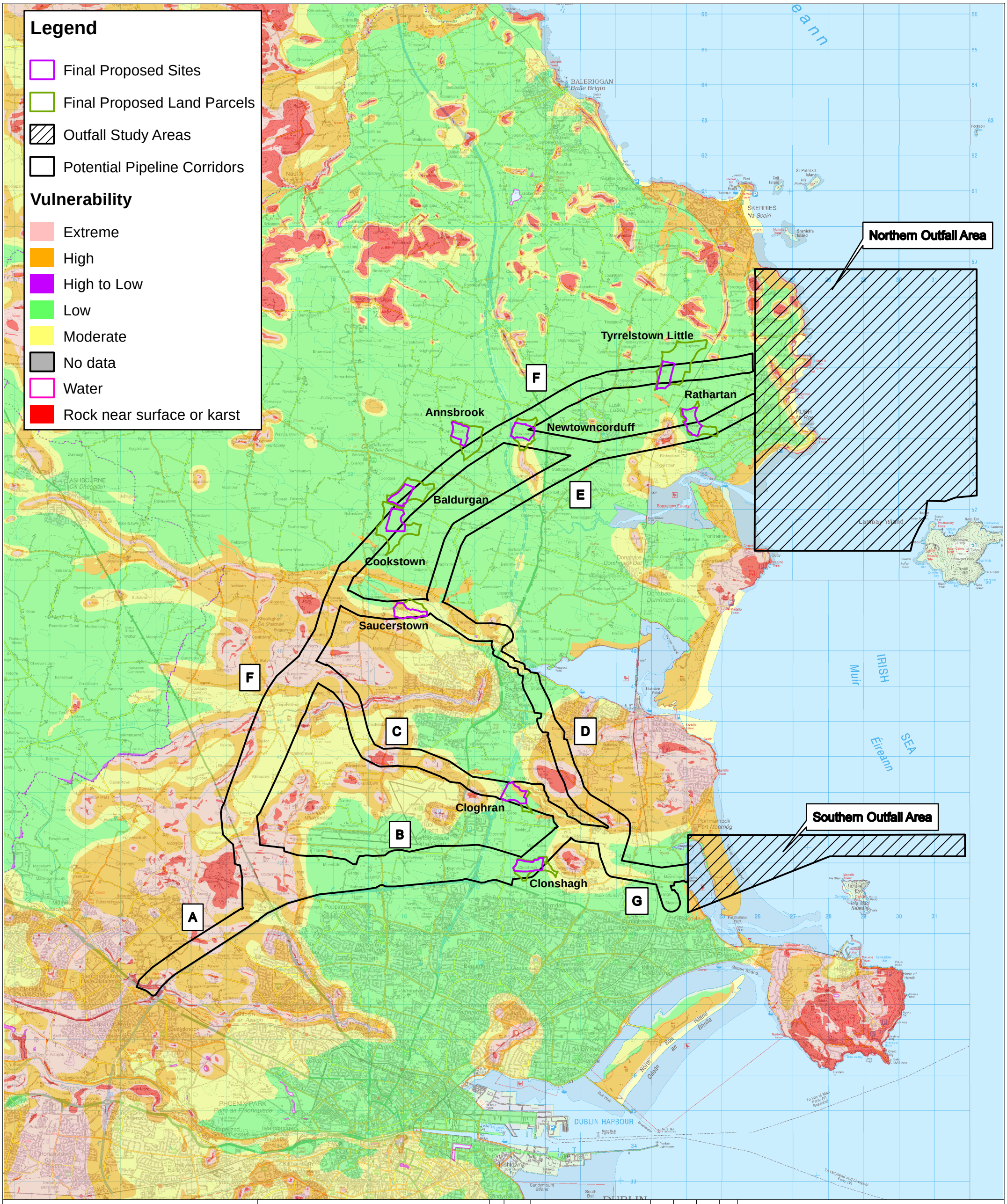
GEOLOGY MAP

Drawing Status: DRAFT

Scale @ A3: 1:100,000 — DO NOT SCALE

Job No.: 218525-00

Drawing No.: FIGURE 8.3

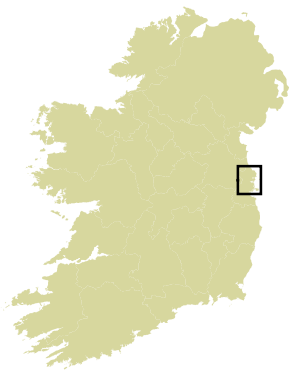


Greater Dublin Drainage

Drawing Title

ASA: PHASE TWO
SITES ASSESSMENT AND ROUTE SELECTION REPORT

GROUNDWATER VULNERABILITY MAP



Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
D02	29/03/12	Updated format	BL			
D01	26/01/12	DRAFT	BL	__	__	__

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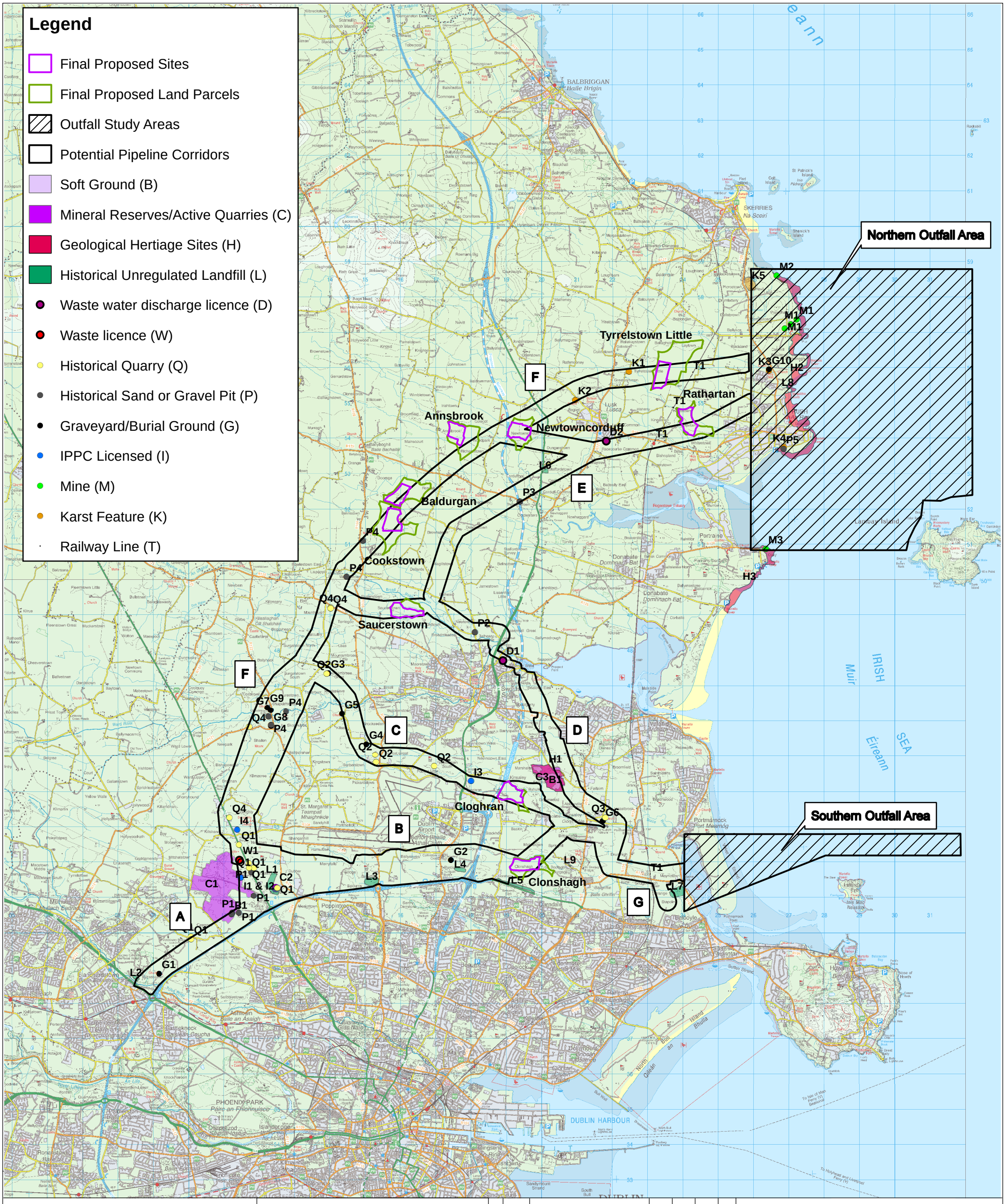
Kilometres

JACOBS TOBIN ARUP

Drawing Status	DRAFT
Scale @ A3	1:100,000 DO NOT SCALE
Job No.	218525-00
Drawing No.	FIGURE 8.4



Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
D03	29/03/12	Constraints updated	BL			
D02	26/01/12	Inclusion of new proposed site boundaries	BL			
D01	23/11/11	DRAFT	BL	__	__	__

Greater Dublin Drainage

Drawing Title

ASA: PHASE TWO
SITES ASSESSMENT AND ROUTE SELECTION REPORT

CONSTRAINTS MAP

JACOBS TOBIN ARUP

Drawing Status	DRAFT
Scale @ A3	1:100,000 DO NOT SCALE
Job No.	218525-00
Drawing No.	FIGURE 8.5