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SOIL WATER BASELINE REPORT FOR AMENDMENT OF SITE BOUNDARY FOR IE LICENCE P1011-01

TOM ROES POINT PORT TERMINAL

Technical Report Prepared For

Drogheda Port Company.

Technical Report Prepared By

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Our Reference

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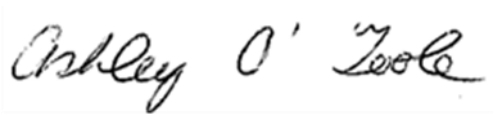
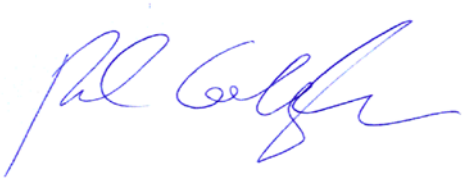
Signature		
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EXECUTIVE SUMMARY

In 2015, a soil and groundwater quality baseline report was completed for Drogheda Port Company as part of an IE Licence application for Tom Roes Point Port Terminal (TRP), Drogheda, Co Louth. The boundary of the TRP site was defined as part of the licence which was subsequently granted (IE Licence Reg No. P1011-01) however DPC now wishes to amend the site boundary to remove an area of 2121 metres squared (m^2). In 2019, AWN was appointed by DPC to update the previous baseline soil and groundwater report compiled in 2015 as a part of this amendment to the licence. This report has been prepared in compliance with *European Commission Guidance concerning baseline reports under Article 22(2) of Directive 2010/75/EU on industrial emissions.*

There is no bulk storage of chemicals or other hazardous substances present within the area proposed for IE Licence activities. The only potential sources identified are accidental releases of contaminated runoff/leachates from RDF & SRF bales, which are set down temporarily on site, and possible minor diesel/oil leaks from operating traffic on site. These were identified as substances of concern at the site which have the potential to impact soil and groundwater if not adequately mitigated on site.

In 2015, the dominant pathway for any potential sources of contamination was through the existing surface water drainage system which discharged via an interceptor to the River Boyne. A new fully contained drainage system for the waste set down areas consisting of modifications to the existing drainage was installed at the site which eliminated this pathway to the estuary. Surface water drains in the licensed area now divert to a suitably sized attenuation tank, the contents of which is removed from the site and disposed of by McBreen Environmental. This eliminates the pathway and subsequently any risk to the Boyne River. Capping of the site has reduced the potential for recharge to mobilise any historically contaminated soil. However, the potential for mobilisation should be considered in the event of any future subsurface construction on the site. The presence of low permeability capping and thickness of soil cover reduces the potential for impact on the underlying bedrock aquifer.

A review of the site history confirmed that the port was constructed in 1997 on reclaimed land and made ground deposits. The site investigations confirmed the presence of gravelly fill, cement by-products and inert landfill materials. These made ground deposits are juxtaposed with black organic silt (estuarine sediments). Beneath the silt is a thick layer up to 13 metres in thickness of fine sand which sits on top of gravels. The depth to possible bedrock was encountered in 103D in at 20.5 metres below ground and confirmed the presence of shaley limestone and pale sandstone (Impure Limestones).

A review of soil quality confirms that there is historic contamination at the site. During the 2015 site investigation, heavy metals (Cadmium, Lead and Copper) were detected within made ground deposits at the centre of the site. Exceedances of Nickel are observed in both made ground and natural ground. Exceedances of Polyaromatic Hydrocarbons are observed within the black organic silt unit. It should be noted that there is no legislative threshold for soils in Ireland. The exceedances noted relate to guideline concentrations. The metal concentrations detected do not exceed guideline levels for commercial use of the site.

During the 2019 site investigation, heavy metals (Arsenic, Cadmium, Copper, Nickel, Lead and Zinc) and Polyaromatic hydrocarbons (PAHs) were detected within and in close proximity to made ground deposits on the site. Capping of the site has reduced the potential for recharge to mobilise any contaminated soil. However, the potential for mobilisation should be considered in the event of any future subsurface construction on the site.

A review of groundwater quality in 2015 found that the groundwater beneath the site is tidally effected. There is also evidence of metal and hydrocarbon contamination likely to originate from the historic made ground deposits which were located at the centre of the port site during the site investigation.

A review of groundwater quality in 2019 also found that the groundwater beneath the site is tidally effected. There is also evidence of metal contamination likely to originate from the historic made ground deposits which were located at the centre of the port site during the site investigation.

There is historical contamination in the underlying soil likely to originate from the historic made ground deposits which were located at the centre of the port site. There is no evidence that this contamination is caused by current activities at the site. Capping of the site has reduced the potential for recharge to mobilise any contamination to the Boyne Estuary.

It is concluded that the portion of land (2121 m^2) proposed to be removed from the IE Licence boundary does not pose a risk of contamination to the site or surrounding lands. However, the potential for mobilisation of historic contamination underlying this area should be considered in the event of any future subsurface construction on the site.

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1.0 INTRODUCTION

1.1 Instruction

In 2015, AWN Consulting Ltd. (AWN) was appointed by Drogheda Port Company (DPC), to complete a baseline soil and groundwater report for a proposed IE waste licensed facility (Figure 3.1) at Tom Roes Point Port Terminal (TRP), Drogheda, Co Louth. Baled/Wrapped MSW waste requires being temporarily stored by Drogheda Port Authority at the TRP Terminal prior to its onward shipment. This operation has been classified by the EPA as a "waste pre-treatment operation" and is licensed by the EPA under IE Licence Reg No. P1011-01.

The boundary of the site has been defined as part of the current licence however DPC now wishes to amend the site boundary to remove an area of 2121 metres squared (m^2), see Figure 1.1 below. In 2019, AWN was appointed by DPC to update the previous baseline soil and groundwater report as a part of this amendment to the licence.

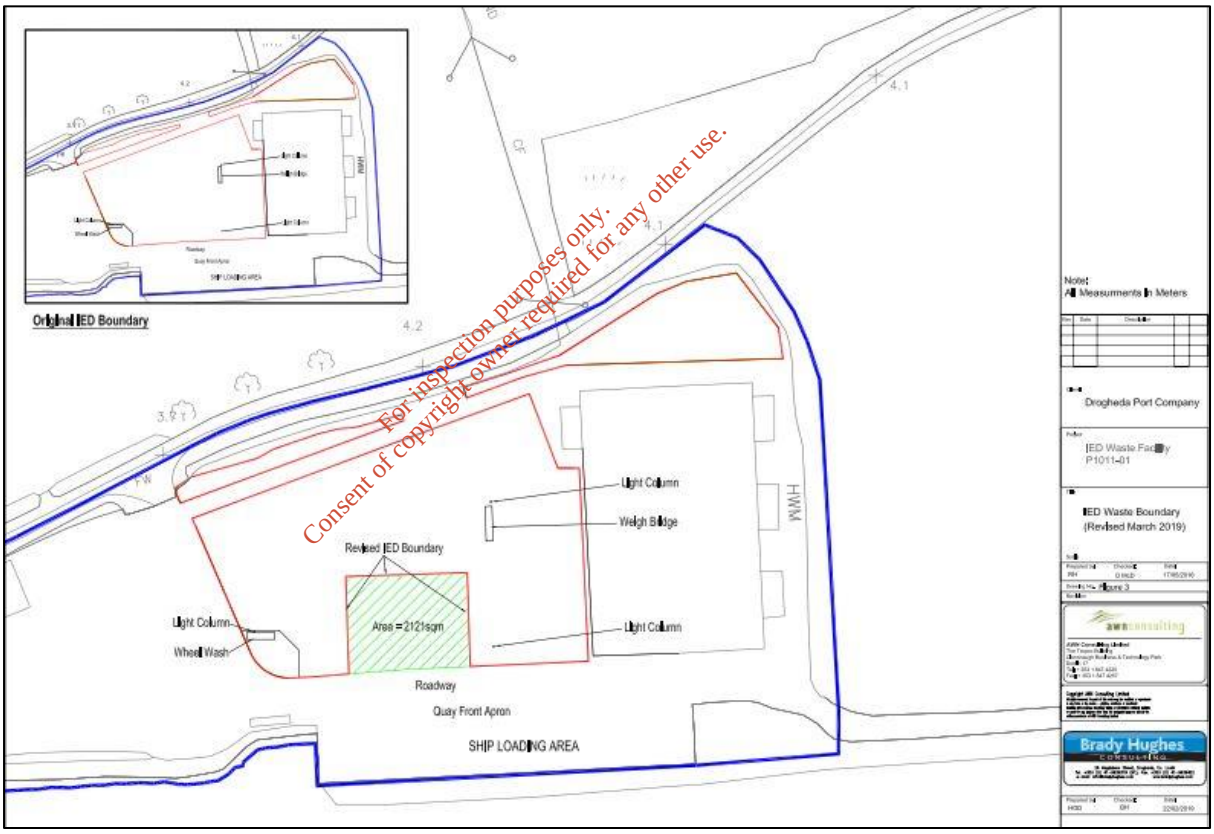

Figure 1.1 *Portion of land to be removed from IE licence boundary*

This report was completed in accordance with European Commission guidance concerning baseline reports under Article 22(2) of Directive 2010/75/EU on industrial emissions.

1.1 Background – Soil & Groundwater Compliance

In April 2013 Ireland implemented the requirements of the Industrial Emissions Directive (IED) through SI 137 of 2013 and SI 138 of 2013. The regulations come into operation on 7 January 2014. The requirements of the IE include a soil and groundwater compliance report.

Soil and groundwater compliance is defined in SI 138 in Regulation 13 as:

'Baseline report and permanent cessation of activity'

Section 86B. (1) Where an industrial emissions directive activity involves the use, production or release of relevant hazardous substances, and having regard to the possibility of soil and groundwater contamination at the site of an installation concerned, the Agency shall require an applicant under this Part for a licence or review of a licence or revised licence relating to the activity, including such a review by the Agency of its own volition, to furnish to the Agency a baseline report in accordance with regulations under section 89.

(2) In relation to the installation, a baseline report shall contain information necessary to determine the state of contamination of soil and groundwater at the time that the report is drawn up in order that a quantified comparison may be made to the state of the site upon the permanent cessation (including cessation by abandonment) of the industrial emissions directive activity concerned and the applicant in preparing the baseline report shall include any information prescribed in regulations under section 89.

(3) Notwithstanding the generality of subsection (2), a baseline report shall include at least the following information —

(a) the current use and, where available, the past use of the site; and
(b) any available information on -

(i) Soil or groundwater measurements that reflect the state of the site at the time that the baseline report is drawn up, or

(ii) New soil and groundwater measurements, having regard to the possibility of soil and groundwater contamination by the hazardous substances proposed to be used, produced or released by the installation concerned.

The scope of the baseline report is outlined in *European Commission Guidance concerning baseline reports under Article 22(2) of Directive 2010/75/EU on industrial emissions.*

1.2 Objectives & Reporting Format

The Soil and Groundwater report includes items listed in Section 1.1 above and follows the guidance below:

- European Commission Guidance concerning baseline reports under Article 22(2) of Directive 2010/75/EU on industrial emissions, and, where relevant:
- Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites, EPA, July 2013;
- Guidance on the Authorisation of Discharges to Groundwater, EPA, December 2011;
- Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements, Draft Guidance, IGI 2013.

1.3 Limitations of Report

The conclusions presented in this report are professional opinions based solely on the tasks outlined herein and the information made available to AWN. They are intended for the purpose outlined herein and for the indicated site and project. Furthermore, this

report is produced solely for the benefit of Drogheda Port Company (Harbourville, Mornington, Drogheda, Co. Meath) to address an EPA requirement for their licence.

This report may not be relied upon by any other party without explicit agreement from AWN. Opinions and recommendations presented herein apply to the site conditions existing at the time of the recently completed field work and subsequent assessment. They cannot apply to changes at the site of which AWN is not aware and has not had the opportunity to evaluate. This report is intended for use in its entirety; no excerpt may be taken to be representative of this baseline assessment. All work carried out in preparing this report has utilised and is based on AWN professional knowledge and understanding of the current relevant Irish and European Community standards, codes and legislation.

2.0 METHODOLOGY

2.1 Methodology Outlined

Table 5 of the Guidance (European Commission Guidance concerning baseline reports under Article 22(2) of Directive 2010/75/EU on industrial emissions), outlines the requirements for this report. These requirements form the methodology adopted for this report which is outlined below as Stages 1 to 8.

- Stage 1 Identifying the potential hazardous substances that are currently used, produced or released at the site
- Stage 2 Identifying the relevant hazardous substances i.e. those which have the potential to cause soil and groundwater contamination
- Stage 3 Assessment of the site specific pollution risk
- Stage 4 Site History
- Stage 5 Environmental Setting
- Stage 6 Conceptual Site Model
- Stage 7 Site Investigation – Soil & Water Quality Assessment
- Stage 8 Production of the Baseline Report

2.2 Sources of Information

Reference is made in this report to information from a number of existing data sources and reports including the following:

- Geological Survey of Ireland (GSI): On-line mapping resources, available at www.gsi.ie including *inter alia* groundwater well database, Karst feature database, geology, aquifer classification and vulnerability;
- Geology Survey of Ireland (2001) Geology of Meath: A Geological Description to accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 13. Meath.
- Environmental Protection Agency (EPA): On-line data resources available at http://gis.epa.ie/Envision/
- National Parks & Wildlife Service (NPWS): On-line data resources available at http://webgis.npws.ie/npwsviewer/
- Kirk McClure Morton (1996). Drogheda Harbour Commissioners Environmental Statement, Proposed Port Development at TRP.

2.3 Scope of Work Undertaken

The scope of the work undertaken for this assessment included the following:

- A desktop review of regional and site geology and hydrogeology, review of baled Refuse Derived Fuel (RDF) and Solid Recovered Fuel (SRF) set down and operations at the Port site;
- Additional site investigation, including soil quality sampling systematically across the site, *in situ* permeability testing and groundwater sampling;
- Review of available soil and groundwater quality data.

3.0 STAGE 1 & 2 - IDENTIFYING SUBSTANCES OF CONCERN

This section summarises any substances of concern that are currently in use or stored within the licensed area at TRP. Within this area there is no bulk chemical storage or any direct discharges to ground. The only potential source of contamination is accidental discharge of contaminated runoff/leachate should a waste bale become damaged and leachate not be contained or accidental minor leakage of hydrocarbon from traffic on site.

A designated area of the Port is currently permitted (under the Waste Management (Facility Permit & Registration Regulations as amended) for the set down of Solid Recovered Fuel (SRF) and Refuse Derived Fuel (RDF) for the purpose of export. SRF and RDF are fuels produced by processing and shredding municipal solid waste. The SRF and RDF is received in the form of sealed shrink wrapped bales of varying (generally 1-2 tonnes) sizes.

The total area of the current site amounts to c.17,400 square metres. Bales are laid end on, two high, on a smooth clean densophalt surface (suitable for high surface loadings) which also provides a protective cover for the underlying soil from runoff. Square bales may be stacked two to four high.

Figure 3.1 *Location of Existing waste set down areas at TRP (in red)*

The sealed bales of RDF and SRF comprise a wide range of materials and include a significant fraction of biodegradable organic waste material. In the event that a bale is damaged during loading or unloading the bales are repaired and will be re-wrapped however some runoff/leachate may arise.

Leachate by its very nature is a highly variable substance. The EPA manual (Leachate Management Treatment EPA manual on Landfill Site Design, 2000) presents typical data for inert or hazardous leachate, neither of which are considered particularly relevant to the leachate likely to arise from RDF and SRF bales for the proposal. The

UK DoE document (Leachate Quality UK Department of Environment Waste Management Paper 26B) also presents leachate generated from acetogenic and methanogenic landfills. Leachate data for acetogenic landfills is considered likely to be closest in terms of comparison to leachate for recently produced bales of treated municipal waste. In simple terms, leachate from methanogenic landfills tends to be more dilute as it is older.

Based on information from Appendix I (Leachate Quality UK Department of Environment, Waste Management Paper 26B), typical constituents of acetogenic leachates as is likely to be generated from set down of RDF and SRF at Tom Roes Point are summarised in Table 3.1. This type of leachate is likely to contain high concentrations of Chemical Oxygen Demand (COD) and other contaminants including heavy metals, which could potentially pose a risk to the water and geological environment without mitigation.

TABLE 7.1: **SUMMARY OF COMPOSITION OF ACETOGENIC LEACHATES SAMPLED FROM LARGE LANDFILLS WITH A RELATIVELY DRY HIGH WASTE INPUT RATE**

	Overall Range		Overall Values	
Determinant	Minimum	Maximum	Median	Mean
pH-value	5.12	7.8	6.0	6.73
conductivity (µS/cm)	5,800	52,000	13,195	16,921
alkalinity (as $CaCO_3$)	2,720	15,870	5,155	7,251
COD	2,740	152,000	23,600	36,817
BOD_{20}	2,000	125,000	14,900	25,108
BOD_5	2,000	68,000	14,600	18,632
TOC	1,010	29,000	7,800	12,217
fatty acids (as C)	963	22,411	5,144	8,197
ammmoniacal-N	194	3,600	582	922
nitrate-N	<0.2	18.0	0.7	1.8
nitrite-N	0.01	1.4	0.1	0.2
sulphate (as SO_4)	<5	1,560	608	676
phosphate (as P)	0.6	22.6	3.3	5.0
chloride	659	4,670	1,490	1,805
sodium	474	2,400	1,270	1,371
magnesium	25	820	400	384
potassium	350	3,100	900	1,143
calcium	270	6,240	1,600	2,241
chromium	0.03	0.3	0.12	0.13
manganese	1.40	164.0	22.95	32.94
iron	48.3	2,300	475	653.8
nickel	<0.03	1.87	0.23	0.42
copper	0.02	1.1	0.075	0.13
zinc	0.09	140.0	6.85	17.37
arsenic	<0.001	0.148	0.010	0.024
cadmium	<0.01	0.1	0.01	0.02
mercury	<0.0001	0.0015	0.0003	0.0004
lead	<0.04	0.65	0.3	0.28

Notes:
Results in mg/l except pH-value and conductivity (µS/cm).
Source: UK Department of the Environment (1995)

Table 3.1 List of typical constituents of Acetogenic Leachate (Source: Appendix I: Leachate Quality UK Department of Environment Waste Management Paper 26B).

4.0 STAGE 3 - ASSESSMENT OF THE SITE SPECIFIC POLLUTION RISK

This section includes a review of the containment measures in place for the chemicals of concerns as identified in Stage 1 & 2 above.

4.1 Protection Systems and Procedures

The following handling and containment arrangements are in place at the site to prevent any release of generated runoff/leachate to the environment:

- Only sealed shrink wrapped bales transported in authorised waste collectors from licenced processing facilities (under Waste Collection Permit Regulations 2007) are accepted at TRP;
- The waste set down area for all bales is on a smooth clean densophalt impervious surface which prevents the vertical migration of potential contaminants into the underlying soil and geological environment. Based on observations during the 2015 site investigation, this densophalt layer ranges in thickness from 0.20-0.35 m across the site;
- Bales are lifted using a forklift fitted with special hydraulic clamshell clamps with clean fair faced damp faces, reducing the risk of damaging the shrink wrap material;
- On completion of unloading each truck, all bales are checked for bale damage and/or perforation, where found tape sealing is immediately applied. Bale damage found beyond the tape sealing are returned to the manufacturing/processing facility;
- Every day, the outer perimeter of bale set down area is checked for bale damage;
- Any material which may have escaped from a damaged bale is collected and deposited in one of several large closed skips, adjacent to the set down area, for return to the manufacturing/processing facility.

4.2 Risk of Environmental Contamination

In terms of environmental contamination at TRP, the highest risk is associated with the release of contaminated runoff/leachate from SRF and RDF bales and small, localised accidental releases of hydrocarbons from operating site traffic. Both scenarios pose the risk of contamination entering the water and soil environments via the surface water drainage system. There is a reduced risk of impact to the underlying aquifer due to the presence of a low permeability surface and a drainage catchment system.

4.2.1 Stormwater Drainage System

The waste set down areas are serviced by a series of surface water drains.

As part of the licensing of the facility, the existing drainage system was enhanced to eliminate the pathway to the estuary and the risk of any impact on water quality. All surface water drains in the waste set down areas divert to a suitably sized (based on 1:100 year storm flow) attenuation tank. The water in the tank is then disposed of by McBreen Environmental.

<u>Stormwater Quality</u>
Annual surface discharge water monitoring at TRP was undertaken by Axis Environmental Services in accordance with the Waste Facility Permit (LH-11-0006-01, LH-12-0004-01 and LH-13-0001-01) requirements in, since September 2012, to assess the quality of discharge to the Boyne River (at the discharge point).

The Waste Facility Permit for Drogheda Port Company at TRP was granted by Louth County Council on 16th of December 2011, which sets the listed parameters for surface water runoff, summarised in Table 4.1, prior to discharge to the Boyne River.

In the period 2012- 2014, the surface water discharge parameters listed in Table 4.1 did not exceed the set Waste Permit limits as set by Louth County Council.

It should be noted that after the diversion of drainage to the onsite attenuation tank, there is no further discharge to the Estuary.

Parameter	Units	Result	Waste Permit Limits
7/11/2014			
Electrical Conductivity	uS/cm	6000	None
Biochemical Oxygen Demand	mg/l	2	25
Chemical Oxygen Demand	mg/l	20	None
pH	pH units	7.4	6-9
Mineral Oil	mg/l	<0.1	5
Suspended Solids	mg/l	11	25
20/12/2013			
Electrical Conductivity	uS/cm	2310	None
Biochemical Oxygen Demand	mg/l	11	25
Chemical Oxygen Demand	mg/l	45	None
pH	pH units	7.8	6-9
Mineral Oil	mg/l	<0.1	5
Suspended Solids	mg/l	23	25
28/12/2012			
Biochemical Oxygen Demand	mg/l	9	25
Chemical Oxygen Demand	mg/l	54	None
Mineral Oil	mg/l	<0.1	5
pH	pH units	7.5	6-9
Suspended Solids	mg/l	6	25

Exceedances in bold

Table 4.1 Surface Water Drainage Parameters and Limits

4.2.3 Operational Traffic

The site operates a strict traffic management system around the main facility. Vehicles enter via the main entrance and traffic operates in a one way direction before returning to the main access road/weighbridge area. The port area leaves sufficient wide areas for turning of waste deliveries at the site if necessary. However, due to the level of traffic, there is the potential for occasional drips and leaks from vehicle fuel tanks to occur.

In the event of an accidental hydrocarbon leak from a vehicle, the minor spillage will be collected by the surface water drainage system and diverted to the attenuation tank mitigating the environmental impact on the Boyne River / Estuary.

5.0 STAGE 4 – SITE HISTORY

This section includes an evaluation of the likelihood of the presence of any historical contamination on soil/ groundwater at the site.

Drogheda has historically been an industrial town with a wide range of manufacturing companies. A zinc study was carried out in July 2013, by AXIS Environmental Services on behalf of Drogheda Port Company, to investigate the potential sources of zinc in the vicinity of TRP to comply with requirements outlines by the Environmental Protection Agency (EPA) Condition 4.4 of Drogheda Ports Dumping at Sea permit S0015-02. The study highlighted that many of the historic industries had contributed to the sources of zinc built up in river sediment. The study found that sediment samples taken along the Boyne River, between the years 1996 – 2011, were Class 2 (marginally contaminated) or lower. The majority of samples were Class 1 (uncontaminated) as classified under the Guidelines for the Assessment of Dredge Material for the Disposal of Irish Waters (2006).

Aerial Imagery from the Ordnance Survey Ireland (OSi) from 2005 (Figure 5.1) and historic maps from 1830 and 1990 of the Port site at TRP (Figure 5.2) were analysed. The historical maps from 1830 and 1990, highlight that the entire port site used to comprise large mud flats between the low and high water mark along the Boyne River.

Figure 5.1 *OSi Aerial Image (2005) (source www.osi.ie)*

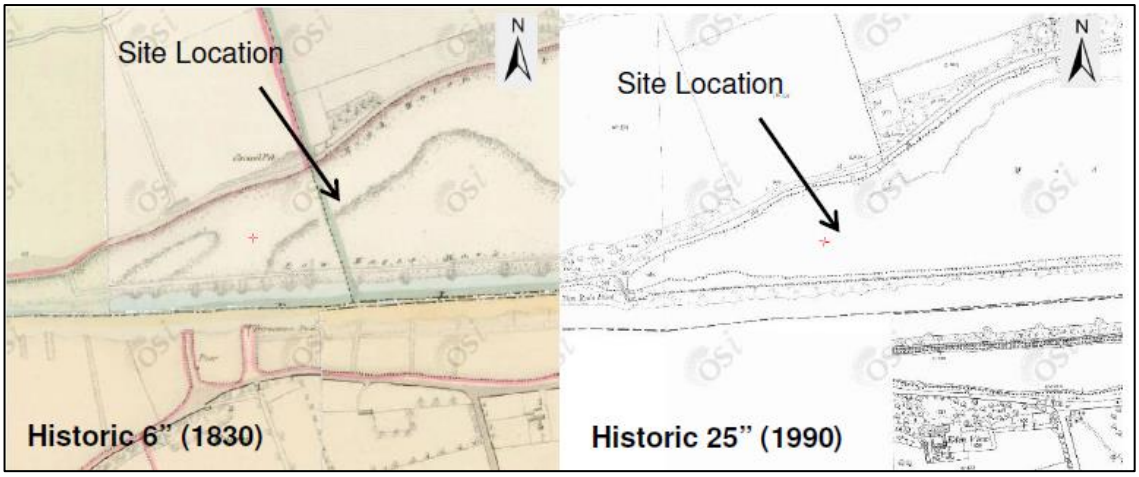

Figure 5.2 *Historical Maps (source www.osi.ie)*

Post 1990 up until 1996, the land was reclaimed and is described as, consisting of an area of grass land with places of standing water to the west. The use of coal storage and distribution depot is listed as one of its historic land-uses (EIS 1996). Later a scrap yard was located towards the centre of the site (comprising a general cargo storage area with shed, temporary buildings, mounds of metallic scrap, a 20 m lightning column and security fencing) and area of bare and waste ground vegetation to the east, according to Kirk McClure Morton Environmental Impact Statement for Drogheda Port (1996), see Figure 5.3. The 6 hectare site of undeveloped reclaimed lands with a total water frontage of 560 m, located 2 km outside of Drogheda and 5km from the sea, was and remains adjacent to the Licenced (IPPC) facility known as RHI Premier Periclase Factory (producer of seawater magnesia products).

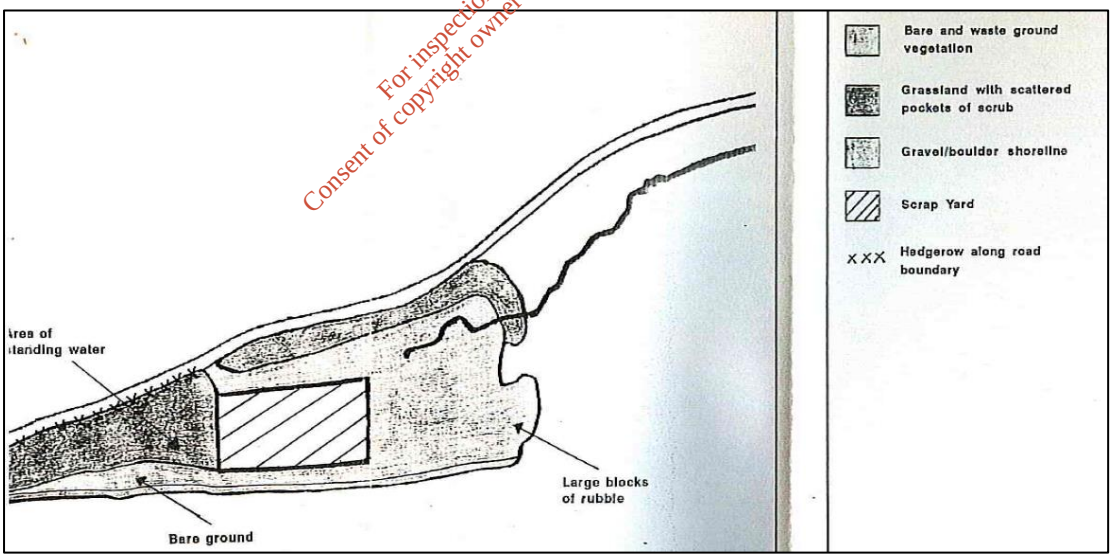

Figure 5.3 *Sketch of TRP in 1996 (EIS 1996)*

Construction of the deep water terminal at TRP began in 1997 to facilitate the handling of larger vessels along the Boyne Estuary. The quay itself consists of a driven anchored sheet pile wall with a reinforced concrete capping beam. The area behind the sheet pile wall was intended to be filled with fill materials obtained from excavations and associated slope stability works adjacent to the quay structure, to make up the difference between the existing ground level and the required quay level (EIS 1996).

6.0 STAGE 5 – ENVIRONMENTAL SETTING

This section includes an assessment of the likely fate of potential spills or leakages based on the topography, soil and groundwater characteristics at the location. Based on the findings of Stages 1 to 5 above, the waste set down areas have been assessed with regard to confirming source-pathway-receptor linkages i.e. in the unlikely event of a leakage/spillage which is not mitigated on site.

6.1 Topography

The natural topography at the site is relatively flat and close to sea level, and situated on the flood plain of the Boyne Estuary. Before the land was reclaimed, the site used to lie between the high and low water marks along the Boyne Estuary, gently sloping east towards the Irish Sea. The concrete terminal lies between 3.50-4.50 metres above Ordinance Datum (mAOD), (Malin Head).

6.2 Hydrology

The site is located along the Boyne River catchment which is the main water feature in the study area. The River Boyne rises near Carbury, Co. Kildare and flows into the Boyne Estuary towards the Irish Sea. The Boyne River, Estuary and Coast is designated as a Special Area of Conservation (SAC – 001957) and a proposed National Heritage Area (pNHA) by the National Parks and Wildlife Service.

The site is located within the Eastern River Basin District (ERBD), as defined under the EU Water Framework Directive (2000/60EC) European Communities Directive 2000/60EC, establishing a framework for community action in the field of water policy, (commonly known as the Water Framework Directive [WFD]).

The WFD requires 'Good Water Status' for all European waters by 2015, to be achieved through a system of river basin management planning and extensive monitoring. 'Good status' means both 'good ecological status' and 'good chemical status'. The current WFD status for the Boyne Estuary (Transitional waterbody) is classified as 'Moderate and is 'at risk of not achieving Good status' by 2015 (GSI 2015).

Figure 6.1 *Site Location and Hydrological Environment (Source www.epa.ie)*

Figure 6.1 presents the site location and the surrounding hydrological environment.

There is expected to be little overland flow onto the site from the surrounding area due to the presence of a quarry to the north and natural drainage to streams located to the north and west which will capture surface water flow in these areas. As part of the application for the waste permit 2012-2013, a flood study was undertaken and the Tom Roes Point Port were set to provide an additional freeboard of approximately 1m (minimum) over the historic quay levels.

The port itself is serviced by a network of surface drains (Section 4.2.1) which currently diverts all surface water into an attenuation tank which is then disposed of by McBreen Environmental.

6.3 Geology & Hydrogeology

6.3.1 Regional Geology

The site appears to be underlain by Dinantian Upper Impure Limestone bedrock (see Figure 6.2 below). The bedrock to the north of the site, bounded by a northeast-southwest trending fault, consists of Dinantian Pure Bedded Limestone. The bedrock forms part of the Milverton Group (which is composed of various Formations) and commonly observed rock types include Limestone, pale coloured Dolomite, feldspathic sandstone, shale and conglomerate (GSI Sheet 13).

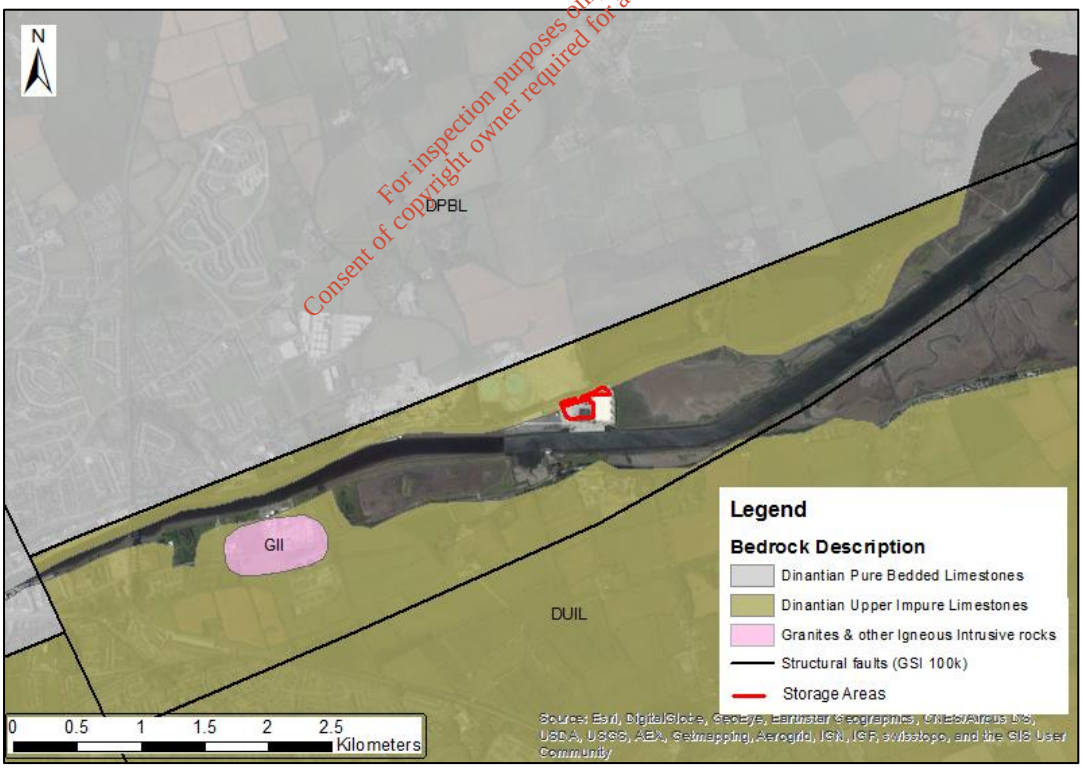

Figure 6.2 Solid Geology Underlying the Site *(source www.gsi.ie)*

The port site is currently covered in Made Ground (Concrete and fill material). According to the GSI (2015) classification the site is underlain by Marine Sediments (MarSed) soils (see Figure 6.3) and Estuarine Sediments (Mesc) subsoils such as silts/clays, as highlighted in Figure 6.4.

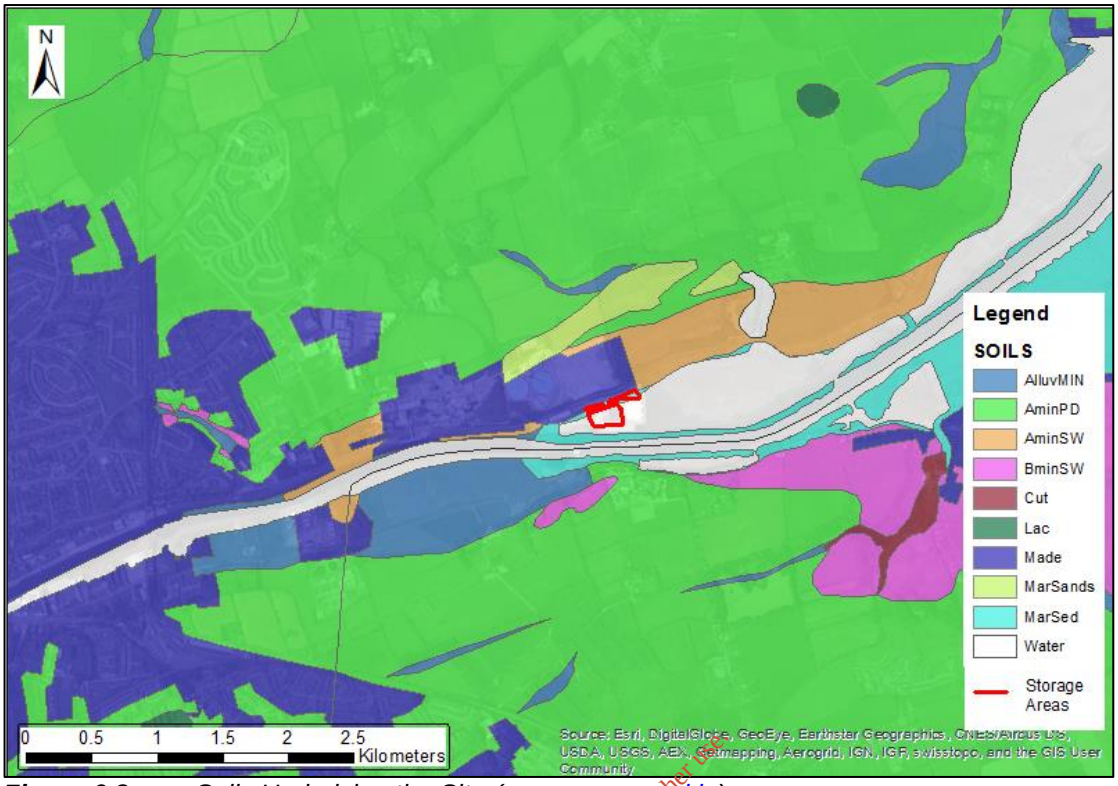

Figure 6.3 *Soils Underlying the Site (source www.gsi.ie)*

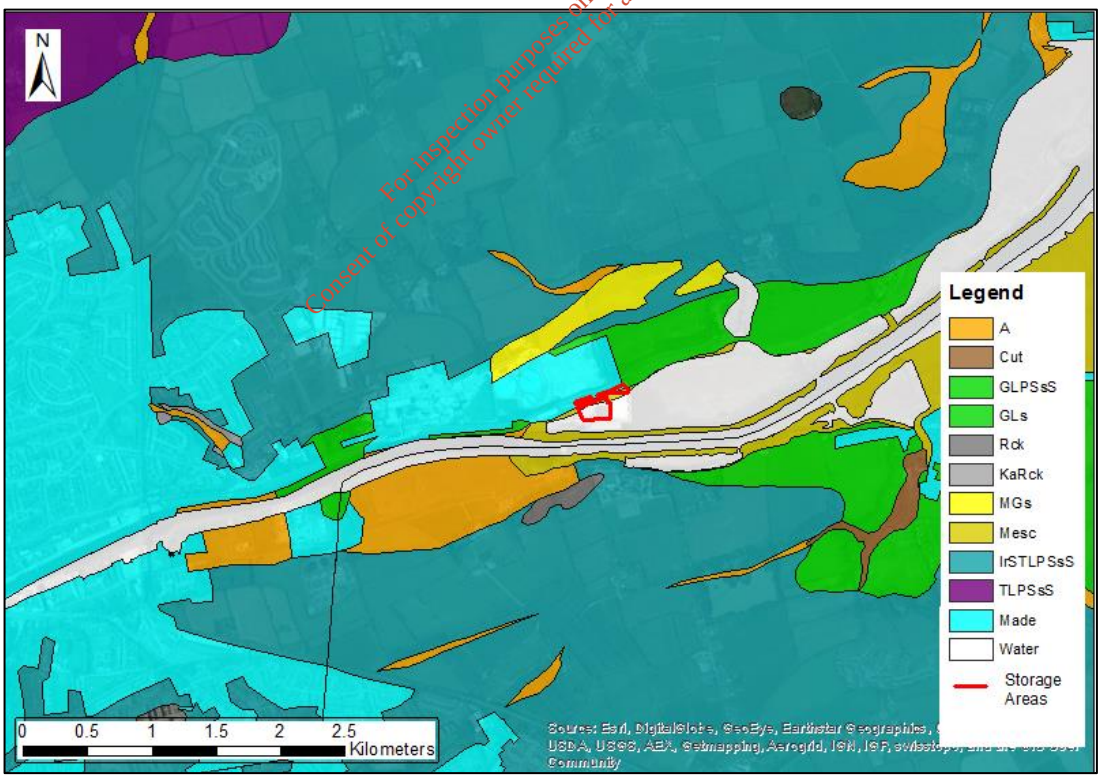

Figure 6.4 *Subsoils Underlying the Site (source www.gsi.ie)*

6.3.2 Superficial Geology – Local Setting

6.3.2.1 2015 Site Investigation

A site investigation completed in January 2015 involved the drilling of 11 no. boreholes across the site at TRP (see Section 8.0). Figure 6.5 below presents the locations of these wells.

Figure 6.5 *Exploratory Borehole Locations at TRP in 2015*

Borehole locations were chosen to be representative of the location of waste set down areas and to provide upgradient and downgradient sampling points. Ground conditions at all locations were recorded during the drilling process by an AWN Hydrogeologist, in conjunction with driller's logs (including geological successions and water strikes).

In general, following review of all borehole logs, the site stratigraphy varies slightly across the site but generally consists of concrete and fill (MADE GROUND) overlying different variations of silt & clays (natural ground), underlain by estuarine sand and gravel, overlying bedrock. A summary of the ground stratigraphy observed together with indicative depths encountered is outlined as follows:

- Concrete (made ground) (0.0-0.4 mbgl);
- Fill (made ground) (0.15-3.0 mbgl);
- Soft to firm gravelly clay with occasional cobbles (1.0-14.3 mbgl);
- Cement by-products or landfill materials (made ground) (0.9-4.5 mbgl);
- Soft black organic silt (2.8-6.5 mbgl);
- Fine sand with shell fragments (2.6-17.00 mbgl);
- Angular to sub-rounded gravels (14.0-20.5 mbgl); and
- Possible bedrock (impure limestones) at 20.5 mbgl (in 103d)

The recorded details of the superficial deposits are presented on the borehole logs in Appendix A. Observed cement by-products consist of soft white and green clay materials and hardened cement fragments. Other manmade deposits include landfill deposits (106S). These manmade deposits are found at the centre of the site (Boreholes 102,106, 108 and 109) and have the potential to contain historic contamination.

The manmade deposits are underlain by gravelly clays in the north and underlain by fine sand in the centre of the site. Closer to the Boyne River the site is underlain by a black silt which sits on top of the fine sand. A pungent odour was observed during drilling from the black organic silt.

Figure 6.6 below presents the geological cross section for the site (approximately west to east) which aims to show the spatial and vertical distribution of the encountered

successions. Similarly Figure 6.7 illustrates the geological section across the site in a northwest to southeast direction.

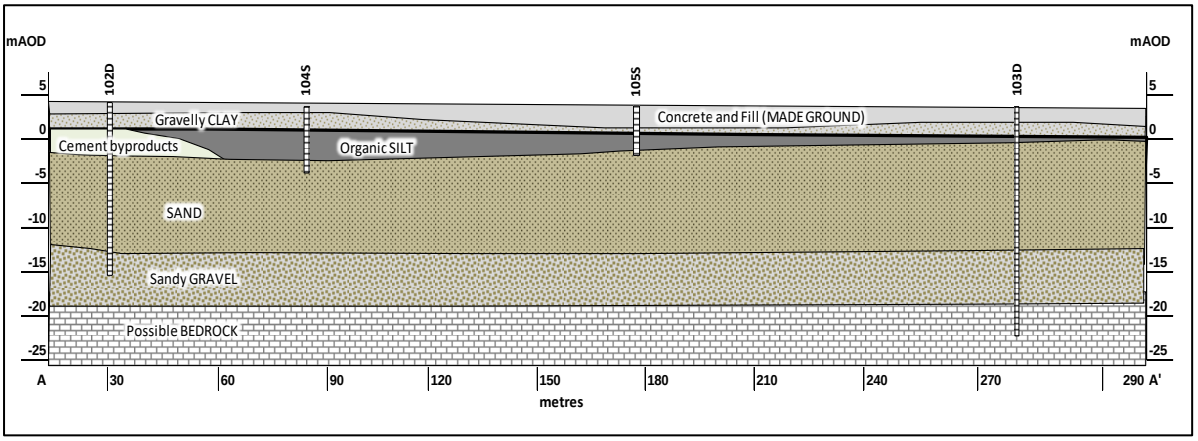

Figure 6.6 *Geological Cross Section (A – A')*

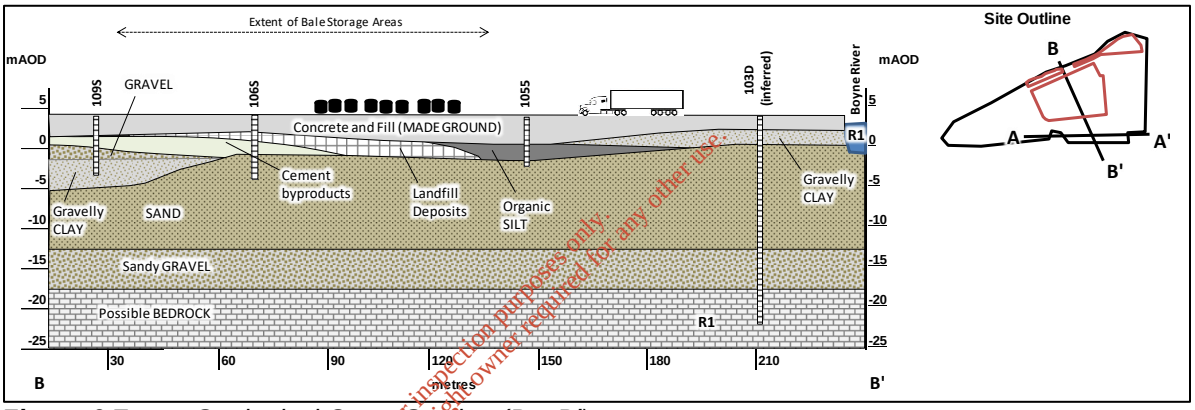

Figure 6.7 *Geological Cross Section (B – B')*

6.3.2.2 2019 Site Investigation

A site investigation completed in May 2019 involved the drilling of 2 no. boreholes on the site at TRP (see Section 8.0) i.e. 1 no. location (BH01) in an area which will remain within the IE licensed boundary and 1 no. location (BH02) which will be removed from the site and will therefore be outside the IE licensed boundary. Figure 6.8 below presents the locations of these boreholes.

Figure 6.8 *Exploratory Borehole Locations at TRP in 2019*

Ground conditions at all locations were recorded during the drilling process by Causeway Geotech Limited.

A summary of the ground stratigraphy observed together with indicative depths encountered is outlined as follows:

- Paved surface: BH01 and BH02 encountered 250mm of macadam surfacing;
- Made Ground (sub-base): BH01 and BH02 encountered 950 – 1050mm of aggregate fill mixed with lean mix concrete beneath the paved surface;
- Made Ground (fill): reworked sandy gravelly clay fill with fragments of concrete, red brick and timber encountered in both boreholes to a maximum depth of 3.00m. A material which was described as hardened cement mix, pink and green in colour was encountered down to 4.0m in BH02; and
- Estuarine deposits: medium dense sands and firm to stiff sandy silt encountered to 8.0m in both holes.

The recorded details of the superficial deposits are presented in the borehole logs in Appendix A.

6.3.3 Regional Hydrogeology

The Milverton Group has been classified as a Locally Important Bedrock Aquifer which is generally moderately productive. Figure 6.9 below presents the aquifer classification for the site according to the GSI (2014).

The site is located within the Drogheda WFD groundwater body (IE_EA_G_025) which is classified as a karstic aquifer. The Drogheda groundwater body encompasses both the regionally important karstified aquifer dominated by diffuse flow to the north of the site (See Figure 6.8) and the locally important aquifer directly underlying the site. The groundwater body WFD Status (which is based on overall chemical status and quantities status) between the years 2007-2009 was 'Poor' and was upgraded to 'Good' between the years 2010-2012. However, the WFD score suggests that the Drogheda groundwater body is 'at risk of not achieving good status' by 2015 (EPA 2015).

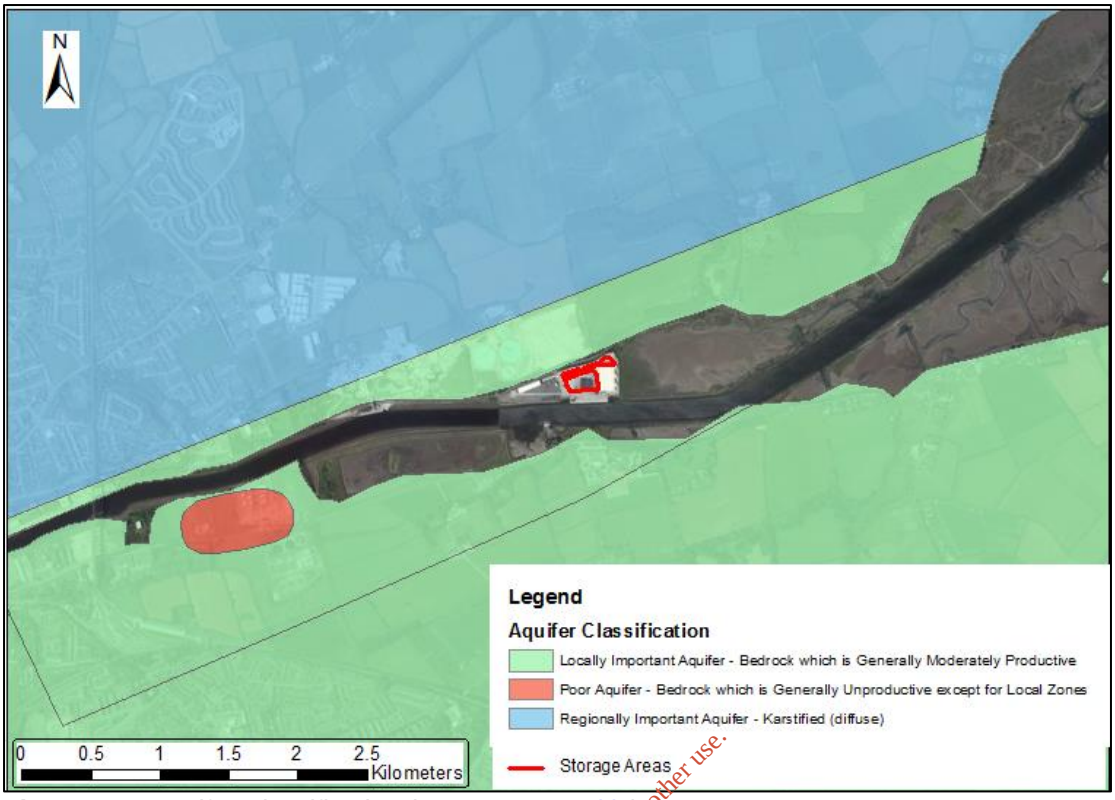

Figure 6.9 *Aquifer Classification (source www.gsi.ie)*

The nature of groundwater flow depends on the degree of karstification of the limestone. Where the aquifer is heavily karstified (north of the site), groundwater flow tends to be concentrated along a relatively small number of enlarged conduits. Where the bedrock is less karstified (i.e. directly beneath the site), the groundwater flow tends to be through a series of connected fractures and joints. Water enters the aquifer by point and diffuse recharge and waters will discharge from the aquifer directly to the coast and also, where the water table is above the river stage, to the rivers in the area (GSI 2015).

The hydrochemical signature for the Drogheda groundwater body consistently shows a calcium bicarbonate signature. Typical electrical conductivity values range from 550 to 650 uS/cm, with moderately hard to very hard waters and alkalinity values of 150 to 350 mg/l.

Figure 6.10 below highlights the groundwater vulnerability beneath the site. The groundwater vulnerability index is related to the thickness and permeability of the overburden. Based on the site investigation which confirmed the presence of a thick layer (up to 0.40 m) of MADE GROUND concrete (densophalt), and a depth to bedrock greater than 20 metres below ground level (mbgl), the aquifer immediately beneath the site may be considered as low.

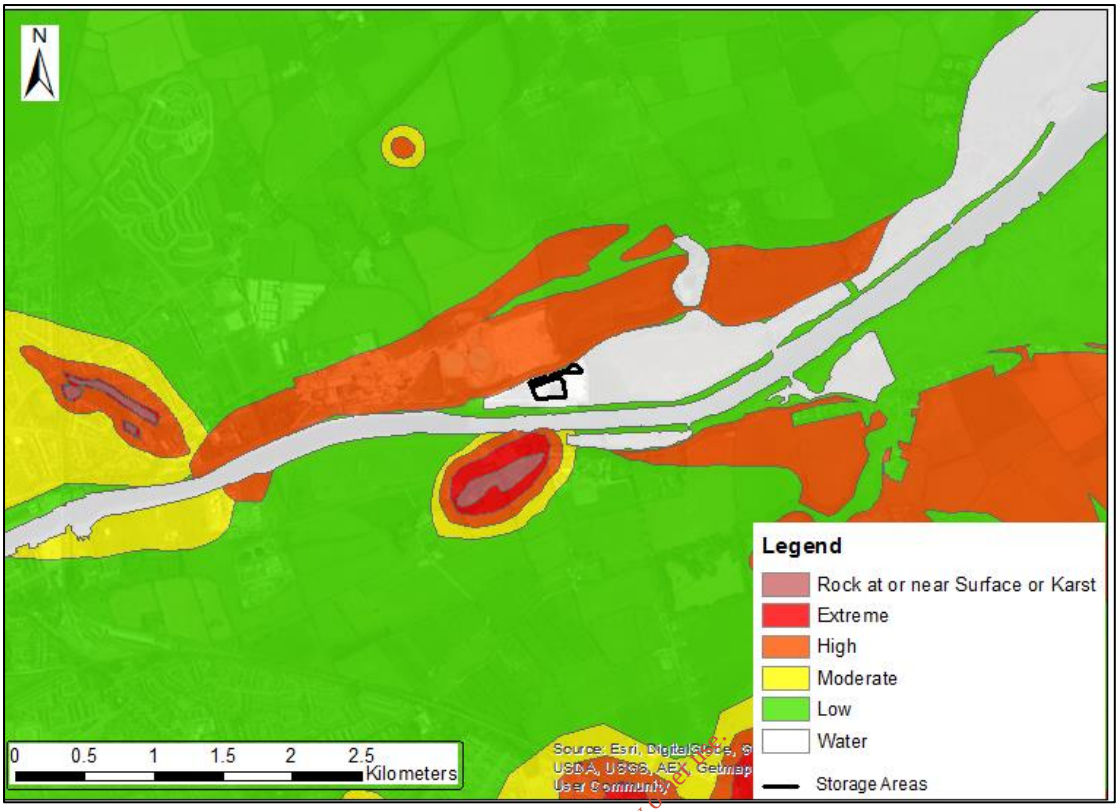

Figure 6.10 Groundwater Vulnerability *(source www.gsi.ie)*

Figure 6.11 presents the GSI listed well data. *Note: As boreholes currently do not require licensing in Ireland, this data source may not be representative of a complete record for the area.*

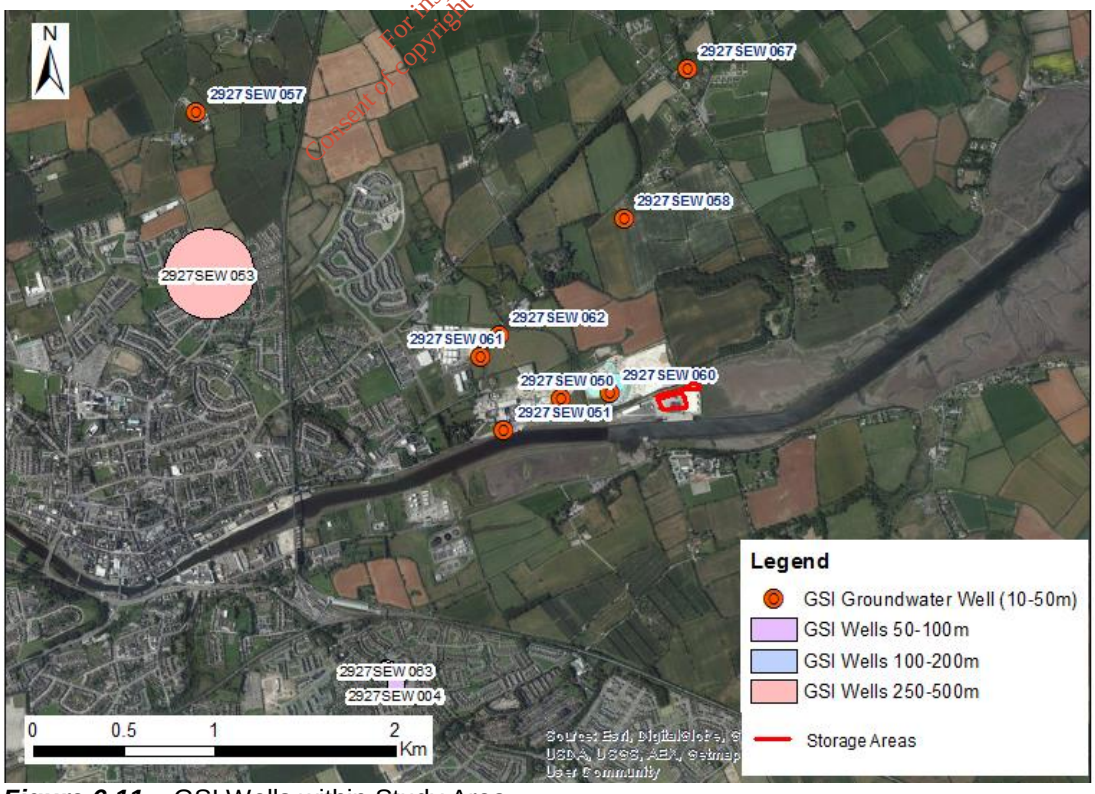

Figure 6.11 GSI Wells within Study Area

The GSI well data highlights the presence of several wells close to TRP, primarily in the regionally important aquifer, north of the site. These industrial and agricultural use wells demonstrate moderate to excellent well yields, as can be seen in Table 6.1 below.

Table 6.1 below summarises the GSI well data including available descriptions.

GSI Name	Type	Depth of Borehole (mbgl)	Depth to Bedrock (mbgl)	Use	Yield Class	Yield m^3/d	Water Strike (mbgl)
2927SEW004	Dug well	3	-	-	-	-	-
2927SEW050	Borehole	25.9	-	Industrial	Good	218.2	-
2927SEW051	Borehole	19.8	-	Industrial	Moderate	54.5	-
2927SEW053	Borehole	62	42	Industrial	Good	231	-
2927SEW057	Borehole	31	Not Met	Agri & domestic	Moderate	43.2	-
2927SEW058	Borehole	17	Not Met	Agri & domestic	Moderate	51.8	-
2927SEW060	Borehole	22	Not Met	Industrial	Excellent	734.4	-
2927SEW061	Borehole	-	-	Industrial	Good	103	-
2927SEW062	Borehole	29	Not Met	Industrial	Good	130	-
2927SEW063	Borehole	50	-	Industrial	Good	130	-
2927SEW064	Borehole	54		Industrial	-	-	-
2927SEW067	Borehole	54.9	21.3	Agri & domestic	Moderate	43.6	42.7

mbgl = metres below ground level

Table 6.1 GSI Well Descriptions

GSI well 2927SEW060 (well depth of 22.0 mbgl) is situated within the RHI Premier Periclase Ltd Site, just north of the Port site at TRP. The groundwater well is present for monitoring purposes and not used for abstraction purposes. An assessment of groundwater quality found "the groundwater beneath the RHI Periclase site had elevated levels of Na, Cl and SO_4 indicating the presence of brackish to saline water and is not fit for human consumption without treatment (RHI Premier Periclase Annual Environmental Reports 2008-2012).

Groundwater Flow

Regional groundwater flow would be expected to be in the direction of the Boyne Estuary and towards the sea provided that water levels are not influenced dewatering/ pumping activities in the immediate vicinity of TRP.

Static water levels (SWLs) were measured following the drilling and installation of the wells at TRP in order to confirm the direction of ground flow. SWLs taken on the 21st of January 2015 are summarised in Table 6.2 below.

Date	23/01/2014		05/02/2015	
Well ID	**mbgl**	**mAOD**	**mbgl**	**mAOD**
101D	2.76	1.2	2.68	1.28
102D	3.95	0.27	2.54	1.68
103D	3.265	0.225	2.41	1.08
104S	3.31	0.2	2.83	0.68
106S	3.74	0.29	2.51	1.52
108S	2.85	1.79	2.29	2.35

Note: mbgl= metres below ground level; mAOD = metres Above Ordnance Datum

Table 6.2 Groundwater Level Measurements

Figure 6.12 *Groundwater Flow at TRP (January 2015)*

Groundwater flow contouring was undertaken to confirm the local groundwater direction beneath the site at TRP as illustrated in Figure 6.12. The local shallow groundwater flow (as determined from 104S, 106S & 108S) is consistent with flow in a south-southeast direction and towards the Boyne River with a hydraulic gradient of approximately 0.02. The direction of groundwater flow in the bedrock could not be determined from the site investigation since only one well (103D) encountered bedrock. However as groundwater will discharge to the estuary it is expected to be also in a southerly direction.

6.4 Surrounding Land Use

Immediately adjacent to Drogheda Port at TRP, is the Licenced Integrated Pollution Prevention and Control (IPPC) facility known as RHI Premier Periclase Limited which produces high quality seawater sinter magnesia at its plant. The magnesia is precipitated from seawater by the addition of slaked lime, the latter of which is produced on-site. Part of the RHI Premier Perglase site includes a landfill for inert material (RHI Premier Periclase Annual Environmental Reports 2008-2012).

The main land uses surrounding the site are agricultural, marsh land between the low and high tide marks and residential areas towards Drogheda town.

7.0 STAGE 6 – CONCEPTUAL SITE MODEL

This section presents the Conceptual Site Model (CSM) for the site based on the information obtained above.

The pollutant linkages based on the primary sources of possible contaminants on site are summarised in Table 7.1. Note this CSM is presented on the basis that contamination following a leak/spill is not mitigated by the mitigation measures operating at the site.

The CSM is illustrated as Figure 7.1 below.

The qualitative risk assessment has considered the following risk levels:

- **High Risk**: These are considered to be high-level risks requiring priority attention. These risks have the potential to be catastrophic and need to be addressed quickly;
- **Moderate Risk**: These are medium-level risks requiring action but not considered critical; and
- **Low Risk:** These are the lowest risks and indicate a need for continuing awareness and a possible need for on-going monitoring.

Contaminant of Concern	Potential Sources	Migration/ Pathways	Receptors	Risk Assessment
Inorganics (including Metals) & Hydrocarbons	Historical leakage from underlying Fill materials (S1)	Migration of contaminants via groundwater (P1)	Migration of potential contaminants through overburden into Boyne River/ Estuary (R1)	**Low to Mod** The presence of waste made ground has the potential for migration of historical contaminants via shallow groundwater flow to the Estuary. Low to medium permeabilties of the sand and silt layers provide a pathway for contamination migration into the River/ Estuary. Direct recharge is limited due to the presence of low permeability capping which will reduce the mobilisation of any contaminants present.
			Vertical migration of potential contaminants into competent bedrock (R2)	**Low** Shallow groundwater flow direction is towards the estuary and flow is less likely to migrate vertically into the bedrock/ aquifer due to the thickness of the overburden and the proximity of the estuary.
	Accidental release of leachate/ contaminated runoff from RDF and SRF set down areas (S2)	Migration of contaminants via groundwater (P1)	Vertical migration of potential contaminants into competent bedrock (R2)	**Low** The presence of low permeability capping and stormwater drains reduces the potential of accidental release of leachate resulting in contaminated water migrating into underlying soils. In addition the thickness of soil will protect the underlying bedrock aquifer
			Migration of potential contaminants through overburden into Boyne River/ Estuary (R1)	
	Accidental minor hydrocarbon drips/leaks from operating traffic (S3)	Migration of contaminants via stormwater drains (P2)	Migration from stormwater drains into Estuary (R1)	**Low to Mod** Strict bale handling procedures are implemented onsite to minimise the volumes of contaminated run-off entering the surface drainage system. An improved closed drainage system is now in place which would divert leachate into an attenuation tank. As this removes any pathway to the river, the risk is considered to be low.

Table 7.1 *Source-Pathway-Receptor Assessment Summary*

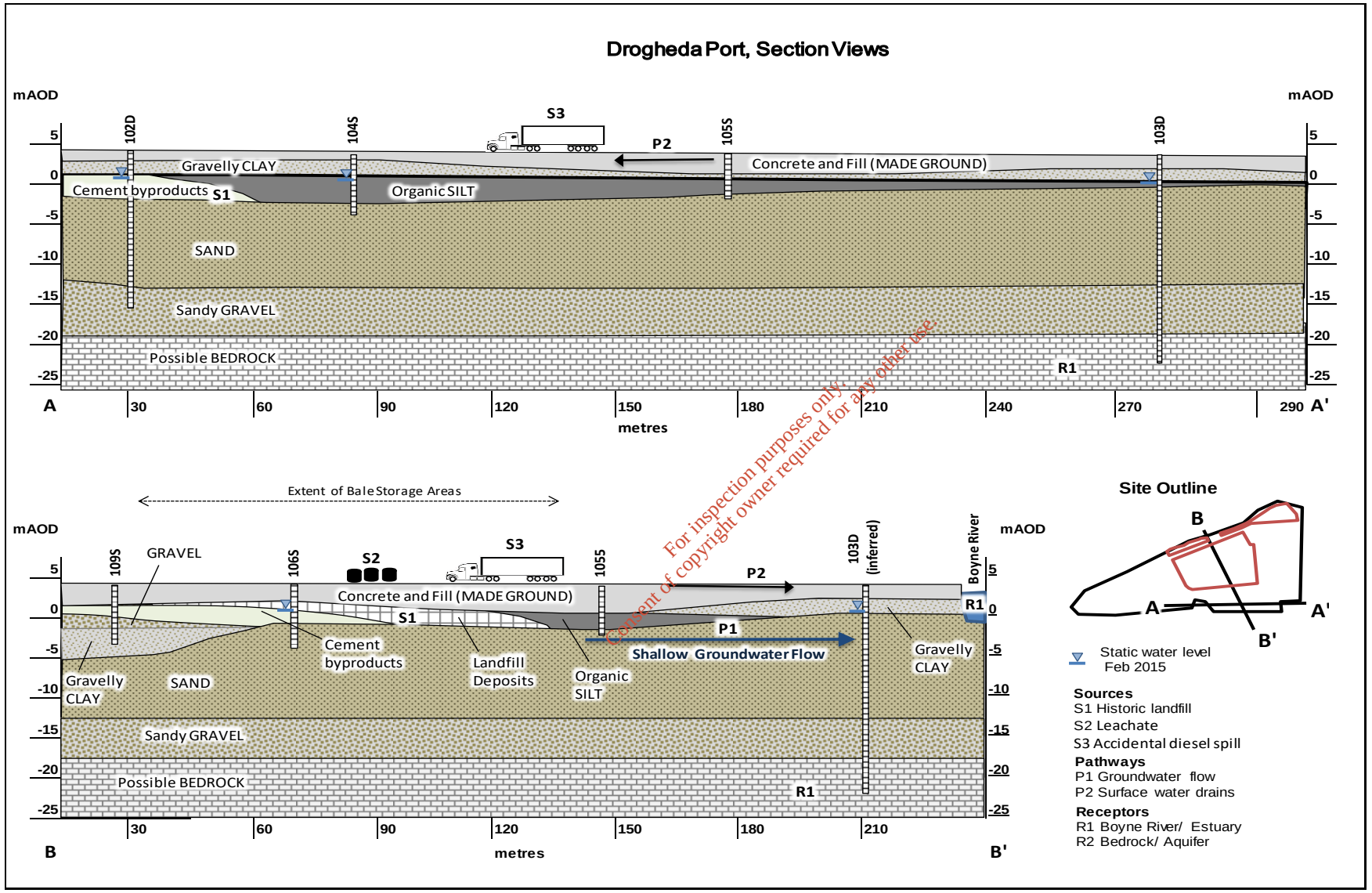

Figure 7.1 *Conceptual Site Model for TRP (Feb 2015)*

8.0 STAGE 7 – SITE INVESTIGATION & BASELINE SOIL & WATER QUALITY ASSESSMENT

Additional site investigation including soil and water sampling was undertaken in 2015 and 2019 at systematically laid out locations to confirm the nature of the geology and soil quality across the site. Baseline soil and groundwater quality is also presented below.

8.1 Additional Site Investigations

8.1.1 2015 Site Investigation

In 2015, a total of 11 no. shallow and deep wells were drilled and installed to obtain soil and groundwater quality data across the Port site. The wells were drilled by Causeway Geotech Limited and supervised by an AWN Hydrogeologist.

3 deep wells to a maximum of 25 metres below ground level (mbgl) were drilled and installed by an air rotary percussive drilling method, commonly used to identify inflowing water strikes at depth. 8 no. shallow wells (to a maximum of 8 mbgl) were drilled by cable percussion technique of which 3 no. wells were installed for groundwater and ground gas monitoring purposes.

Locations of all shallow and deep wells across the site are shown in Figure 6.5. Borehole log descriptions are presented in Appendix A.

8.1.2 2019 Site Investigation

In 2019, 2 no. light cable percussion boreholes were drilled and installed between the 13th and the 15th of May 2019 to obtain soil and groundwater quality data i.e. 1 no. location (BH01) in an area which will remain within the IE licensed boundary and 1 no. location (BH02) in the area which will be removed from the site and will therefore be outside the IE licensed boundary. The wells were drilled by Causeway Geotech Limited.

The 2 no. boreholes (BH01-BH02) were drilled down to completion (to a maximum of 8 mbgl) in minimum 200mm diameter using a Dando 2000 light cable percussion boring rig. Both boreholes were terminated at their scheduled completion depths. A groundwater monitoring standpipe was installed in both boreholes.

Locations of the wells across the site are shown in Figure 6.8. Borehole log descriptions are presented in Appendix A.

8.2 Installation of Groundwater Monitoring Wells

8.2.1 2015 Site Investigation

The groundwater monitoring wells were drilled and installed between the 13th and 21st of January 2015. The well construction details are summarised in Table 8.1 below.

Well ID	Date drilled	Depth to bedrock (mbgl)	Depth of pipe (mbgl)	Standpipe diameter (mm)	Well depth (m)	Well diameter (mm)
101D	13/01/2015	n/a	20.1	50	20.1	128
102D	14/01/2015	n/a	20.0	50	20.0	128
103D	15/01/2015	20.5	25.0	50	25.0	128
104S	15/01/2015	n/a	7.9	50	7.9	203
105S	15/01/2015	n/a	No installation		5.5	203
106S	16/01/2015	n/a	8.0	50	8.0	203
107S	19/01/2015	n/a	No installation		7.5	203
108S	20/01/2015	n/a	8.5	50	8.5	203
109S	20/01/2015	n/a	No installation		7.4	203
110S	21/01/2015	n/a	No installation		1.7	203
101S	21/01/2015	n/a	No installation		8.0	203

Note: mbgl = metres below ground level;

Table 8.1 Monitoring Well Construction Details (January 2015)

Each monitoring well was constructed with the following specifications:

- 50mm diameter PVC liner installed from ground surface to base of borehole with machine-slotted sections as indicated on borehole logs;
- The annular space around the well is filled with gravel pack on top of which a bentonite seal (0.3-0.5m) is placed, to prevent vertical migration of any solute down the well;
- The tops standpipe installations require removable gas tables for water and gas monitoring; and
- Well head construction consisted of steel flush covers secured by simple bolts.

The locations of the wells are highlighted on Figure 6.5. The borehole and well construction details for all wells 101-108 (S-Shallow, D-Deep) are presented in Appendix A.

8.2.2 2019 Site Investigation

The groundwater monitoring wells were drilled and installed between the 13th and 15th of May 2019 according to the specifications outlined in Section 8.2.1 above. The well construction details are summarised in Table 8.2 below.

Well ID	Date drilled	Depth to bedrock (mbgl)	Depth of pipe (mbgl)	Standpipe diameter (mm)	Well depth (m)
BH01	13/05/2019	n/a	8	50	8
BH02	15/05/2019	n/a	8	50	8

Table 8.2 Monitoring Well Construction Details (May 2019)

Locations of the wells are shown in Figure 6.8. Borehole log descriptions are presented in Appendix A.

8.3 Soil Sampling

8.3.1 2015 Site Investigation

In 2015, soil samples were taken at a minimum of one sample per metre or at every change in strata, during the drilling by the AWN Hydrogeologist. The soil samples were taken between the 13th and 21st of January 2015 sent to Chemtest Laboratories (UKAS accredited) immediately following the completion of drilling.

The suite of soil quality parameters tested is listed below:

- Asbestos - Screening
- Aluminium
- Arsenic-total
- Boron-water soluble
- Cadmium-total
- Chromium-total
- Chromium-hexavalent
- Copper-total
- Lead-total
- Iron
- Manganese
- Magnesium
- Sodium
- Potassium
- Mercury-total
- Nickel-total
- Zinc-total
- Cyanide, Total
- Phenols-total
- Sulphate, Total
- Sulphate, water 2:1
- pH
- PAH
- Ammonical Nitrogen
- Total Petroleum Hydrocarbons
- Mineral Oil

Soil sampling depths are recorded on borehole logs presented in Appendix A.

8.3.2 2019 Site Investigation

The soil samples were taken between the 13th and 15th of May 2019 and sent to Chemtest Laboratories (UKAS accredited) immediately following the completion of drilling. The suite of soil quality parameters tested is listed in Section 8.3.1 above. Soil sampling depths are recorded on borehole logs presented in Appendix A.

8.3.3 Soil Analysis and Quality

The presence of any contamination above the laboratory detection limits has been considered. In addition, soil samples were compared to a Generic Assessment Criteria (GAC) derived to be protective of human health and also ecology for a commercial/industrial end use.

Generic Assessment Criteria are soil concentrations that have been derived for a defined set of generic assumptions and are used as trigger values in determining whether further risk management action is required in cases where detailed quantitative risk assessment is not being undertaken. There are no published Generic Assessment Criteria for soils in the Republic of Ireland. Instead reliance is often placed on criteria from the UK and the Netherlands.

Generic Assessment Criteria in the UK has been derived using the Contaminated Land Exposure Assessment (CLEA) model to be protective of human health for a number of

different land uses. To date, the UK's Environment Agency has released reports with Soil Guidance Values on a number of organic substances including BTEX and is intending to release further reports for PAHs. In the interim, LQM (Land Quality Management) and the CIEH (Chartered Institute of Environmental Health) developed a document in July 2009 detailing their own research and derivation of their own 'LQM GACs'. A total of 82 substances including many organic substances had LQM GACs derived, for the standard land uses of residential, commercial/industrial and allotments.

The Dutch Guideline values are derived based on a consideration of toxicity to human and ecological receptors. There are two values for each contaminant, an intervention value and a target value. The target value is the value one would expect in un-contaminated soil (from say an agricultural environment). The intervention value is set on the basis of a toxicological assessment of the impact of the contaminant on the health of human receptors and assumes that the human receptor is exposed to the contaminant through ingestion of soil and water, dermal contact with soil and water, eating vegetables grown on soil and inhalation of soil dust and vapour. According to the publication accompanying the Dutch Values, any value above the intervention value is regarded as indicating contamination, which may require further investigation and possible remediation. However, caution was used when applying the Dutch Values as they are not site end use specific and assess for vegetable growing, provision of drinking water and washing and showering in water from the site. Nevertheless, they are a useful screening tool for determining the significance of site contamination.

Neither the Dutch nor the UK values have any legal standing within the Republic of Ireland and no statutory guidance for assessing the significance of soil contamination currently exists. However, the values do provide a means of placing the data within context when considering magnitude of risk and have been used in that capacity for this assessment. The main basis of the assessment remains the conceptual site model and consideration of the pollutant linkages: Source - Pathway – Receptor.

The laboratory results for 11 no. of selected samples analysed in 2015 and the 8 no. of samples analysed in 2019 are attached in Appendix B. A comparison of the soil data against UK and Dutch derived guideline values was made. Tables 8.3, 8.4, 8.5, 8.6 and 8.7 below summarises results for representative soil quality testing where a GAC is exceeded it is highlighted in pink.

8.3.3.1 2015 Site Investigation

Date 26-Jan 2015 Sample ID.:	COMMER-CIAL/ INDUST-RIAL HHRA	Ref.	Dutch S-Value	Dutch I-Value	Units	LOD	BH102	BH103	BH104	BH104	BH106	BH106
Sample Type:							SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Top Depth (m):							5.00	18.50	2.00	6.00	2.00	4.50
Inorganics												
Asbestos Identification					%	0.001	NAD	NAD	NAD	NAD	NAD	NAD
Moisture					%	0.02	42	15	32	19	34	24
pH							11.4	9.3	10.1	9.9	9.3	8.9
Boron (Hot Water Soluble)					mg/kg	0.4	1.7	0.84	1.6	0.65	5.5	3
Sulphate (2:1 Water Soluble) as SO4					g/l	0.01	2.3	0.13	1.1	0.39	1.5	0.77
Cyanide (Total)			1	20	mg/kg	0.5	-	-	-	-	-	-
Potassium (Available)					mg/l	2	13000	420	8500	950	280	950
Sodium					mg/l	2	16000	2800	3400	600	250	650
Ammoniacal Nitrogen					mg/kg	0.5	-	-	-	-	3	5.1
Heavy Metals												
Aluminium (Total)					mg/kg	100	6300	8600	9200	3600	6400	5400
Iron (Total)					mg/kg	100	7600	14000	14000	10000	8800	12000
Magnesium (Total)					mg/kg		1100	790	620	410	1200	610
Sulphate (Total)					%	0.01	1.3	0.43	1.5	0.27	2.9	1.4
Arsenic	640	SGV	29	55	mg/kg	1	24	16	21	8.4	24	8.7
Cadmium	230	SGV	0.8	12	mg/kg	0.1	3.2	0.33	0.58	0.26	6.6	0.28
Chromium	35	LQM GAC	100	380	mg/kg	1	22	40	27	15	24	18
Copper	71700	LQM GAC	39	190	mg/kg	0.5	56	26	24	6.6	36	9.5
Mercury	3600	SGV	0.3	10	mg/kg	0.1	-	-	0.15	-	-	-
Manganese					mg/kg	5	540	740	440	290	530	330
Nickel	1800	SGV	35	210	mg/kg	0.5	23	51	25	15	23	18
Lead			85	530	mg/kg	0.5	1000	23	59	11	170	20
Zinc	665000	LQM GAC	140	720	mg/kg	0.5	57	55	65	29	55	38
Chromium (Hexavalent)					mg/kg	0.5	-	-	-	-	-	-
TPHs												
Mineral Oil			50	5000	mg/kg	10	-	-	-	-	-	-
Total TPH >C6-C40					mg/kg	10	-	-	-	-	-	-
PAHs												
Naphthalene					mg/kg	0.1	-	-	-	-	-	-
Acenaphthylene					mg/kg	0.1	-	-	-	-	-	-
Acenaphthene					mg/kg	0.1	-	-	-	-	-	-
Fluorene					mg/kg	0.1	-	-	-	-	-	-
Phenanthrene					mg/kg	0.1	-	-	0.5	-	-	-
Anthracene					mg/kg	0.1	-	-	1.5	-	-	-
Fluoranthene					mg/kg	0.1	0.15	-	0.47	-	-	-
Pyrene					mg/kg	0.1	0.28	-	0.45	-	-	-
Benzo[a]anthracene					mg/kg	0.1	-	-	0.21	-	-	-
Chrysene					mg/kg	0.1	-	-	0.49	-	-	-
Benzo[b]fluoranthene					mg/kg	0.1	-	-	0.32	-	-	-
Benzo[k]fluoranthene					mg/kg	0.1	-	-	0.26	-	-	-
Benzo[a]pyrene					mg/kg	0.1	-	-	0.42	-	-	-
Indeno(1,2,3-c,d)Pyrene					mg/kg	0.1	-	-	0.16	-	-	-
Dibenz(a,h)Anthracene					mg/kg	0.1	-	-	-	-	-	-
Benzo[g,h,i]perylene					mg/kg	0.1	-	-	0.3	-	-	-
Total Of 16 PAH's			1	40	mg/kg	2	-	-	5.1	-	-	-
Phenols												
Total Phenols					mg/kg	0.3	0.55	-	-	-	-	-

Note: Dutch values for normal uncontaminated soil

Legend: - below detection limit NAD No Asbestos Detected

above Dutch S value LOD Limits of Detection

Table 8.3 Soil Quality Results (BH102-BH106) in 2015

Date 26-Jan 2015 Sample ID.:	COMMER-CIAL/ INDUST-RIAL HHRA	Ref.	Dutch S-Value	Dutch I-Value	Units	LOD	BH107	BH108	BH109	BH109	BH111
Sample Type:							SOIL	SOIL	SOIL	SOIL	SOIL
Top Depth (m):							**5.00**	**3.50**	**1.20**	**7.00**	**3.00**
Inorganics											
Asbestos Identification					%	0.001	NAD	NAD	NAD	NAD	NAD
Moisture					%	0.02	27	28	13	12	37
pH							8.8	10.1	8.6	9.5	10.2
Boron (Hot Water Soluble)					mg/kg	0.4	8.5	7.2	0.79	0.74	0.85
Sulphate (2:1 Water Soluble) as SO4					g/l	0.01	0.97	1.2	0.08	0.081	0.1
Cyanide (Total)			1	20	mg/kg	0.5	-	-	-	-	-
Potassium (Available)					mg/l	2	1600	3400	320	480	6500
Sodium					mg/l	2	3100	4000	200	1300	6500
Ammoniacal Nitrogen					mg/kg	0.5	4.6	-	5.7	-	-
Heavy Metals											
Aluminium (Total)					mg/kg	100	3600	7000	5000	12000	11000
Iron (Total)					mg/kg	100	20000	14000	16000	19000	19000
Magnesium (Total)					mg/kg		2100	540	820	1500	440
Sulphate (Total)					%	0.01	0.62	1.1	0.13	0.027	1.6
Arsenic	640	SGV	29	55	mg/kg	1	24	16	21	10	17
Cadmium	230	SGV	0.8	12	mg/kg	0.1	0.51	0.36	1.9	0.2	0.49
Chromium	35	LQM GAC	100	380	mg/kg	1	14	22	19	41	37
Copper	71700	LQM GAC	39	190	mg/kg	0.5	9	18	23	26	24
Mercury	3600	SGV	0.3	10	mg/kg	0.1	-	0.14	-	-	0.21
Manganese					mg/kg	5	1900	820	1700	720	500
Nickel	1800	SGV	35	210	mg/kg	0.5	37	22	44	51	34
Lead			85	530	mg/kg	0.5	32	62	72	17	69
Zinc	665000	LQM GAC	140	720	mg/kg	0.5	73	77	88	55	120
Chromium (Hexavalent)					mg/kg	0.5	-	-	-	-	-
TPHs											
Mineral Oil			50	5000	mg/kg	10	-	-	-	-	-
Total TPH >C6-C40					mg/kg	10	-	-	-	-	-
PAHs											
Naphthalene					mg/kg	0.1	-	-	-	-	-
Acenaphthylene					mg/kg	0.1	-	-	-	-	-
Acenaphthene					mg/kg	0.1	-	-	-	-	-
Fluorene					mg/kg	0.1	-	-	-	-	-
Phenanthrene					mg/kg	0.1	1.1	1.7	-	-	-
Anthracene					mg/kg	0.1	0.65	0.64	-	-	-
Fluoranthene					mg/kg	0.1	0.34	0.38	-	-	0.56
Pyrene					mg/kg	0.1	0.43	0.31	-	-	0.63
Benzo[a]anthracene					mg/kg	0.1	-	0.51	-	-	0.26
Chrysene					mg/kg	0.1	0.24	0.22	-	-	0.31
Benzo[b]fluoranthene					mg/kg	0.1	0.29	0.14	-	-	0.64
Benzo[k]fluoranthene					mg/kg	0.1	0.21	0.17	-	-	0.66
Benzo[a]pyrene					mg/kg	0.1	0.25	0.22	-	-	0.41
Indeno(1,2,3-c,d)Pyrene					mg/kg	0.1	-	0.17	-	-	0.27
Dibenz(a,h)Anthracene					mg/kg	0.1	-	0.2	-	-	0.2
Benzo[g,h,i]perylene					mg/kg	0.1	-	0.47	-	-	0.62
Total Of 16 PAH's			1	40	mg/kg	2	3.5	5.1	-	-	4.6
Phenols											
Total Phenols					mg/kg	0.3	-	1.3	-	-	0.8

Note: Dutch values for normal uncontaminated soil

Legend: - below detection limit NAD No Asbestos Detected

above Dutch S value LOD Limits of Detection

Table 8.4 Soil Quality Results (BH107-BH111)

The results show the exceedances of Dutch S values in a number of different heavy metals and Polyaromatic hydrocarbons (PAHs), but these do not exceed the Dutch I values or CLEA guidance concentrations.

Table 8.5 briefly summarises these exceedances above Dutch S values, with associated soil horizons more clearly. The results highlight that these exceedances of cadmium, lead and copper are associated with the Made Ground deposits found at the centre of the site. Exceedances of Nickel on the other hand are observed both in Made Ground and at much greater depth, with a possible natural geological background concentration in the deeper units.

Parameters in exceedance of Dutch S value	BH ID	Depth mbgl	Soil Description
Cadmium	106S	2.0	Grey/Brown Clay with cement by-products (MADE GROUND)
	109S	1.2	Sandy gravelly CLAY (MADE GROUND)
Lead	106S	2.0	Grey/Brown Clay with cement by-products (MADE GROUND)
	102D	5.0	Cement by-product (MADE GROUND)
Copper	102D	5.0	Cement by-product (MADE GROUND)
Nickel	109S	1.2	Sandy gravelly CLAY (MADE GROUND)
	107S	5.0	Silty SAND
	109S	7.0	Brown gravelly CLAY
	103D	18.5	GRAVEL
PAH	104S	2.0	Black organic SILT
	107S	5.0	
	108S	3.5	
	111S	3.0	

Table 8.5 Soil Quality exceedances (Dutch S) at TRP in 2015
Note no exceedances above Dutch I or CIEA guidance concentrations.

The presence of PAH correspond to the black SILT horizon (with notably pungent odour) at all corners of the site.

8.3.3.1 2019 Site Investigation

Date: 15 May 2019 Sample ID	Commerical/ Industrial HHRA	Ref.	Dutch S Value	Dutch L Value	Units	LOD	BH01	BH01	BH01	BH01	BH02	BH02	BH02	BH02
Sample Type							SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Top Depth (m)							0.50	1.50	2.00	4.00	0.50	1.00	2.00	4.00
ACM Type						N/A	Fibres/ Clumps	Fibres/ Clumps	-	-	-	-	-	-
Asbestos Identification					%	0.001	Chrysotile	Chrysotile Crocidolite	NAD	NAD	NAD	NAD	NAD	NAD
ACM Detection Stage						N/A	Stereo Microscopy	Stereo Microscopy	-	-	-	-	-	-
Moisture					%	0.020	15	19	6.8	24	11	38	40	43
pH						N/A	9.3	9.7	9.7	9.3	9.3	12.3	12.1	11.8
Boron (Hot Water Soluble)					mg/kg	0.40	1.5	1.6	0.87	0.61	0.88	1.2	1.7	1.6
Sulphate (2:1 Water Soluble) as SO4					g/l	0.010	0.80	0.48	0.034	0.13	0.39	2.0	2.2	2.0
Cyanide (Free)					mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Cyanide (Total)			1	20	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Thiocyanate					mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Sulphide (Easily Liberatable)					mg/kg	0.50	18	13	4.5	5.8	4.7	9.8	7.7	7.7
Sulphate (Total)					%	0.010	0.47	0.37	0.040	0.17	0.25	2.8	2.4	2.5
Arsenic	640	SGV	29	55	mg/kg	1.0	27	25	30	4.8	23	42	40	40
Cadmium	230	SGV	0.8	12	mg/kg	0.10	1.8	6.4	0.36	< 0.10	0.78	1.9	1.9	1.7
Chromium	8600	LQM GAC	100	380	mg/kg	1.0	28	99	13	10	16	37	34	35
Copper	71700	LQM GAC	39	190	mg/kg	0.50	27	44	8.5	2.0	14	48	44	44
Mercury	3600	SGV	0.3	10	mg/kg	0.10	0.13	0.14	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Nickel	1800	SGV	35	210	mg/kg	0.50	24	39	9.2	10	24	37	32	32
Lead			85	530	mg/kg	0.50	130	170	6.4	2.8	15	170	140	120
Selenium					mg/kg	0.20	< 0.20	0.87	< 0.20	< 0.20	0.20	0.83	0.75	0.77
Zinc	665000	LQM GAC	140	720	mg/kg	0.50	58	80	11	19	29	140	120	97
Chromium (Hexavalent)					mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Organic Matter					%	0.40	1.2	1.1	< 0.40	< 0.40	0.59	< 0.40	0.41	< 0.40
Total Aliphatic Hydrocarbons					mg/kg	5.0	< 5.0	39	100	33	16	22	22	34
Total Aromatic Hydrocarbons					mg/kg	5.0	< 5.0	53	130	51	25	68	68	62
Total Petroleum Hydrocarbons					mg/kg	10.0	< 10	92	240	84	41	90	89	96
Naphthalene					mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene					mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene					mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene					mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene					mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene					mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene					mg/kg	0.10	0.37	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene					mg/kg	0.10	0.36	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene					mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene					mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene					mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene					mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene					mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene					mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene					mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene					mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's			1	40	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Benzene					µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene					µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene					µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene					µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene					µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Phenols					mg/kg	0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30

Note: Dutch values for normal uncontaminated soil

Legend - below detection limit; above Dutch S value; NAD No asbestos detected; LOD Limits of detection

Table 8.6 Soil Quality Results (BH01-BH02)

The results show the exceedances of Dutch S values in a number of different heavy metals and Polyaromatic hydrocarbons (PAHs), and no exceedances of the LQM GAC for any of the parameters in both borehole locations.

Table 8.7 briefly summarises these exceedances with associated soil horizons more clearly. The results highlight that these exceedances of arsenic, cadmium, copper, nickel, lead, zinc and PAHs are associated with (either within or in close proximity) the Made Ground deposits found on the site.

Parameters in exceedance of Dutch S value	BH ID	Depth mbgl	Soil Description
Arsenic	BH01	2.0	MADE GROUND: Very stiff brown slightly sandy gravelly CLAY
	BH02	1.0	MADE GROUND: Very stiff green SILT (described by driller has hardened cement mix)
	BH02	2.0	MADE GROUND: Very stiff green SILT (described by driller has hardened cement mix)
	BH02	4.0	Medium dense silty fine to coarse SAND
Cadmium	BH01	0.5	MADE GROUND: Grey sandy angular fine to coarse GRAVEL
	BH01	1.5	MADE GROUND: Stiff brown slightly sandy CLAY with fragments of red brick, concrete and timber
	BH02	1.0	MADE GROUND: Very stiff green SILT (described by driller has hardened cement mix)
	BH02	2.0	MADE GROUND: Very stiff green SILT (described by driller has hardened cement mix)
	BH02	4.0	Medium dense silty fine to coarse SAND
Copper	BH01	1.5	MADE GROUND: Stiff brown slightly sandy CLAY with fragments of red brick, concrete and timber
	BH02	1.0	MADE GROUND: Very stiff green SILT (described by driller has hardened cement mix)
	BH02	2.0	MADE GROUND: Very stiff green SILT (described by driller has hardened cement mix)
	BH02	4.0	Medium dense silty fine to coarse SAND
Nickel	BH01	1.5	MADE GROUND: Stiff brown slightly sandy CLAY with fragments of red brick, concrete and timber
	BH02	1.0	MADE GROUND: Very stiff green SILT (described by driller has hardened cement mix)
Lead	BH01	0.5	MADE GROUND: Grey sandy angular fine to coarse GRAVEL
	BH01	1.5	MADE GROUND: Stiff brown slightly sandy CLAY with fragments of red brick, concrete and timber
	BH02	1.0	MADE GROUND: Very stiff green SILT (described by driller has hardened cement mix)
	BH02	2.0	MADE GROUND: Very stiff green SILT (described by driller has hardened cement mix)
	BH02	4.0	Medium dense silty fine to coarse SAND

Zinc	BH02	1.0	MADE GROUND: Very stiff green SILT (described by driller has hardened cement mix)
PAH	BH01	0.5	MADE GROUND: Grey sandy angular fine to coarse GRAVEL
	BH01	1.5	MADE GROUND: Stiff brown slightly sandy CLAY with fragments of red brick, concrete and timber
	BH01	2.0	MADE GROUND: Very stiff brown slightly sandy gravelly CLAY
	BH01	4.0	Firm grey sandy SILT
	BH02	0.5	MADE GROUND: Grey sandy angular fine to coarse GRAVEL
	BH02	1.0	MADE GROUND: Very stiff green SILT (described by driller has hardened cement mix)
	BH02	2.0	MADE GROUND: Very stiff green SILT (described by driller has hardened cement mix)
	BH02	4.0	Medium dense silty fine to coarse SAND

Table 8.7 Soil Quality exceedances at TRP in 2019

Asbestos was also detected in BH01 i.e. fibres/clumps of chrysotile at 0.5mbgl and fibres/clumps of chrysotile/crocidolite at 1.5mbgl. BH01 is located inside the area of the IE Licence boundary and therefore will remain as part of the TRP Set Down Facility and will not be subject to possible disturbance/excavation. As asbestos does not pose a risk to human health if it remains buried and undisturbed, further quantification of the asbestos at this location is not required at this time.

8.4 Permeability of Soils

8.4.1 2015 Site Investigation

To add to our understanding of shallow permeability data within the overburden at the site, a range of tests (including falling head, U100s and Particle Size Distribution) were also undertaken on selected soil sections/samples.

Permeability is a measure of the ease at which water can migrate through the soil. There are a number of tests which can provide an indication of soil permeability or provide a direct measure of permeability (hydraulic conductivity). Permeability data of the overburden allows assessment of potential vertical migration of contamination to the underlying bedrock aquifer.

Three samples were taken for Particle Size Distribution (PSD) laboratory testing. PSD testing provides information of the percentage of different grain sizes contained in a soil sample and aids in the overall classification of subsoil materials. The distribution of different grain sizes affects the permeability of subsoils. PSD laboratory results are presented in Appendix A and summarised in Table 8.7 below.

Well ID	Depth (mbgl)	PSD Description	Associated Permeability
105S	3.0-3.5	Slightly sandy organic SILT	Low - Med
105S	5.0-5.5	Grey SAND	Med
108S	7.0	Grey gravelly very silty SAND	Low- Med

Table 8.8 Particle Size Distribution Sample Results

2 no. of in-situ fallen head tests were undertaken during the drilling process in wells 105S and 107S. Falling head tests consist of instantaneously adding a known volume of water to the well (generally clean tap water) and measuring the rate of water level decline over time. Water levels are measured using a standard water level dip meter. The water level decline over time data was subsequently analysed using the Hvorslev (1951) method for variable head/slug analysis to estimate values of hydraulic conductivity (permeability) in metres/ day for each target zone. The tests were carried out and analysed by Causeway Geotech Ltd.

The results are presented in Appendix A and summarised in Table 8.9 below.

Well ID	Type of Test	Depth (mbgl)	Log Description	Hydraulic Conductivity (metres/day)
105S	Falling	5.3	Fine SAND with shell fragments	$4.15x10^{-04}$
107S	Falling	7.5	Silty SAND with occasional cobbles	$9.50x10^{-04}$
105S	U100s	3.0	Organic SILT	$3.72x10^{-03}$
106S	U100s	2.0	Cement by-product	$4.75x10^{-03}$

Table 8.9 Permeability Tests

2 no. of U100 samples were also taken during drilling of clay rich horizons in wells 105S and 106S. The U100 samples are used to determine the permeability of undisturbed soil samples. These samples were analysed by Causeway Geotech Ltd.

The results are consistent with typical permeability ranges of silts (10^{-9}-10^{-5} m/s) and silty sands (10^{-7}-10^{-3} m/s), (Freeze and Cherry 1979) which are considered of relative low to medium permeability, based on a permeability range from Stiff Clays (low) to loose Gravels (high). The natural sands and silt estuarine deposits there provide a pathway, beneath the site, for contaminant migration towards the Boyne River.

Permeability testing was not considered to be necessary as part of the 2019 site investigation.

8.5 Ground Gas Monitoring

8.5.1 2015 Site Investigation

Ground gas monitoring was undertaken on 5th of February 2015 by Causeway Geotech Ltd. engineers. All installed wells have specially designed gas monitoring gas taps which allows the measuring of gases including Methane, Carbon Dioxide, Oxygen, Hydrogen Sulphide and Carbon Monoxide.

The gas monitoring results are presented in Appendix B. The results highlight that no detection of any of the aforementioned gases was made in any of the installed wells BH01 or BH02. The locations of the wells are illustrated in Figure 6.5.

8.5.2 2019 Site Investigation

Ground gas monitoring was undertaken on 12th of July 2019 by Causeway Geotech Ltd. engineers. All installed wells have specially designed gas monitoring gas taps which allows the measuring of gases including Methane, Carbon Dioxide, Oxygen, Hydrogen Sulphide and Carbon Monoxide.

The gas monitoring results are presented in Appendix B. The results highlight that no detection of any of the aforementioned gases at significant levels was made in either of the installed wells BH01 or BH02. The locations of the wells are illustrated in Figure 6.8.

8.6 Baseline Groundwater Quality

8.6.1 2015 Site Investigation

Groundwater samples were taken on two separate days (30th of January 2015 and 4th February 2015) due to restricted access to wells on the first day. The wells were purged (by 3 times the water well column) using a bailer and sampled immediately after. The water samples were sent to Chemtest Laboratories (UKAS accredited) immediately following.

The suite of groundwater quality parameters tested is listed below:

• pH • Conductivity • Total Dissolved Solids • Arsenic-total • Cadmium-total • Chromium-total • Chromium-hexavalent • Lead-total • Mercury-total • Calcium • Sodium • Potassium • Iron • Manganese • Magnesium • Boron - water soluble • Copper-total	• Nickel-total • Zinc-total • Cyanide, Total • Ammonical Nitrogen as N • Total Oxidised Nitrogen • Total Organic Carbon • Phenols total • Sulphate • Chloride • Total Alkalinity • Fluoride • Total Petroleum Hydrocarbons • Mineral Oil • Diesel Range Organics • Petrol Range Organics • VOCs and SVOCs • Pesticide suite

The laboratory analytical results are presented in Appendix B.

Groundwater quality is briefly assessed herein by comparing analytical results to the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (Statutory Instrument No. 9 of 2010) and the Environmental Protection Agency's Draft Interim Guidelines Values (IGVs) for the Protection of Groundwater, 2003. It should be noted that the groundwater on site is adjacent to an estuary which is tidal and as such these guidelines may not strictly apply.

Tables 8.10 – 8.14 highlight the exceedances for groundwater threshold values (in pink) for inorganics (including metals), hydrocarbons, volatiles and pesticides.

The results highlight exceedances in electrical conductivity, total dissolved solids, ammoniacal nitrogen, potassium, sodium and chloride likely due to brackish water from estuary.

Exceedances of metals are observed in most wells particularly nickel, chromium and arsenic both in shallow and deep wells all across the site.

Hydrocarbons are found in 102 D (20m), 104S (7.9m) and 108 (8.5m) towards the centre of the site (where the scrap yard was formerly located) and is found at both shallow and deep (20m) depth.

No VOCs or Semi-VOC are found with the exception of Acenaphthene in 102D which is just above detection limit at 0.67 ug/l.

No pesticides were detected in any of the wells.

The groundwater results at TRP provides a baseline quality for the Port and highlights the presence of metal and hydrocarbon contamination which is most likely due to historic made ground fill material which was used to reclaim the land between 1990 and 1997 or as a result of discharges to ground on upgradient lands.

Sample ID	Ground-water Regs SI No 9 of 2010	EPA Interim Ground-water	Surface Water Regs SI No. 272 of			BH101D	BH104S	BH108S	BH102D	BH103D	BH106S
Depth						2.30	6.00	11.50	2.30	6.00	11.50
Date Samples						30-Jan-15	30-Jan-15	30-Jan-15			
Inorganics				Units	LOD						
pH	6.5-9.5	6.5 - 9.5	4.5-9.0			7.9	9.6	12	8	10	9.1
Electrical Conductivity	1875	1000		µS/cm	1	13000	2700	7900	11000	2100	2000
Total Dissolved Solids		1000		mg/l	1	7900	1600	4800	6800	1200	1200
Alkalinity (Total)		N.A.C		mg CaCO3/l	10	89	240	1600	110	70	66
Chloride	187.5	30		mg/l	1	4200	640	730	4000	480	350
Fluoride		1	0.5	mg/l	0.05	0.25	3.1	1.3	-	0.18	0.32
Ammoniacal Nitrogen	0.175	0.15	0.065	mg/l	0.01	1.4	16	0.61	1.3	0.29	6.5
Sulphate	187.5	200		mg/l	1	830	2300	67	610	130	510
Total Oxidised Nitrogen		NAC		mg/l	0.2	1	-	1.6	-	4.1	0.32
Cyanide (Total)	0.0375	0.01		mg/l	0.05	-	0.06	-	-	-	-
Calcium		200		mg/l	5	410	79	19	540	150	120
Potassium		5		mg/l	0.5	120	180	1100	41	79	78
Magnesium		50		mg/l	0.5	150	15	0.8	110	79	4.2
Sodium	150	150		mg/l	0.5	3100	500	910	1100	1000	260
Boron (Dissolved)	750	1000		µg/l	20	1400	430	73	760	520	180
Manganese (Dissolved)		50		µg/l	1	600	130	19	510	9.5	-
Arsenic (Total)	7.5	10	20	µg/l	1	19	18	11	58	12	7.4
Cadmium (Total)	3.75	5		µg/l	0.08	0.27	0.2	0.18	1.5	-	0.091
Chromium (Total)	37.5	30	32	µg/l	1	49	31	14	200	140	46
Copper (Total)	1500	30	32	µg/l	1	46	5.3	8	29	13	7.7
Mercury (Total)	0.75	1	0.05	µg/l	0.5	-	-	-	-	-	-
Nickel (Total)	15	20	20	µg/l	1	9.2	19	17	33	2.3	5.1
Lead (Total)	18.75	10	7.2	µg/l	1	37	8.1	1.6	-	-	-
Zinc (Total)		100	40	µg/l	1	170	170	46	41	12	20
Iron (Dissolved)		200		µg/l	20	-	130	70	20	-	-
Chromium (Hexavalent)		30	3.4	µg/l	20	-	-	-	-	(A) 91	-
Total Organic Carbon		NAC		mg/l	1	2.5	36	74	3.8	7.2	7.6

Legend - Below detection limit; Above groundwater guideline values (lowest); NAC No abnormal change; LOD Limits of Detection; A Deviating sample (date not supplied)

Table 8.10 Groundwater Quality (Inorganics) 2015

Sample ID	Ground-water Regs SI No 9 of 2010	EPA Interim Ground-water Values	Surface Water Regs SI No. 272 of 2009			BH101D	BH104S	BH108S	BH102D	BH103D	BH106S
Depth						2.30	6.00	11.50	2.30	6.00	11.50
Date Samples						30-Jan-15	30-Jan-15	30-Jan-15			
Hydrocarbons				Units	LOD						
Mineral Oil		10 (Total Hydrocarbons)		µg/l	10	-	460	960	A -	A -	A -
TPH >C6-C10				µg/l	0.1	-	-	-	A -	A -	A -
TPH >C10-C21				µg/l	0.1	-	180	7.2	(A) 1800	A -	A -
TPH >C21-C40				µg/l	0.1	-	480	1200	(A) 21	A -	A -
Total TPH >C6-C40				µg/l	10	-	660	1200	(A) 1800	A -	A -

Legend - Below detection limit; Above groundwater guideline values (lo; NAC No abnormal change; LOD Limits of Detection; A Deviating sample (date not supplied)

Table 8.11 Groundwater Quality (Hydrocarbons) 2015

Sample ID	Ground-water Regs SI No 9 of 2010	EPA Interim Ground-water Values 2003	Surface Water Regs SI No. 272 of 2009			BH101D	BH104S	BH108S	BH102D	BH103D	BH106S
Depth						2.30	6.00	11.50	2.30	6.00	11.50
Date Samples						30-Jan-15	30-Jan-15	30-Jan-15			
VOCs				Units	LOD						
Dichlorodifluoromethane				µg/l	1	-	-	-	-	-	-
Chloromethane				µg/l	1	-	-	-	-	-	-
Vinyl Chloride	0.375			µg/l	1	-	-	-	-	-	-
Bromomethane				µg/l	5	-	-	-	-	-	-
Chloroethane				µg/l	2	-	-	-	-	-	-
Trichlorofluoromethane				µg/l	1	-	-	-	-	-	-
1,1-Dichloroethene		30		µg/l	1	-	-	-	-	-	-
Trans 1,2-Dichloroethene				µg/l	1	-	-	-	-	-	-
1,1-Dichloroethane				µg/l	1	-	-	-	-	-	-
cis 1,2-Dichloroethene				µg/l	1	-	-	-	-	-	-
Bromochloromethane				µg/l	5	-	-	-	-	-	-
Trichloromethane				µg/l	1	-	-	-	-	-	-
1,1,1-Trichloroethane		500		µg/l	1	-	-	-	-	-	-
Tetrachloromethane				µg/l	1	-	-	-	-	-	-
1,1-Dichloropropene				µg/l	1	-	-	-	-	-	-
Benzene	0.75	1	50	µg/l	1	-	-	-	-	-	-
1,2-Dichloroethane	2.25	30	10	µg/l	2	-	-	-	-	-	-
Trichloroethene	7.5	70		µg/l	1	-	-	-	-	-	-
1,2-Dichloropropane				µg/l	1	-	-	-	-	-	-
Dibromomethane				µg/l	10	-	-	-	-	-	-
Bromodichloromethane				µg/l	5	-	-	-	-	-	-
cis-1,3-Dichloropropene				µg/l	10	-	-	-	-	-	-
Toluene		10		µg/l	1	-	-	-	-	-	-
Trans-1,3-Dichloropropene				µg/l	10	-	-	-	-	-	-
1,1,2-Trichloroethane				µg/l	10	-	-	-	-	-	-
Tetrachloroethene	7.5	40		µg/l	1	-	-	-	-	-	-
1,3-Dichloropropane				µg/l	2	-	-	-	-	-	-
Dibromochloromethane				µg/l	10	-	-	-	-	-	-
1,2-Dibromoethane				µg/l	5	-	-	-	-	-	-
Chlorobenzene		1		µg/l	1	-	-	-	-	-	-
1,1,1,2-Tetrachloroethane				µg/l	2	-	-	-	-	-	-
Ethylbenzene		10		µg/l	1	-	-	-	-	-	-
m & p-Xylene		10		µg/l	1	-	-	-	-	-	-
o-Xylene		10		µg/l	1	-	-	-	-	-	-
Styrene				µg/l	1	-	-	-	-	-	-
Tribromomethane				µg/l	1	-	-	-	-	-	-
Isopropylbenzene				µg/l	1	-	-	-	-	-	-
Bromobenzene				µg/l	1	-	-	-	-	-	-
1,2,3-Trichloropropane				µg/l	50	-	-	-	-	-	-
N-Propylbenzene				µg/l	1	-	-	-	-	-	-
2-Chlorotoluene				µg/l	1	-	-	-	-	-	-
1,3,5-Trimethylbenzene				µg/l	1	-	-	-	-	-	-
4-Chlorotoluene				µg/l	1	-	-	-	-	-	-
Tert-Butylbenzene				µg/l	1	-	-	-	-	-	-
1,2,4-Trimethylbenzene				µg/l	1	-	-	-	-	-	-
Sec-Butylbenzene				µg/l	1	-	-	-	-	-	-
1,3-Dichlorobenzene		10		µg/l	1	-	-	-	-	-	-
4-Isopropyltoluene				µg/l	1	-	-	-	-	-	-
1,4-Dichlorobenzene				µg/l	1	-	-	-	-	-	-
N-Butylbenzene				µg/l	1	-	-	-	-	-	-
1,2-Dichlorobenzene				µg/l	1	-	-	-	-	-	-
1,2-Dibromo-3-Chloropropane				µg/l	50	-	-	-	-	-	-
1,2,4-Trichlorobenzene		0.4		µg/l	1	-	-	-	-	-	-
Hexachlorobutadiene				µg/l	1	-	-	-	-	-	-
1,2,3-Trichlorobenzene		0.4		µg/l	2	-	-	-	-	-	-

Table 8.12 Groundwater Quality (Volatile Organic Compounds) 2015

Sample ID	Ground-water Regs SI No 9 of 2010	EPA Interim Ground-water	Surface Water Regs SI No. 272 of			BH101D	BH104S	BH108S	BH102D	BH103D	BH106S
Depth						2.30	6.00	11.50	2.30	6.00	11.50
Date Samples						30-Jan-15	30-Jan-15	30-Jan-15			
Semi VOCs				Units	LOD						
Methyl Tert-Butyl Ether				µg/l	1	-	-	-	-	-	-
N-Nitrosodimethylamine				µg/l	0.5	-	-	-	-	-	-
Phenol		0.5	46	µg/l	0.5	-	-	-	-	-	-
2-Chlorophenol		200		µg/l	0.5	-	-	-	-	-	-
Bis-(2-Chloroethyl)Ether				µg/l	0.5	-	-	-	-	-	-
1,3-Dichlorobenzene				µg/l	0.5	-	-	-	-	-	-
1,4-Dichlorobenzene				µg/l	0.5	-	-	-	-	-	-
1,2-Dichlorobenzene		10		µg/l	0.5	-	-	-	-	-	-
2-Methylphenol (o-Cresol)				µg/l	0.5	-	-	-	-	-	-
Bis(2-Chloroisopropyl)Ether				µg/l	0.5	-	-	-	-	-	-
Hexachloroethane				µg/l	0.5	-	-	-	-	-	-
N-Nitrosodi-n-propylamine				µg/l	0.5	-	-	-	-	-	-
4-Methylphenol				µg/l	0.5	-	-	-	-	-	-
Nitrobenzene		10		µg/l	0.5	-	-	-	-	-	-
Isophorone				µg/l	0.5	-	-	-	-	-	-
2-Nitrophenol				µg/l	0.5	-	-	-	-	-	-
2,4-Dimethylphenol				µg/l	0.5	-	-	-	-	-	-
Bis(2-Chloroethoxy)Methane				µg/l	0.5	-	-	-	-	-	-
2,4-Dichlorophenol				µg/l	0.5	-	-	-	-	-	-
1,2,4-Trichlorobenzene		0.4	0.4	µg/l	0.5	-	-	-	-	-	-
Naphthalene		1	2.4	µg/l	0.5	-	-	-	-	-	-
4-Chloroaniline				µg/l	0.5	-	-	-	-	-	-
Hexachlorobutadiene		0.1	0.6	µg/l	0.5	-	-	-	-	-	-
4-Chloro-3-Methylphenol				µg/l	0.5	-	-	-	-	-	-
2-Methylnaphthalene				µg/l	0.5	-	-	-	-	-	-
Hexachlorocyclopentadiene				µg/l	0.5	-	-	-	-	-	-
2,4,6-Trichlorophenol				µg/l	0.5	-	-	-	-	-	-
2,4,5-Trichlorophenol				µg/l	0.5	-	-	-	-	-	-
2-Chloronaphthalene				µg/l	0.5	-	-	-	-	-	-
2-Nitroaniline				µg/l	0.5	-	-	-	-	-	-
Acenaphthylene				µg/l	0.5	-	-	-	-	-	-
Dimethylphthalate				µg/l	0.5	-	-	-	-	-	-
2,6-Dinitrotoluene				µg/l	0.5	-	-	-	-	-	-
Acenaphthene				µg/l	0.5	-	-	-	0.67	-	-
3-Nitroaniline				µg/l	0.5	-	-	-	-	-	-
Dibenzofuran				µg/l	0.5	-	-	-	-	-	-
4-Chlorophenylphenylether				µg/l	0.5	-	-	-	-	-	-
2,4-Dinitrotoluene				µg/l	0.5	-	-	-	-	-	-
Fluorene				µg/l	0.5	-	-	-	-	-	-
Diethyl Phthalate				µg/l	0.5	-	-	-	-	-	-
4-Nitroaniline				µg/l	0.5	-	-	-	-	-	-
2-Methyl-4,6-Dinitrophenol				µg/l	0.5	-	-	-	-	-	-
Azobenzene				µg/l	0.5	-	-	-	-	-	-
4-Bromophenylphenyl Ether				µg/l	0.5	-	-	-	-	-	-
Hexachlorobenzene		0.03		µg/l	0.5	-	-	-	-	-	-
Pentachlorophenol		2		µg/l	0.5	-	-	-	-	-	-
Phenanthrene				µg/l	0.5	-	-	-	-	-	-
Anthracene		10000	0.4	µg/l	0.5	-	-	-	-	-	-
Carbazole				µg/l	0.5	-	-	-	-	-	-
Di-N-Butyl Phthalate				µg/l	0.5	-	-	-	-	-	-
Fluoranthene		1	1	µg/l	0.5	-	-	-	-	-	-
Pyrene				µg/l	0.5	-	-	-	-	-	-
Butylbenzyl Phthalate				µg/l	0.5	-	-	-	-	-	-
Benzo[a]anthracene				µg/l	0.5	-	-	-	-	-	-
Chrysene				µg/l	0.5	-	-	-	-	-	-
Bis(2-Ethylhexyl)Phthalate				µg/l	0.5	-	-	-	-	-	-
Di-N-Octyl Phthalate				µg/l	0.5	-	-	-	-	-	-
Benzo[b]fluoranthene		0.5	0.3	µg/l	0.5	-	-	-	-	-	-
Benzo[k]fluoranthene		0.5	0.3	µg/l	0.5	-	-	-	-	-	-
Benzo[a]pyrene	0.0075	0.01	0.1	µg/l	0.5	-	-	-	-	-	-
Indeno(1,2,3-c,d)Pyrene		0.05		µg/l	0.5	-	-	-	-	-	-
Dibenz(a,h)Anthracene				µg/l	0.5	-	-	-	-	-	-
Benzo[g,h,i]perylene		0.05	0.02	µg/l	0.5	-	-	-	-	-	-
4-Nitrophenol				µg/l	0.5	-	-	-	-	-	-
Total Phenols				mg/l	0.03	-	0.31	0.38	0.06	0.04	0.08

Table 8.13 Groundwater Quality (Semi-Volatile Organic Compounds) 2015

Sample ID	Ground-water Regs SI No 9 of 2010	EPA Interim Ground-water	Surface Water Regs SI No. 272 of			BH101D	BH104S	BH108S	BH102D	BH103D	BH106S
Depth						2.30	6.00	11.50	2.30	6.00	11.50
Date Samples						30-Jan-15	30-Jan-15	30-Jan-15			
Pesticides				Units	LOD						
Demeton-O				µg/l	0.2	-	-	-	-	-	-
Phorate				µg/l	0.2	-	-	-	-	-	-
Demeton-S				µg/l	0.2	-	-	-	-	-	-
Disulfoton				µg/l	0.2	-	-	-	-	-	-
Fenthion				µg/l	0.2	-	-	-	-	-	-
Trichloronate				µg/l	0.2	-	-	-	-	-	-
Prothiofos				µg/l	0.2	-	-	-	-	-	-
Fensulphothion				µg/l	0.2	-	-	-	-	-	-
Sulprofos				µg/l	0.2	-	-	-	-	-	-
Azinphos-Methyl				µg/l	0.2	-	-	-	-	-	-
Coumaphos				µg/l	0.2	-	-	-	-	-	-
Atraton				µg/l	0.2	-	-	-	-	-	-
Prometon				µg/l	0.2	-	-	-	-	-	-
Simazine	0.075	1	4	µg/l	0.2	-	-	-	-	-	-
Atrazine	0.075	1	0.7	µg/l	0.2	-	-	-	-	-	-
Propazine				µg/l	0.2	-	-	-	-	-	-
Terbuthylazine				µg/l	0.2	-	-	-	-	-	-
Secbumeton				µg/l	0.2	-	-	-	-	-	-
Simetryn				µg/l	0.2	-	-	-	-	-	-
Ametryn				µg/l	0.2	-	-	-	-	-	-
Prometryn				µg/l	0.2	-	-	-	-	-	-
Terbutryn				µg/l	0.2	-	-	-	-	-	-
Alpha-Lindane	0.075	0.1		µg/l	0.2	-	-	-	-	-	-
Gamma-Lindane				µg/l	0.2	-	-	-	-	-	-
Beta-Lindane				µg/l	0.2	-	-	-	-	-	-
Delta-Lindane				µg/l	0.2	-	-	-	-	-	-
Heptachlor				µg/l	0.2	-	-	-	-	-	-
Aldrin		0.01	0.005	µg/l	0.2	-	-	-	-	-	-
Heptachlor Epoxide				µg/l	0.2	-	-	-	-	-	-
Gamma-Chlordane				µg/l	0.2	-	-	-	-	-	-
Alpha-Chlordane				µg/l	0.2	-	-	-	-	-	-
Endosulfan I		0.001		µg/l	0.2	-	-	-	-	-	-
4,4-DDE				µg/l	0.2	-	-	-	-	-	-
Dieldrin	0.075	0.01	0.005	µg/l	0.2	-	-	-	-	-	-
Endrin			0.005	µg/l	0.2	-	-	-	-	-	-
4,4-DDD				µg/l	0.2	-	-	-	-	-	-
Endosulfan II		0.001		µg/l	0.2	-	-	-	-	-	-
Endrin Aldehyde				µg/l	0.2	-	-	-	-	-	-
4,4-DDT	0.075		0.025	µg/l	0.2	-	-	-	-	-	-
Endosulfan Sulphate		0.001		µg/l	0.2	-	-	-	-	-	-
Methoxychlor				µg/l	0.2	-	-	-	-	-	-
Endrin Ketone				µg/l	0.2	-	-	-	-	-	-
Total Pesticides	0.375	0.5		µg/l							

Legend - Below detection limit; Above groundwater guideline values (lowest); NAC No abnormal change; LOD Limits of Detection; A Deviating sample (date not supplied)

Table 8.14 Groundwater Quality (Pesticides) 2015

8.6.2 2019 Site Investigation

Groundwater samples were taken on the 12th of July 2019. The wells were purged (by 3 times the water well column) using a bailer and sampled immediately after. The water samples were sent to Chemtest Laboratories (UKAS accredited) immediately following.

The suite of groundwater quality parameters tested is listed below:

• pH • Conductivity • Total Dissolved Solids • Arsenic-total • Cadmium-total • Chromium-total • Chromium-hexavalent • Lead-total • Mercury-total • Calcium • Sodium • Potassium • Iron • Manganese • Magnesium • Boron - water soluble • Copper-total	• Nickel-total • Zinc-total • Cyanide, Total • Ammonical Nitrogen as N • Total Oxidised Nitrogen • Total Organic Carbon • Phenols total • Sulphate • Chloride • Total Alkalinity • Fluoride • Total Petroleum Hydrocarbons • Mineral Oil • Diesel Range Organics • Petrol Range Organics • VOCs and SVOCs • Pesticide suite

The laboratory analytical results are presented in Appendix B.

Groundwater quality is briefly assessed herein by comparing analytical results to the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (Statutory Instrument No. 9 of 2010) and the Environmental Protection Agency's Draft Interim Guidelines Values (IGVs) for the Protection of Groundwater, 2003. It should be noted that the groundwater on site is adjacent to an estuary which is tidal and as such these guidelines may not strictly apply.

Tables 8.15 – 8.19 highlight any exceedances for groundwater threshold values (in pink) for inorganics (including metals), hydrocarbons, volatiles and pesticides.

The results highlight exceedances in pH, electrical conductivity, total dissolved solids, ammoniacal nitrogen, sulphate, potassium, sodium, fluoride and chloride most likely due to brackish water from the estuary.

Exceedances of metals are observed in both wells particularly iron, chromium, copper and arsenic.

No hydrocarbons were detected in either of the wells.

No VOCs or Semi-VOCs were detected in either of the wells.

No pesticides were detected in either of the wells.

The groundwater results at TRP provides a baseline quality for the Port and highlights the presence of metal contamination which is most likely due to historic made ground fill material which was used to reclaim the land between 1990 and 1997 or as a result of discharges to ground on upgradient lands.

Sample ID	Groundwater Regs SI 9 of 2010	EPA Interim Groundwater Values	Surface Water Regs SI No. 272 of 2009			BH01	BH02
Date Samples						12-Jul-2019	12-Jul-2019
Inorganics				**Units**	**LOD**		
pH	6.5 - 9.5	6.5 - 9.5	4.5 - 9		N/A	8.5	8.6
Electrical Conductivity	1875	1000		µS/cm	1.0	1900	3800
Total Dissolved Solids		1000		mg/l	1.0	1200	2500
Alkalinity (Total)		NAC		mg/l	10	43	240
Chloride	187.5	30		mg/l	1.0	290	990
Fluoride		1	0.5	mg/l	0.050	0.38	0.83
Ammoniacal Nitrogen	0.175	0.15	0.065	mg/l	0.050	3.6	6.1
Sulphate	187.5	200		mg/l	1.0	470	280
Total Oxidised Nitrogen		NAC		mg/l	0.20	0.29	-
Cyanide (Total)	0.0375	0.01		mg/l	0.050	-	-
Calcium		200		mg/l	5.0	120	27
Potassium		5		mg/l	0.50	93	310
Magnesium		50		mg/l	0.50	0.95	3.1
Sodium	150	150		mg/l	0.50	210	630
Boron (Dissolved)	750	1000		µg/l	20	210	470
Iron (Dissolved)		200		µg/l	20	560	520
Manganese (Dissolved)		50		µg/l	1.0	7.2	22
Arsenic (Total)	7.5	10	20	µg/l	1.0	8.8	18
Cadmium (Total)	3.75	5		µg/l	0.080	-	0.11
Chromium (Total)	37.5	30	32	µg/l	1.0	8.3	32
Copper (Total)	1500	30	32	µg/l	1.0	7.5	55
Mercury (Total)	0.75	1	0.05	µg/l	0.50	-	-
Nickel (Total)	15	20	20	µg/l	1.0	3.8	8.6
Lead (Total)	18.75	10	7.2	µg/l	1.0	-	1.8
Zinc (Total)		100	40	µg/l	1.0	5.4	7.9
Chromium (Hexavalent)		30	3.4	µg/l	20	-	-
Total Organic Carbon		NAC		mg/l	2.0	16	41

Legend

-	below detection limit	NAC	No abnormal change
	above Groundwater guideline values (lowest)	LOD	Limits of detection
		A	Deviated sample

Table 8.15 Groundwater Quality (Inorganics) 2019

Sample ID	Groundwater Regs SI 9 of 2010	EPA Interim Groundwater Values	Surface Water Regs SI No. 272 of 2009			BH01	BH02
Date Samples						12-Jul-2019	12-Jul-2019
Hydrocarbons				**Units**	**LOD**		
Mineral Oil				µg/l	10	-	-
TPH >C6-C10				µg/l	0.10	-	-
TPH >C10-C21				µg/l	0.10	-	-
TPH >C21-C40				µg/l	0.10	-	-
Total TPH >C6-C40		10		µg/l	10	-	-

Legend

-	below detection limit	NAC	No abnormal change
	above Groundwater guideline values (lowest)	LOD	Limits of detection
		A	Deviated sample

Table 8.16 Groundwater Quality (Hydrocarbons) 2019

Sample ID	Groundwater Regs SI 9 of 2010	EPA Interim Groundwater Values	Surface Water Regs SI No. 272 of 2009			BH01	BH02
Date Samples						12-Jul-2019	12-Jul-2019
VOCs				**Units**	**LOD**		
Dichlorodifluoromethane				µg/l	1.0	A -	A -
Chloromethane				µg/l	1.0	A -	A -
Vinyl Chloride	0.375			µg/l	1.0	A -	A -
Bromomethane				µg/l	5.0	A -	A -
Chloroethane				µg/l	2.0	A -	A -
Trichlorofluoromethane				µg/l	1.0	A -	A -
1,1-Dichloroethene		30		µg/l	1.0	A -	A -
Trans 1,2-Dichloroethene				µg/l	1.0	A -	A -
1,1-Dichloroethane				µg/l	1.0	A -	A -
cis 1,2-Dichloroethene				µg/l	1.0	A -	A -
Bromochloromethane				µg/l	5.0	A -	A -
Trichloromethane				µg/l	1.0	A -	A -
1,1,1-Trichloroethane		500		µg/l	1.0	A -	A -
Tetrachloromethane				µg/l	1.0	A -	A -
1,1-Dichloropropene				µg/l	1.0	A -	A -
Benzene	0.75	1	50	µg/l	1.0	A -	A -
1,2-Dichloroethane	2.25	30	10	µg/l	2.0	A -	A -
Trichloroethene	7.5	70		µg/l	1.0	A -	A -
1,2-Dichloropropane				µg/l	1.0	A -	A -
Dibromomethane				µg/l	10	A -	A -
Bromodichloromethane				µg/l	5.0	A -	A -
cis-1,3-Dichloropropene				µg/l	10	A -	A -
Toluene		10		µg/l	1.0	A -	A -
Trans-1,3-Dichloropropene				µg/l	10	A -	A -
1,1,2-Trichloroethane				µg/l	10	A -	A -
Tetrachloroethene	7.5	40		µg/l	1.0	A -	A -
1,3-Dichloropropane				µg/l	2.0	A -	A -
Dibromochloromethane				µg/l	10	A -	A -
1,2-Dibromoethane				µg/l	5.0	A -	A -
Chlorobenzene		1		µg/l	1.0	A -	A -
1,1,1,2-Tetrachloroethane				µg/l	2.0	A -	A -
Ethylbenzene		10		µg/l	1.0	A -	A -
m & p-Xylene		10		µg/l	1.0	A -	A -
o-Xylene		10		µg/l	1.0	A -	A -
Styrene				µg/l	1.0	A -	A -
Tribromomethane				µg/l	1.0	A -	A -
Isopropylbenzene				µg/l	1.0	A -	A -
Bromobenzene				µg/l	1.0	A -	A -
1,2,3-Trichloropropane				µg/l	50	A -	A -
N-Propylbenzene				µg/l	1.0	A -	A -
2-Chlorotoluene				µg/l	1.0	A -	A -
1,3,5-Trimethylbenzene				µg/l	1.0	A -	A -
4-Chlorotoluene				µg/l	1.0	A -	A -
Tert-Butylbenzene				µg/l	1.0	A -	A -
1,2,4-Trimethylbenzene				µg/l	1.0	A -	A -
Sec-Butylbenzene				µg/l	1.0	A -	A -
1,3-Dichlorobenzene		10		µg/l	1.0	A -	A -
4-Isopropyltoluene				µg/l	1.0	A -	A -
1,4-Dichlorobenzene				µg/l	1.0	A -	A -
N-Butylbenzene				µg/l	1.0	A -	A -
1,2-Dichlorobenzene				µg/l	1.0	A -	A -
1,2-Dibromo-3-Chloropropane				µg/l	50	A -	A -
1,2,4-Trichlorobenzene		0.4		µg/l	1.0	A -	A -
Hexachlorobutadiene				µg/l	1.0	A -	A -
1,2,3-Trichlorobenzene		0.4		µg/l	2.0	A -	A -

Legend - below detection limit NAC No abnormal change

	above Groundwater guideline values (lowest)	LOD	Limits of detection
		A	Deviated sample

Table 8.17 Groundwater Quality (Volatile Organic Compounds) 2019

Sample ID	Groundwater Regs SI 9 of 2010	EPA Interim Groundwater Values	Surface Water Regs SI No. 272 of 2009			BH01	BH02
Date Samples						12-Jul-2019	12-Jul-2019
Semi VOCs				Units	LOD		
Methyl Tert-Butyl Ether				µg/l	1.0	A -	A -
N-Nitrosodimethylamine				µg/l	0.50	-	-
Phenol		0.5	46	µg/l	0.50	-	-
2-Chlorophenol		200		µg/l	0.50	-	-
Bis-(2-Chloroethyl)Ether				µg/l	0.50	-	-
1,3-Dichlorobenzene				µg/l	0.50	-	-
1,4-Dichlorobenzene				µg/l	0.50	-	-
1,2-Dichlorobenzene		10		µg/l	0.50	-	-
2-Methylphenol (o-Cresol)				µg/l	0.50	-	-
Bis(2-Chloroisopropyl)Ether				µg/l	0.50	-	-
Hexachloroethane				µg/l	0.50	-	-
N-Nitrosodi-n-propylamine				µg/l	0.50	-	-
4-Methylphenol				µg/l	0.50	-	-
Nitrobenzene		10		µg/l	0.50	-	-
Isophorone				µg/l	0.50	-	-
2-Nitrophenol				µg/l	0.50	-	-
2,4-Dimethylphenol				µg/l	0.50	-	-
Bis(2-Chloroethoxy)Methane				µg/l	0.50	-	-
2,4-Dichlorophenol				µg/l	0.50	-	-
1,2,4-Trichlorobenzene		0.4	0.4	µg/l	0.50	-	-
Naphthalene		1	2.4	µg/l	0.50	-	-
4-Chloroaniline				µg/l	0.50	-	-
Hexachlorobutadiene		0.1	0.6	µg/l	0.50	-	-
4-Chloro-3-Methylphenol				µg/l	0.50	-	-
2-Methylnaphthalene				µg/l	0.50	-	-
Hexachlorocyclopentadiene				µg/l	0.50	-	-
2,4,6-Trichlorophenol				µg/l	0.50	-	-
2,4,5-Trichlorophenol				µg/l	0.50	-	-
2-Chloronaphthalene				µg/l	0.50	-	-
2-Nitroaniline				µg/l	0.50	-	-
Acenaphthylene				µg/l	0.50	-	-
Dimethylphthalate				µg/l	0.50	-	-
2,6-Dinitrotoluene				µg/l	0.50	-	-
Acenaphthene				µg/l	0.50	-	-
3-Nitroaniline				µg/l	0.50	-	-
Dibenzofuran				µg/l	0.50	-	-
4-Chlorophenylphenylether				µg/l	0.50	-	-
2,4-Dinitrotoluene				µg/l	0.50	-	-
Fluorene				µg/l	0.50	-	-
Diethyl Phthalate				µg/l	0.50	-	-
4-Nitroaniline				µg/l	0.50	-	-
2-Methyl-4,6-Dinitrophenol				µg/l	0.50	-	-
Azobenzene				µg/l	0.50	-	-
4-Bromophenylphenyl Ether				µg/l	0.50	-	-
Hexachlorobenzene		0.03		µg/l	0.50	-	-
Pentachlorophenol		2		µg/l	0.50	-	-
Phenanthrene				µg/l	0.50	-	-
Anthracene		10000	0.4	µg/l	0.50	-	-
Carbazole				µg/l	0.50	-	-

Di-N-Butyl Phthalate				µg/l	0.50	-	-
Fluoranthene		1	1	µg/l	0.50	-	-
Pyrene				µg/l	0.50	-	-
Butylbenzyl Phthalate				µg/l	0.50	-	-
Benzo[a]anthracene				µg/l	0.50	-	-
Chrysene				µg/l	0.50	-	-
Bis(2-Ethylhexyl)Phthalate				µg/l	0.50	-	-
Di-N-Octyl Phthalate				µg/l	0.50	-	-
Benzo[b]fluoranthene		0.5	0.3	µg/l	0.50	-	-
Benzo[k]fluoranthene		0.5	0.3	µg/l	0.50	-	-
Benzo[a]pyrene	0.0075	0.01	0.1	µg/l	0.50	-	-
Indeno(1,2,3-c,d)Pyrene		0.05		µg/l	0.50	-	-
Dibenz(a,h)Anthracene				µg/l	0.50	-	-
Benzo[g,h,i]perylene		0.05	0.02	µg/l	0.50	-	-
4-Nitrophenol				µg/l	0.50	-	-

Legend	-	below detection limit	NAC	No abnormal change
		above Groundwater guideline values (lowest)	LOD	Limits of detection
			A	Deviated sample

Table 8.18 Groundwater Quality (Semi-Volatile Organic Compounds) 2019

Sample ID	Groundwater Regs SI 9 of 2010	EPA Interim Groundwater Values	Surface Water Regs SI No. 272 of 2009			BH01	BH02
Date Samples						12-Jul-2019	12-Jul-2019
Pesticides				**Units**	**LOD**		
Demeton-O				µg/l	0.20	-	-
Phorate				µg/l	0.20	-	-
Demeton-S				µg/l	0.20	-	-
Disulfoton				µg/l	0.20	-	-
Fenthion				µg/l	0.20	-	-
Trichloronate				µg/l	0.20	-	-
Prothiofos				µg/l	0.20	-	-
Fensulphothion				µg/l	0.20	-	-
Sulprofos				µg/l	0.20	-	-
Azinphos-Methyl				µg/l	0.20	-	-
Coumaphos				µg/l	0.20	-	-
Atraton				µg/l	0.20	-	-
Prometon				µg/l	0.20	-	-
Simazine	0.075	1	4	µg/l	0.20	-	-
Atrazine	0.075	1	0.7	µg/l	0.20	-	-
Propazine				µg/l	0.20	-	-
Terbuthylazine				µg/l	0.20	-	-
Secbumeton				µg/l	0.20	-	-
Simetryn				µg/l	0.20	-	-
Ametryn				µg/l	0.20	-	-
Prometryn				µg/l	0.20	-	-
Terbutryn				µg/l	0.20	-	-
Alpha-HCH				µg/l	0.20	-	-
Gamma-HCH (Lindane)	0.075	0.1		µg/l	0.20	-	-
Beta-HCH				µg/l	0.20	-	-
Delta-HCH				µg/l	0.20	-	-
Heptachlor				µg/l	0.20	-	-
Aldrin		0.01	0.005	µg/l	0.20	-	-
Heptachlor Epoxide				µg/l	0.20	-	-
Gamma-Chlordane				µg/l	0.20	-	-
Alpha-Chlordane				µg/l	0.20	-	-
Endosulfan I		0.001		µg/l	0.20	-	-
4,4-DDE				µg/l	0.20	-	-
Dieldrin	0.0075	0.01	0.005	µg/l	0.20	-	-
Endrin			0.005	µg/l	0.20	-	-
4,4-DDD				µg/l	0.20	-	-
Endosulfan II		0.001		µg/l	0.20	-	-
Endrin Aldehyde				µg/l	0.20	-	-
4,4-DDT	0.075		0.025	µg/l	0.20	-	-
Endosulfan Sulphate		0.001		µg/l	0.20	-	-
Methoxychlor				µg/l	0.20	-	-
Endrin Ketone				µg/l	0.20	-	-
Total Phenols				mg/l	0.030	-	-

Legend

-	below detection limit	NAC	No abnormal change
	above Groundwater guideline values (lowest)	LOD	Limits of detection
		A	Deviated sample

Table 8.19 Groundwater Quality (Pesticides) 2019

9.0 CONCLUSIONS

On the basis of the current soil and groundwater investigation undertaken at the Tom Roes Port Terminal and an assessment of source, pathways and receptors the following conclusions have been made:

There is no bulk storage of chemicals present within the area proposed for IE Licence activities. The only potential sources identified are accidental releases of contaminated runoff/leachates from RDF & SRF bales, which are stored temporarily on site, and possible minor hydrocarbon leakages from operating traffic on site. Soil and groundwater sampling has also confirmed the presence of historical contamination most likely originating from the material used in infilling the site or due to discharges to ground on upgradient sites.

The port site was constructed on reclaimed land along the Boyne Estuary. Beneath a layer (0-0.40m) of concrete/ densophalt and fill material, the site is underlain by different types of made ground including cement by-products, landfill material and gravelly clays. These made ground deposits are juxtaposed with black organic silt (estuarine sediments). Beneath the silt is a thick layer up to 13 metres in thickness of fine sand which sits on top of gravels. The depth to possible bedrock was encountered in 103D in at 20.5 metres below ground and confirmed the presence of shaley limestone and pale sandstone (Impure Limestones).

Environmental receptors include the aquifer and the SAC Boyne River/ Estuary. The thick layer of overburden provides protection to the underlying locally important karstified and fractured aquifer.

A review of soil quality confirms that there is historic contamination at the site.

During the 2015 site investigation, heavy metals (Cadmium, Lead and Copper) were detected within made ground deposits at the centre of the site. Exceedances of Nickel are observed in both made ground and natural ground. Exceedances of Polyaromatic Hydrocarbons are observed within the black organic silt unit. It should be noted that there is no legislative threshold for soils in Ireland. The exceedances noted relate to guideline concentrations. The metal concentrations detected do not exceed guideline levels for commercial use of the site.

During the 2019 site investigation, heavy metals (Arsenic, Cadmium, Copper, Nickel, Lead and Zinc) and Polyaromatic hydrocarbons (PAHs) were detected within and in close proximity to made ground deposits on the site. Capping of the site has reduced the potential for recharge to mobilise any contaminated soil. However, the potential for mobilisation should be considered in the event of any future subsurface construction on the site.

A review of groundwater quality in 2015 found that the groundwater beneath the site is tidally affected. There is also evidence of metal and hydrocarbon contamination likely to originate from the historic made ground deposits which were located at the centre of the port site during the site investigation.

A review of groundwater quality in 2019 also found that the groundwater beneath the site is tidally affected. There is also evidence of metal contamination likely to originate from the historic made ground deposits which were located at the centre of the port site during the site investigation.

Currently the primary pathway for any contaminated water (originating from a leaking bale or hydrocarbon from a leaking vehicle) is through the stormwater drainage system

via a hydrocarbon interceptor to the Boyne Estuary. With the installation of the new drainage system, the leachate/runoff and possible hydrocarbon runoff will be directed to the attenuation tank and will subsequently be removed from the site and disposed of by McBreen Environmental, removing the risk of contamination reaching the SAC Boyne River/ Estuary.

There is historical contamination in the underlying soil likely to originate from the historic made ground deposits which were located at the centre of the port site. There is no evidence that this contamination is caused by current activities at the site. Capping of the site has reduced the potential for recharge to mobilise any contamination to the Boyne Estuary. However, the potential for mobilisation should be considered in the event of any future subsurface construction on the site.

It is concluded that the portion of land (2121 m^2) proposed to be removed from the IE Licence boundary does not pose a risk of contamination to the site or surrounding lands. However, the potential for mobilisation of historic contamination underlying this area should be considered in the event of any future subsurface construction on the site.

10.0 REFERENCES

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APPENDICES

Appendix A Exploratory Logs and Permeability Tests

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Exploratory Log:	101 Deep

Sheet 1/2

AWN Project Ref: 14/7893	Client: Drogheda Port Company	Drill date: 13/01/2015
Ground Level (mAOD): 3.96		
Grid Reference: 312023.694, 276112.361	Location: Drogheda Port	Logged/Checked: JN/PG

SUBSURFACE PROFILE	Depth mbgl (mAOD)	Lithology	Well Construction
Ground surface		sample (mbgl, PID)	Flush cover
Concrete (MADE GROUND)			Concrete
Brown/grey slightly clayey, sandy Gravel FILL (MADE GROUND) Detail : Dry, NEC	0.26 (3.70)		
(Soft) Dark brown slightly sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse (possible MADE GROUND) Detail : Damp stratum, NEC	1.00 (2.96)	(1.0, 0.0)	Arisings
(Soft) Grey slightly gravelly CLAY Gravel is subrounded, fine to medium, Dry, NEC	2.30 (1.66)	(3.8, 1.7)	50mm dia. slotted standpipe
(Soft) Brown slightly gravelly CLAY Gravel is subangular to subrounded, fine to medium. Wet, NEC	5.30	(6.5, 1.6)	
(Firm) Brown slightly gravelly CLAY Gravel is subangular to subrounded, fine to coarse, Dry, NEC	11.30 (-7.34)	(13.0, 0.0)	Betonite
(Cont'd/..)			

Drill Method: Air Rotary	Hole Diameter: 5"			
Drill Rig: Commachio MC405	Top of Casing (mAOD):	-		
Casing Length (m): 20.1mbgl (retracted)				
	Water Strikes (mbgl):	5.30		
Driller: Causeway Geotech Ltd.	Static Water Level (mbgl):	2.76 on 21/01/2015		

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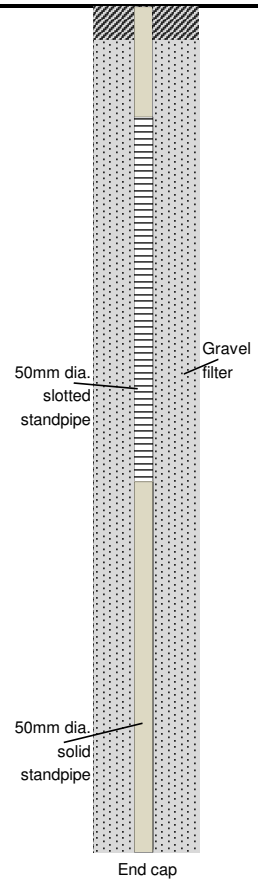
Exploratory Log: 101 Deep

Sheet 2/2

AWN Project Ref: 14/7893	Client: Drogheda Port Company	Drill date: 13/01/2015
Ground Level (mAOD): 3.96		
Grid Reference: 312023.694, 276112.361	Location: Drogheda Port	Logged/Checked: JN/PG

SUBSURFACE PROFILE	Depth mbgl (mAOD)	Lithology	Well Construction
Ground surface		sample (mbgl, PID)	
(Firm) Brown slightly gravelly CLAY Gravel is subangular to subrounded, fine to coarse, Dry, NEC			
Brown/grey clayey GRAVEL Gravel is subangular, fine to medium.	14.30 (-10.34)		
Detail: 16.00 m Gravel is subangular to subrounded, fine to coarse (Chert and quartz noted).			
(Soft) Brown/grey gravelly CLAY.Gravel is subangular, fine to coarse, we	18.60 (-14.64)		
(Firm-Stiff) Brown slightly gravelly CLAY. Gravel is subangular to subrounded, fine to coarse	19.20 (-15.24)		
End of Borehole at 20.10 mbgl	**20.10 (-16.14)**		



Drill Method: Air Rotary	Hole Diameter: 5"			
Drill Rig: Commachio MC405	Top of Casing (mAOD):	-		
Casing Length (m): 20.1mbgl (retracted)				
	Water Strikes (mbgl):	14.30		
Driller: Causeway Geotech Ltd.	Static Water Level (mbgl):	2.76 on 21/01/2015		

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Exploratory Log:	102 Deep

Sheet 1/2

AWN Project Ref: 14/7893	Client: Drogheda Port Company	Drill date: 14/01/2015
Ground Level (mAOD): 4.22		
Grid Reference: 311809.8, 275924.111	Location: Drogheda Port	Logged/Checked: JN/PG

SUBSURFACE PROFILE	Depth mbgl (mAOD)	Lithology	Well Construction
Ground surface		sample (mbgl, PID)	Flush cover
Bitmac (MADE GROUND)	0.15 (4.07)		Concrete
Brown/grey slightly clayey, Gravel FILL (MADE GROUND), Dry, NEC		(1.0, 0.2)	
(Soft-Firm) Dark brown slightly gravelly CLAY (possible MADE GROUND) Gravel is subangular to subrounded fine to medium, Dry, NEC	1.80 (2.42)		Arisings
(Soft) Light grey/green CLAYs (Cement by-products - MADE GROUND) Slightly gravelly, subrounded, fine to medium, damp	3.00		50mm dia. solid standpipe
Detail: 4.10m Waterstrike: slight inflow		(4.0, 0.0)	
Detail: 5.00m soil sample taken		(5.0, 0.0)	
Grey fine SAND with many shell fragments, dry	6.00 (-2.22)		
Detail: 10.00-17.00m damp			

Drill Method: Air Rotary	Hole Diameter: 5"			
Drill Rig: Commachio MC405	Top of Casing (mAOD):	-		
Casing Length (m): 20.00mbgl (retracted)				
	Water Strikes (mbgl):	4.10		
Driller: Causeway Geotech Ltd.	Static Water Level (mbgl):	3.95 on 21/01/2015		

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Exploratory Log: 102 Deep

Sheet 2/2

AWN Project Ref: 14/7893	Client: Drogheda Port Company	Drill date: 14/01/2015
Ground Level (mAOD): 4.22		
Grid Reference: 311809.8, 275924.111	Location: Drogheda Port	Logged/Checked: JN/PG

SUBSURFACE PROFILE	Depth mbgl (mAOD)	Lithology	Well Construction
Ground surface		sample (mbgl, PID)	
Grey fine SAND with many shell fragments			
Detail: 14.00-17.00m large/whole shell fragments			
Detail: 15.80m Waterstrike, slight to moderate inflow			
Brown/grey slightly clayey, slightly sandy GRAVEL. Gravel is angular to subangular, fine to coarse.	17.00 (-12.78)		
Detail: 18:00m Waterstrike, moderate to high inflow			
End of Borehole at 20.00 mgbl	**20.00 (-15.78)**		

Bentonite
Gravel filter
50mm dia. slotted standpipe
End cap

Drill Method: Air Rotary	Hole Diameter: 5"			
Drill Rig: Commachio MC405	Top of Casing (mAOD):	-		
Casing Length (m): 20.00mbgl (retracted)				
	Water Strikes (mbgl):	15.80	18.00	-
Driller: Causeway Geotech Ltd.	Static Water Level (mbgl):	3.95 on 21/01/2015		

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Exploratory Log:	103 Deep

Sheet 1/2

AWN Project Ref: 14/7893	Client: Drogheda Port Company	Drill date: 15/01/2015
Ground Level (mAOD): 3.49		
Grid Reference: 312047.723, 275939.619	Location: Drogheda Port	Logged/Checked: JN/PG

SUBSURFACE PROFILE	Depth mbgl (mAOD)	Lithology	Well Construction
Ground surface		sample (mbgl, PID)	Flush cover
Concrete (MADE GROUND)	0.28		Concrete
Brown/grey slightly clayey, Gravel FILL (MADE GROUND)			
(Soft-Firm) Dark brown gravelly CLAY, occasionally red/brown, mottled Gravel is subrounded fine to medium. Damp, NEC	1.10 (2.39)	(1.8, 0.0)	Arisings
Grey fine SAND with many shell fragments, dry Occasional whole shells (Bivalves)	2.60 (0.89)		50mm dia. standpipe
Detail: 6.00-7.50m wet stratum			
Detail: 6.50m waterstrike, slight to moderate inflow		(9.0, 0.0)	

Drill Method: Air Rotary	Hole Diameter: 5"		
Drill Rig: Commachio MC405	Top of Casing (mAOD):	-	
Casing Length (m): 25.00mbgl (retracted)			
	Water Strikes (mbgl):	6.50	13.00
Driller: Causeway Geotech Ltd.	Static Water Level (mbgl):	3.265 on 21/01/2015	

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Exploratory Log: 103 Deep

Sheet 2/2

AWN Project Ref: 14/7893	Client: Drogheda Port Company	Drill date: 15/01/2015
Ground Level (mAOD): 3.49		
Grid Reference: 312047.723, 275939.619	Location: Drogheda Port	Logged/Checked: JN/PG

SUBSURFACE PROFILE	Depth mbgl (mAOD)	Lithology	Well Construction
Ground surface		sample (mbgl, PID)	
Grey fine SAND with many shell fragments. Occasional whole shells (Bivalves)			
Grey sandy GRAVEL. Gravel is subangular to subrounded, fine to coarse. Detail: 16:00 m waterstrike, high inflow	15.90 (-12.41)		
Detail: 17:00m sample taken			
Detail: 18:00m slightly clayey, gravel is angular to subangular, fine to coarse			
Gravel-sized fragments of MUDSTONE & SANDSTONE (Possible weathered rockhead) Detail: 20.50-25.00m slow to drill,	20.50 (-17.01)		
Detail: 22.00m Water strike, moderate water inflow			
Detail: 24.00-24.50 collapsing material, possible fracture zone			
End of Borehole at 25.00 mbgl	**25.00 (-21.51)**		

Arisings
50mm dia. standpipe
Bentonite
Gravel filter
50mm dia. slotted standpipe
End cap

Drill Method: Air Rotary	Hole Diameter: 5"			
Drill Rig: Commachio MC405	Top of Casing (mAOD):	-		
Casing Length (m): 25.00mbgl (retracted)				
	Water Strikes (mbgl):	16.00	22.00	-
Driller: Causeway Geotech Ltd.	Static Water Level (mbgl):	3.265 on 21/01/2015		

awnconsulting

Exploratory Log: 104 Shallow

Sheet 1/1

AWN Project Ref: 14/7893	Client: Drogheda Port Company	Drill date: 15/01/2015
Ground Level (mAOD): 3.51		
Grid Reference: 311861.524, 275928.557	Location: Drogheda Port	Logged/Checked: JN/PG

SUBSURFACE PROFILE	Depth mbgl (mAOD)	Lithology	Well Construction
Ground surface		sample (mbgl, PID)	Flush cover
Concrete (MADE GROUND)	0.30 (3.21)		Concrete
Brown/grey slightly clayey Gravel FILL (MADE GROUND)		(1.5, 0.0)	
(Uncompact) Black slightly gravelly SILT. Gravel is subrounded, fine to medium. Detail: Occasional lenses of grey/brown (firm) CLAY Detail: 2.00m soil sample taken	1.90 (1.61)		Arisings 50mm dia. solid standpipe
Grey fine SAND with many shell fragments Detai: 6.00m soil sample taken	6.00 (-2.49)		Bentonite 50mm dia. slotted standpipe Gravel filter
End of Borehole at 7.90 mbgl	**7.90 (-4.39)**		End cap

Drill Method: Cable Percussion (water added to progress drilling)	Hole Diameter: 8"			
Drill Rig: Dando 2000	Top of Casing (mAOD):	-		
Casing Length (m): 7.90mbgl (retracted)				
	Water Strikes (mbgl):	-	-	-
Driller: Causeway Geotech Ltd.	Static Water Level (mbgl):	3.31 on 21/01/2015		

awnconsulting

Exploratory Log: 105 Shallow

Sheet 1/1

AWN Project Ref: 14/7893	Client: Drogheda Port Company	Drill date: 15/01/2015
Ground Level (mAOD): 3.66		
Grid Reference: 311940.024, 275945.789	Location: Drogheda Port	Logged/Checked: JN/PG

SUBSURFACE PROFILE	Depth mbgl (mAOD)	Lithology	Well Construction
Ground surface		sample (mbgl, PID)	
Concrete (MADE GROUND)	0.38 (3.28)	(1.0, 0.0)	No installation Backfilled with bentonite, arisings and cement seal
Brown/grey slightly clayey Gravel FILL (MADE GROUND) Detail: Occasional clods of black (firm) CLAY, slight odour - undefined			
(Uncompact) Dark grey/black slightly sandy, organic SILT Detail: 3.00m-3.50m U100 & PSD sample taken Detail: occasionally lenses of light brown/grey silty CLAY.	3.00 (0.66)	(3.5, 0.6)	
Grey fine SAND with many shell fragments Detail: 5.00-5.30m Falling Head Test, and PSD sample, rare gravel.	5.00		
End of Borehole at 5.50 mbgl	**5.50 (-1.84)**		

Drill Method: Cable Percussion (water added to progress drilling)	Hole Diameter: 8"			
Drill Rig: Dando 2000	Top of Casing (mAOD):	-		
Casing Length (m): 5.50mbgl (retracted)				
	Water Strikes (mbgl):	-	-	-
Driller: Causeway Geotech Ltd.	Static Water Level (mbgl):	-		

awnconsulting

Exploratory Log: 106 Shallow

Sheet 1/1

AWN Project Ref: 14/7893	Client: Drogheda Port Company	Drill date: 16/01/2015
Ground Level (mAOD): 4.03		
Grid Reference: 311920.386, 275998.113	Location: Drogheda Port	Logged/Checked: JN/PG

SUBSURFACE PROFILE	Depth mbgl (mAOD)	Lithology	Well Construction
Ground surface		sample (mbgl, PID)	Flush cover
Concrete (Made Ground)	0.22 (3.81)		50mm dia. solid standpipe; Concrete; Bentonite
Brown/grey slightly sandy Gravel Fill (MADE GROUND)			
Sandy GRAVEL with some cobbles and red brick, tiles, string, animal tooth, delph china (MADE GROUND)	1.50 (2.53)		
(Soft) Light grey/brown slightly gravelly CLAY, dry Detail: 2.00m soil sample taken & U100 sample taken Detail: Contains modules of white soft clays and black clays. Gravel is subangular to subrounded, medium to coarse (Cement by-product- MADE GROUND).	1.90 (2.13)	(2.0, 0.0)	Gravel filter
Dark Grey/Black silty fine SAND with many shell fragments. Detail: 4.50m soil sample taken Detail: Silt content reduces with depth and shell fragments become more frequent, becoming grey in colour.	4.50 (-0.47)	(4.5, 0.0)	50mm dia. slotted standpipe
End of Borehole at 8.00 mbgl	**8.00 (-3.97)**		End cap

Drill Method: Cable Percussion (water added to progress drilling)	Hole Diameter: 8"			
Drill Rig: Dando 2000	Top of Casing (mAOD):	-		
Casing Length (m): 7.90mbgl (retracted)				
	Water Strikes (mbgl):	-	-	-
Driller: Causeway Geotech Ltd.	Static Water Level (mbgl):	3.74 on 21/01/2015		

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Exploratory Log: 107 Shallow

Sheet 1/1

AWN Project Ref: 14/7893	Client: Drogheda Port Company	Drill date: 19/01/2015
Ground Level (mAOD): 3.84		
Grid Reference: 312029.827, 276104.598	Location: Drogheda Port	Logged/Checked: JN/PG

SUBSURFACE PROFILE	Depth mbgl (mAOD)	Lithology	Well Construction
Ground surface		sample (mbgl, PID)	
Concrete (MADE GROUND)	0.27 (3.87)		No installation. Backfilled with bentonite, arisings and cement seal
Brown/grey slightly sandy Gravel FILL (MADE GROUND)			
(Soft) Light grey, slightly gravelly CLAY with occasional cobbles. Gravel is subrounded to rounded, coarse. Occasional large (possible cement by-products - MADE GROUND)	2.70 (1.14)	(2.7, 0.0)	
(Soft-firm) Dark grey/ black gravelly, cobbly CLAY. occasional shell fragments. Gravel is subrounded to rounded, coarse.	3.80 (0.04)		
Detail: 5.00m soil sample taken			
Grey slightly silty, SAND with occasional cobbles and some shell fragments wet	5.30 (-1.46)	(5.5, 0.0)	
Detail: 7.00-7.50m Falling Head test			
End of Borehole at 7.50 mbgl	**7.50 (-3.66)**		

Drill Method: Cable Percussion (water added to progress drilling)	Hole Diameter: 8"			
Drill Rig: Dando 2000	Top of Casing (mAOD):	-		
Casing Length (m): 7.50mbgl (retracted)				
	Water Strikes (mbgl):	-	-	-
Driller: Causeway Geotech Ltd.	Static Water Level (mbgl):	-		

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Exploratory Log: 108 Shallow

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AWN Project Ref: 14/7893	Client: Drogheda Port Company	Drill date: 20/01/2015
Ground Level (mAOD): 4.64		
Grid Reference: 311797.045, 276021.658	Location: Drogheda Port	Logged/Checked: JN/PG

SUBSURFACE PROFILE	Depth mbgl (mAOD)	Lithology	Well Construction
Ground surface		sample (mbgl, PID)	Flush cover
Concrete (MADE GROUND)	0.24 (4.40)		50mm dia solid standpipe; Concrete; Bentonite
Grey slightly sandy Gravel FILL (MADE GROUND)	0.90 (5.54)	(0.9, 0.0)	
(Soft-firm) Light grey/brown slightly gravelly CLAY. Contains modules of white soft clay. Gravel is angular to subangular, fine to medium. Contains green/grey cement fragments (Cement by-product - MADE GROUND). Detail: 1.90m pure cement (difficult to drive casing)	3.50 (1.14)	(3.5, 0.6)	Gravel filter
(Soft-firm) Dark grey gravelly CLAY with occasional cobbles and many shell fragments. Gravel is rounded, fine to coarse, pungent odour, wet stratum Detail: 3.5m soil sample taken, Gravel content increases with depth	5.00	(5.5, 0.7)	
(Compact) Grey/brown slightly gravelly SILT with occasional cobbles. Gravel is subangular to subrounded, fine to coarse, slight pungent odour, dry Detail: Becoming sandier with depth, gravel content also increases with depth Detail: 7.00m PSD sample taken,			50mm dia. slotted standpipe
End of Borehole at 8.50 mbgl	**8.50 (-3.86)**		End cap

Drill Method: Cable Percussion (water added to progress drilling)	Hole Diameter: 8"			
Drill Rig: Dando 2000	Top of Casing (mAOD):	-		
Casing Length (m): 8.00mbgl (retracted)				
	Water Strikes (mbgl):	-	-	-
Driller: Causeway Geotech Ltd.	Static Water Level (mbgl):	2.85 on 21/01/15		

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Exploratory Log: **109 Shallow**

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AWN Project Ref: 14/7893	Client: Drogheda Port Company	Drill date: 20/01/2015
Ground Level (mAOD): 3.5		
Grid Reference: 312050.227, 276023.289	Location: Drogheda Port	Logged/Checked: JN/PG

SUBSURFACE PROFILE	Depth mbgl (mAOD)	Lithology	Well Construction
Ground surface		sample (mbgl, PID)	
Concrete (MADE GROUND)	0.30 (3.20)		
(Soft-firm) Brown/grey slightly gravelly CLAY , wih occasional cobbles. Gravel is angular to subangular, fine to coarse (possible MADE GROUND)			
Grey slighlty gravelly coarse SAND with shell fragments and occasional cobbles.	1.00 (4.50)		No installation Backfilled with bentonite, arisings and cement seal
Grey, sandy gravelly CLAY with shell fragments and occasional rounded cobbles. Gravel is angular to rounded, fine to coarse. Soil sample taken	1.20 (2.30)	(1.5, 0.0)	
Fine to Coarse GRAVEL wih occasional cobbles comprised of broken cement fragments. (Cement by-products - MADE GROUND). Detail: 2.5m pure cement? (difficult to drive casing).	1.80 (1.70)		
Fine to course GRAVEL with occasional cobbles. Gravel is rounded.	3.60		
(Stiff-Very stiff) Red/brown slightly gravelly CLAY with occasional cobbles. Gravel is subangular to subrounded, fine to coarse, dry Detail: 4.50 soil sample taken, clay becoming firmer with depth.	4.40 (-0.9)	(4.5, 0.2)	
End of Borehole at 7.40 mbgl	**7.40 (-3.9)**		

Drill Method: Cable Percussion (water added to progress drilling)	Hole Diameter: 8"			
Drill Rig: Dando 2000	Top of Casing (mAOD):	-		
Casing Length (m): 7.40mbgl (retracted)				
	Water Strikes (mbgl):	-	-	-
Driller: Causeway Geotech Ltd.	Static Water Level (mbgl):			

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Exploratory Log:	110 Shallow

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AWN Project Ref: 14/7893	Client: Drogheda Port Company	Drill date: 21/01/2015
Ground Level (mAOD): 4.15		
Grid Reference: 311830.782, 275987.602	Location: Drogheda Port	Logged/Checked: JN/PG

SUBSURFACE PROFILE	Depth mbgl (mAOD)	Lithology	Well Construction
Ground surface		sample (mbgl, PID)	
Concrete (MADE GROUND)	0.23 (3.92)		
Sandy Gravel FILL (MADE GROUND). Contains red brick.	0.70 (3.45)		
Concrete encounted (MADE GROUND)			Backfilled with cement seal
Detail: 1.70m no further depth achieved, due to thickness of concrete			
End of Borehole at 1.70 mbgl	**1.70 (2.45)**		

Drill Method: Cable Percussion	Hole Diameter: 8"			
Drill Rig: Dando 2000	Top of Casing (mAOD):	-		
Casing Length (m):				
	Water Strikes (mbgl):	-	-	-
Driller: Causeway Geotech Ltd.	Static Water Level (mbgl):	-		

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Exploratory Log: **111 Shallow**

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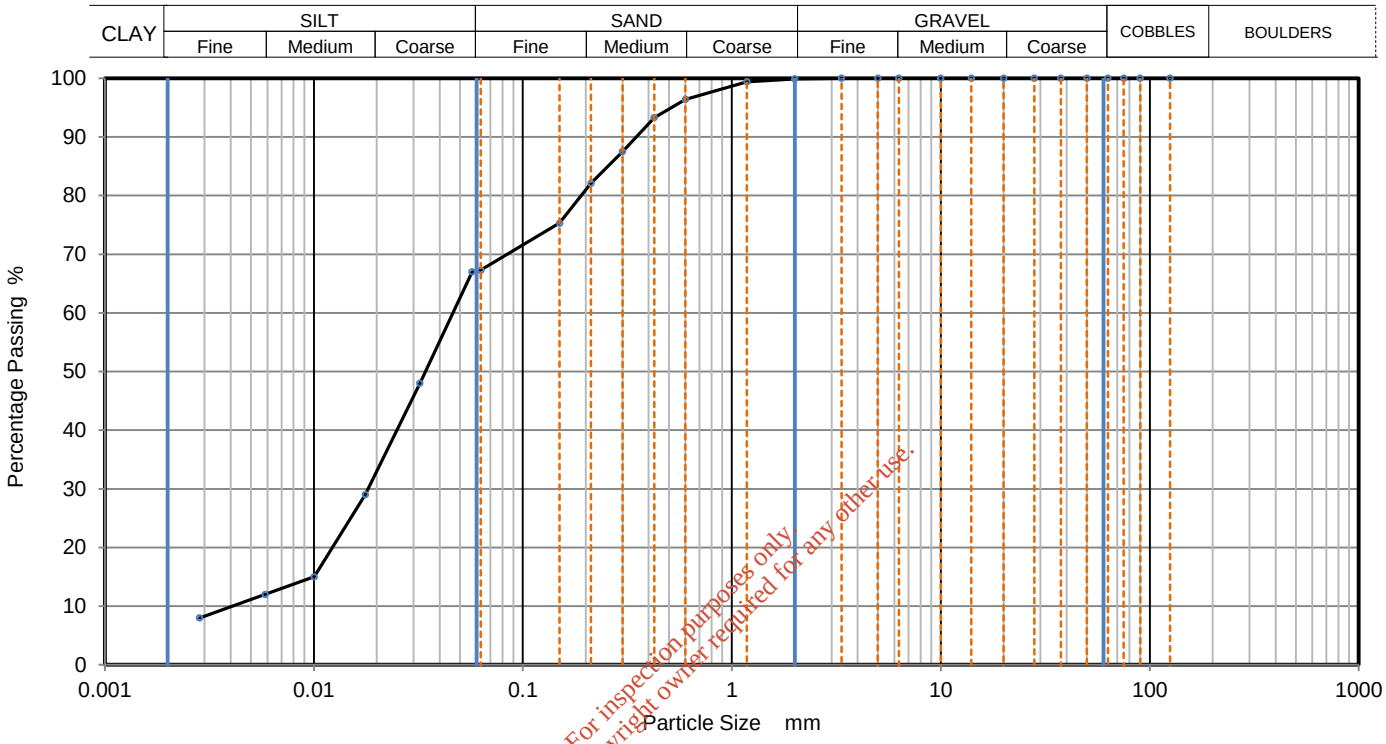
AWN Project Ref: 14/7893	Client: Drogheda Port Company	Drill date: 21/01/2015
Ground Level (mAOD): 4.39		
Grid Reference: 311880.258, 276045.22	Location: Drogheda Port	Logged/Checked: JN/PG

SUBSURFACE PROFILE	Depth mbgl (mAOD)	Lithology	Well Construction
Ground surface		sample (mbgl, PID)	
Concrete (MADE GROUND)			
Brown/grey slightly clayey Gravel FILL (MADE GROUND)	0.35 (4.04)		
(Soft) Light grey CLAY, with occasional subangular, coarse gravel (Cement by-products - MADE GROUND)	2.00 (2.39)	(2.0, 0.0)	No installation Backfilled with bentonite, arisings and cement seal
(Firm) Green/grey CLAY with cement fragments (Cement by-products- MADE GROUND). Undefined odour	2.60 (1.79)		
(Uncompact) Black SILT, wet, pungent odour	2.80 (1.59)	(2.8, 0.0)	
		(3.5, 0.3)	
Grey fine SAND with many shell fragments Detail: 7.00m soil sample taken	6.50 (-2.11)		
End of Borehole at 8.00 mbgl	**8.00 (-3.61)**		

Drill Method: Cable Percussion (water added to progress drilling)	Hole Diameter: 8"			
Drill Rig: Dando 2000	Top of Casing (mAOD):	-		
Casing Length (m): 7.50mbgl (retracted)				
	Water Strikes (mbgl):	-	-	-
Driller: Causeway Geotech Ltd.	Static Water Level (mbgl):			

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref	14-1076
				Borehole/Pit No.	BH105
Site Name	Tom Roes Point Drogheda			Sample No.	2
Soil Description	Slightly sandy organic SILT			Depth, m	3.00
Specimen Reference	2	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	141076BH105B1



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0571	67
90	100	0.0322	48
75	100	0.0176	29
63	100	0.0100	15
50	100	0.0059	12
37.5	100	0.0028	8
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	99		
0.6	96	Particle density	(assumed)
0.425	93	1.50	Mg/m3
0.3	88		
0.212	82		
0.15	75		
0.063	67		

Dry Mass of sample, g	1354

Sample Proportions	% dry mass
Very coarse	0
Gravel	0
Sand	33
Fines <0.063mm	67

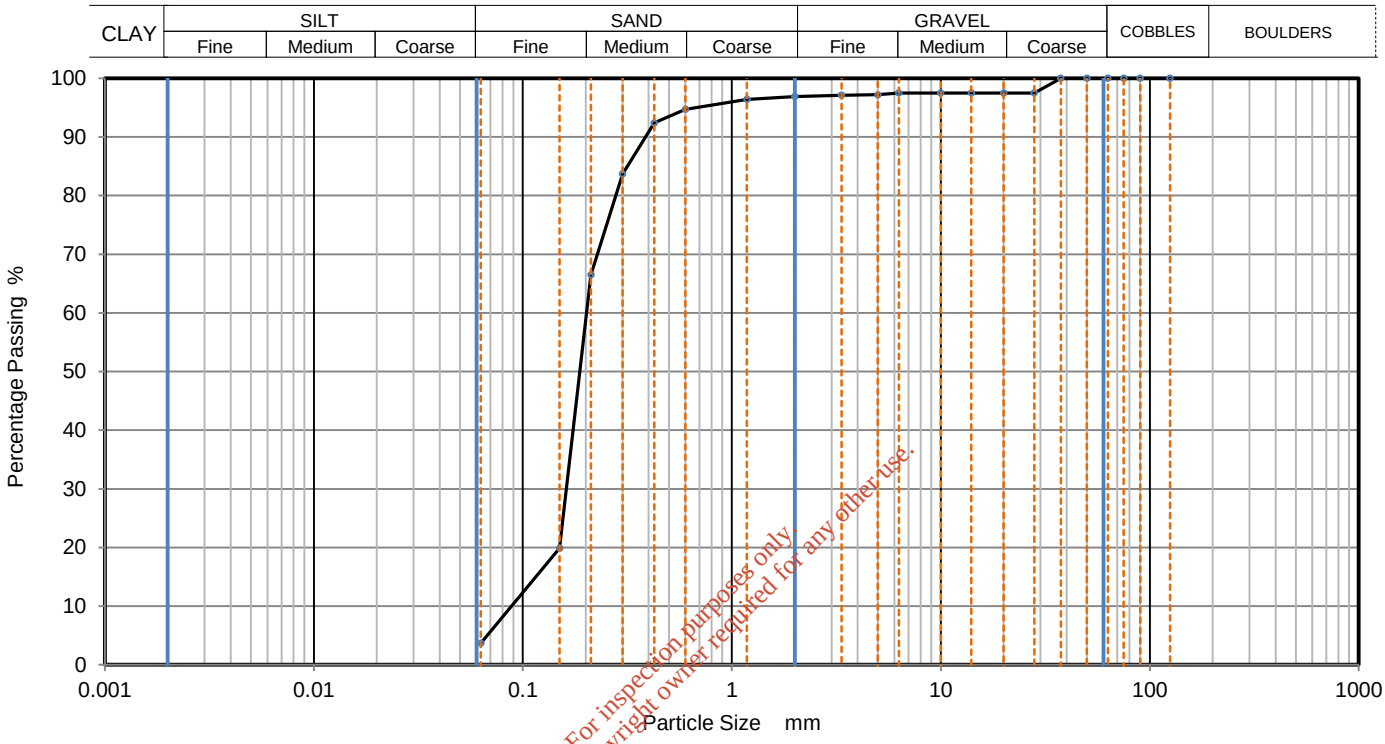
Grading Analysis		
D100	mm	
D60	mm	0.0459
D30	mm	0.0183
D10	mm	0.00438
Uniformity Coefficient		10
Curvature Coefficient		1.7

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved	Sheet printed	Fig 1
Stephen.Watson	11/02/2015 15:27	Sheet

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref	14-1076
				Borehole/Pit No.	BH105
Site Name	Tom Roes Point Drogheda			Sample No.	3
Soil Description	Grey SAND			Depth, m	5.00
Specimen Reference	2	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	141076BH105B3



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	98		
20	98		
14	98		
10	98		
6.3	98		
5	97		
3.35	97		
2	97		
1.18	96		
0.6	95		
0.425	92		
0.3	84		
0.212	67		
0.15	20		
0.063	4		

Dry Mass of sample, g	4794

Sample Proportions	% dry mass
Very coarse	0
Gravel	3
Sand	93
Fines <0.063mm	4

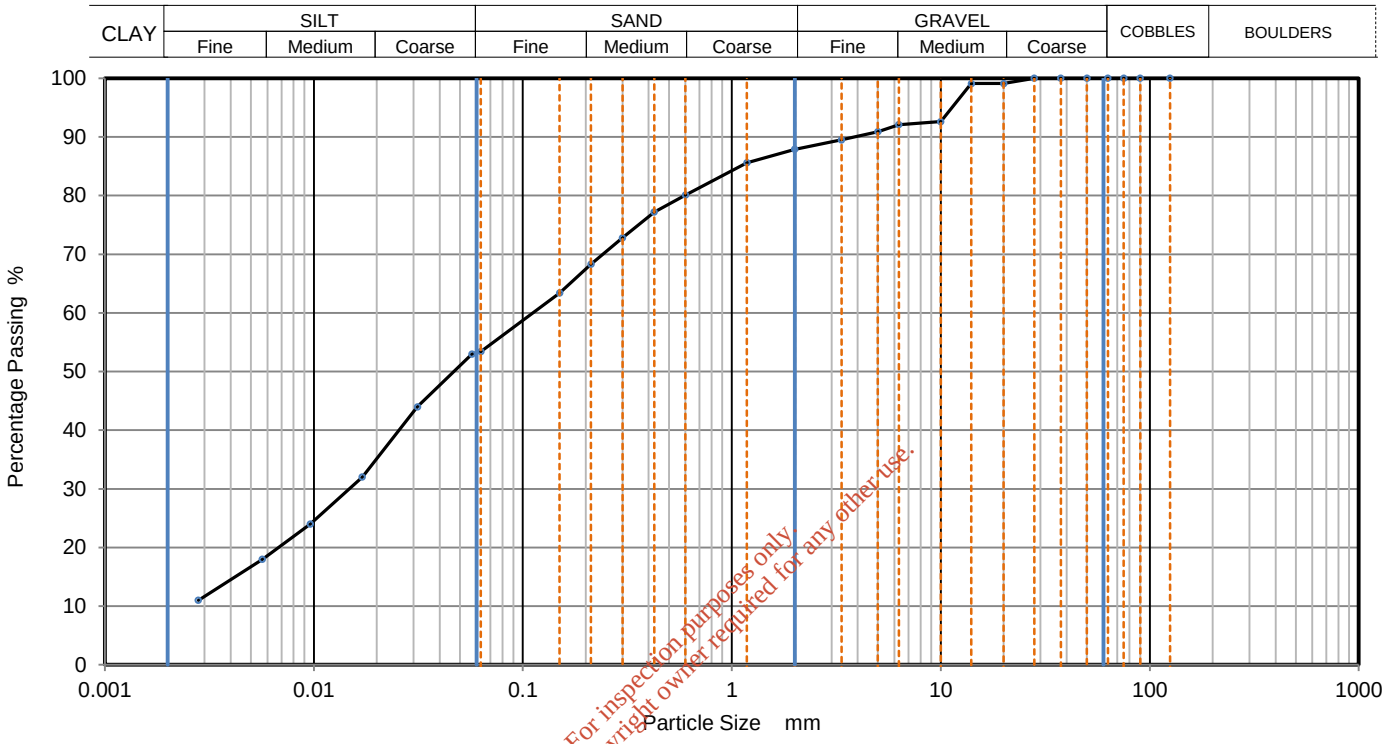
Grading Analysis		
D100	mm	
D60	mm	0.202
D30	mm	0.162
D10	mm	0.0882
Uniformity Coefficient		2.3
Curvature Coefficient		1.5

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved	Sheet printed	Fig 2
Stephen.Watson	11/02/2015 15:27	Sheet

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref	14-1076
				Borehole/Pit No.	BH108
Site Name	Tom Roes Point Drogheda			Sample No.	1
Soil Description	Grey gravelly very silty SAND			Depth, m	7.00
Specimen Reference	2	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	141076BH108B1



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0571	53
90	100	0.0313	44
75	100	0.0170	32
63	100	0.0096	24
50	100	0.0057	18
37.5	100	0.0028	11
28	100		
20	99		
14	99		
10	93		
6.3	92		
5	91		
3.35	90		
2	88		
1.18	86		
0.6	80	Particle density	(assumed)
0.425	77	1.50	Mg/m3
0.3	73		
0.212	68		
0.15	63		
0.063	53		

Dry Mass of sample, g	3250

Sample Proportions	% dry mass
Very coarse	0
Gravel	12
Sand	35
Fines <0.063mm	53

Grading Analysis		
D100	mm	
D60	mm	0.112
D30	mm	0.0146
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved	Sheet printed	Fig 3
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Causeway Geotech

Date	06-Feb-15			
Client	AWN consulting		Sample Height mm	100
Test	Constant Head		Sample Diameter mm	105
	Permeability			
Site	Drogheda Port		Sample Volume cm3	865
Sample Reference		BH105	Initial Wet Mass g	1735
Area/Cell		NA	Final Wet Mass g	1725
S.no		NA	Dry Mass g	1404
Sampling Method		U4	Bulk Density Mg/m3	2005
Depth m		3	Dry Density Mg/m3	1622
			Initial Water Content %	23.6
			Final Water Content %	22.9

Soil type
Grey Sandy SILT

Saturation Stage

Initail B Value	<0.5
Back Pore Water Pressure During Saturation kPa	350
Cell Pressure kPa	340
Final B Value	1
Duration days	4

Consolidation Stage

Cell pressure kPa	400
Back Pore Water Pressure kPa	350
Duration of Consolidation days	1

Permeability Stage

Temperature C^o	20
Cell Pressure kPa	400
Pore Water Pressure (Top) kPa	358
Pore Water Pressure (Bottom) kPa	365
Average Effective Stress kPa	38.5
Head Difference kPa	7
Head Loss kPa	2
Net Head difference m	0.51
Sample Height m	0.098
Hydraulic Gradient i	5.22
Flow Rate cm^3/min	0.11
Area of the Sample cm^2	82.5
Permeability m/s	4.3E-08
Duration of permeability stage days	1

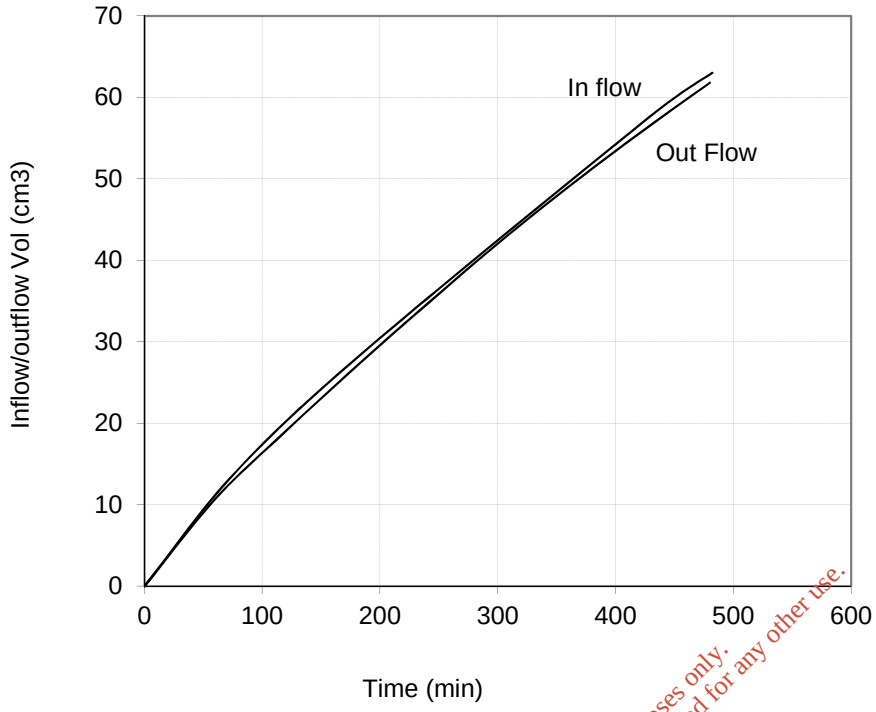


Figure 1 In Flow and Out Flow Against Time

Causeway Geotech

Date	06-Feb-15			
Client	AWN consulting		Sample Height mm	100
Test	Constant Head		Sample Diameter mm	105
	Permeability			
Site	Drogheda Port		Sample Volume cm3	865
Sample Reference		BH106	Initial Wet Mass g	1342
Area/Cell		NA	Final Wet Mass g	1328
S.no		NA	Dry Mass g	853
Sampling Method		U4	Bulk Density Mg/m3	1551
Depth m		2	Dry Density Mg/m3	986
			Initial Water Content %	57.3
			Final Water Content %	55.7

Soil type

Light brown gravelly clayey SILT

Saturation Stage

Initail B Value	<0.5
Back Pore Water Pressure During Saturation kPa	350
Cell Pressure kPa	340
Final B Value	1
Duration days	4

Consolidation Stage

Cell pressure kPa	400
Back Pore Water Pressure kPa	350
Duration of Consolidation days	1

Permeability Stage

Temperature C^o	20
Cell Pressure kPa	400
Pore Water Pressure (Top) kPa	358
Pore Water Pressure (Bottom) kPa	365
Average Effective Stress kPa	38.5
Head Difference kPa	7
Head Loss kPa	2
Net Head difference m	0.51
Sample Height m	0.099
Hydraulic Gradient i	5.15
Flow Rate cm^3/min	0.144
Area of the Sample cm2	84.9
Permeability m/s	5.5E-08
Duration of permeability stage days	1

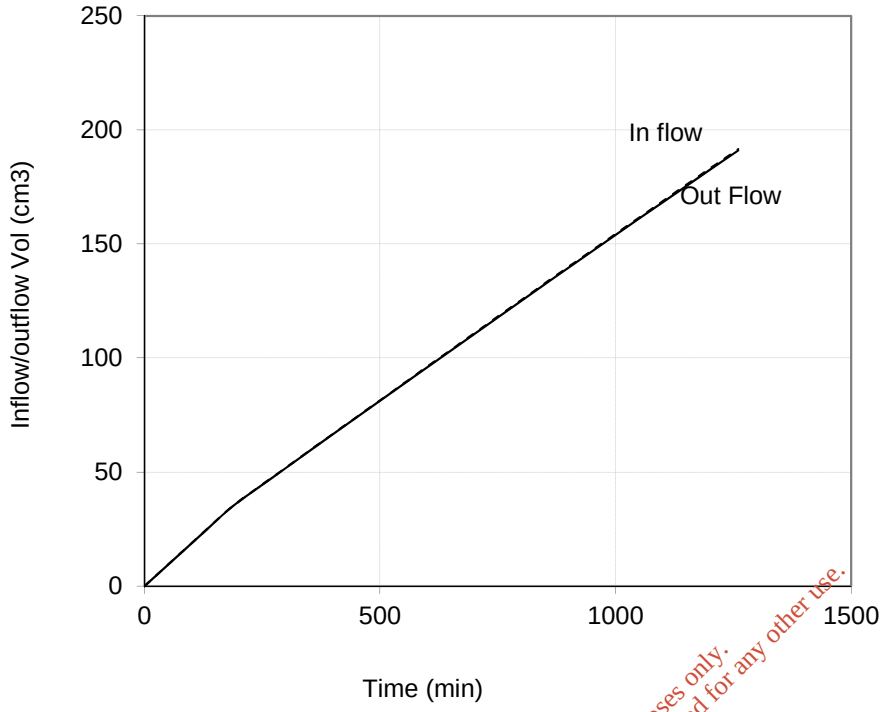


Figure 1 In Flow and Out Flow Against Time

VARIABLE HEAD PERMEABILITY TEST (STANDPIPE PIEZOMETER)

CONTRACT: 14-1076: Drogheda Port BOREHOLE: BH106 TEST No: 1
DATE: 16-Jan-15

TYPE OF TEST: ***Falling*** HEAD

Diameter of standpipe (d):	*50*	(mm)
Height of TOP of standpipe above ground level:	*0.00*	(m) (use -ve values if BELOW g.l.)
Depth to centre of piezo. tip below ground level (	*NA*	(m)
Depth to top of filter below ground level (m):	*0.00*	(m)
Depth to bottom of filter below ground level (m):	*5.30*	(m)
Diameter of filter (D):	*200*	(mm)
Standing ground water level SWL (mbgl):	*2.95*	(m) on: #######

DATUM:All depths to water level measured from top of casing. i.e.SWL 2.95 m below datum.

TIME ELAPSED (mins)	WATER LEVEL* (m)	HEAD H (m)	HEAD RATIO H/Ho
0	0	2.95	1.0000
0.5	0.01	2.94	0.9966
1	0.02	2.93	0.9932
1.5	0.03	2.92	0.9898
2	0.04	2.91	0.9864
2.5	0.04	2.91	0.9864
3	0.04	2.91	0.9864
3.5	0.04	2.91	0.9864
4	0.05	2.9	0.9831
4.5	0.06	2.89	0.9797
5	0.07	2.88	0.9763
6	0.08	2.87	0.9729
7	0.08	2.87	0.9729
8	0.08	2.87	0.9729
9	0.09	2.86	0.9695
10	0.1	2.85	0.9661
12	0.13	2.82	0.9559
14	0.13	2.82	0.9559
16	0.14	2.81	0.9525
18	0.14	2.81	0.9525
20	0.15	2.8	0.9492
22	0.15	2.8	0.9492
24	0.17	2.78	0.9424
26	0.17	2.78	0.9424
28	0.18	2.77	0.9390
30	0.18	2.77	0.9390
35	0.19	2.76	0.9356
40	0.2	2.75	0.9322
45	0.21	2.74	0.9288
50	0.22	2.73	0.9254
55	0.23	2.72	0.9220
60	0.24	2.71	0.9186

CALCULATION OF PERMEABILITY OF SOIL:

Employing Hvorslev formula: k = A/FT
where:
k is the permeability of soil
A is the cross-section area of standpipe
F is the intake factor (see below)
T is the basic time lag factor as defined in Figure 9 of BS 5930:1981 (page 38)

Values of intake factors (F/D) for various cylindrical intake zones of length to diameter ratio (L/D) are given in Figure 8 of BS 5930:1981 (p37); also Dunn and Razouki formula:
F/D = 2.32*PI*(L/D)/loge[1.1*(L/D)+{1+1.1*(L/D)^2}^0.5]

L/D ratio = 26.50 thus F/D= 47.78
i.e. F = 9.56 (m)
and A = 0.00196 (m^2)
and T = 708.33 mins
(see graph of log H/Ho v Time.)

hence, k **4.8E-09 m/s**

i.e., k = 4.8×10^{-9} m/s

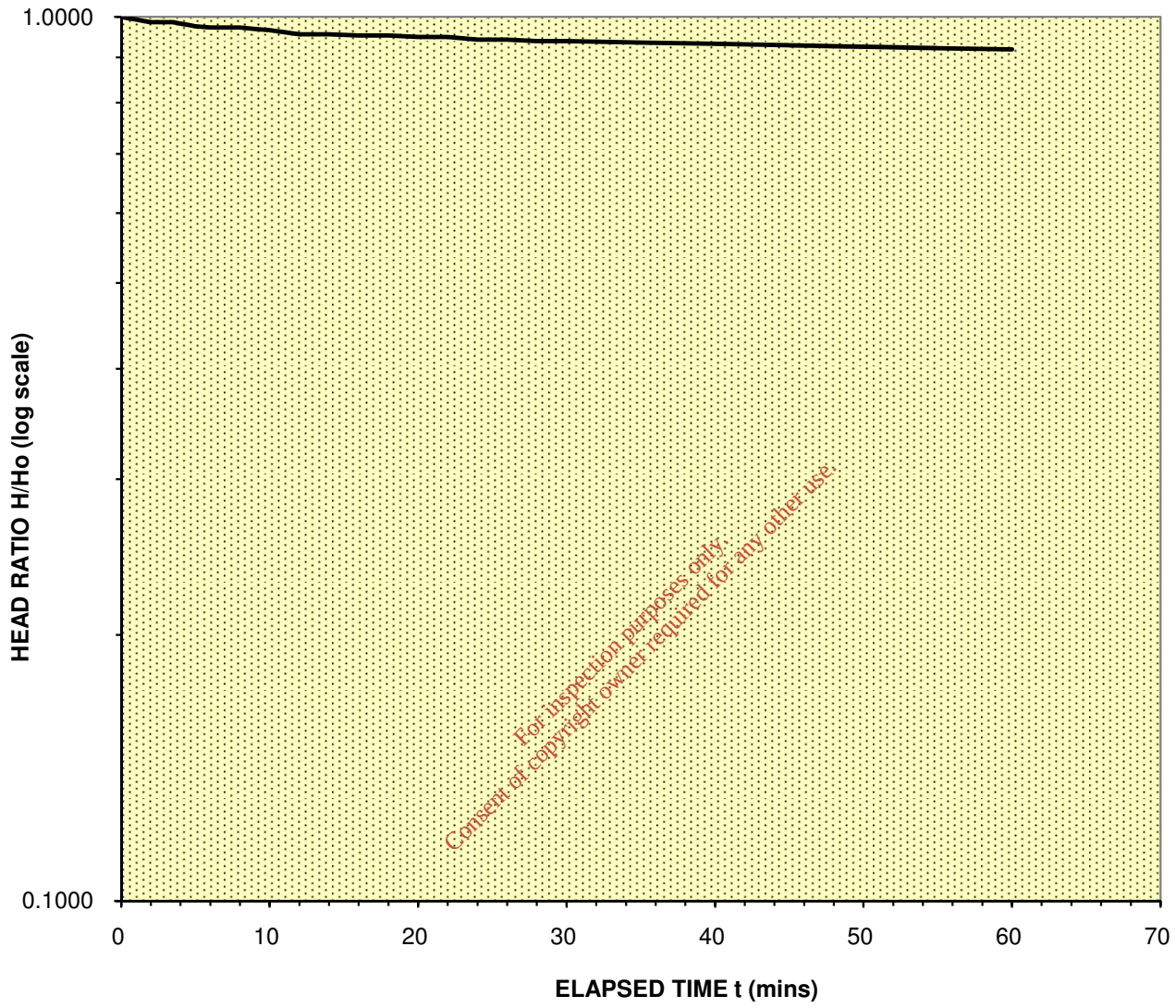
Causeway Geotech Ltd

VARIABLE HEAD PERMEABILITY TEST (STANDPIPE PIEZOMETER)

TYPE OF TEST: ***Falling*** **HEAD**

CONTRACT: 14-1076: Drogheda Port **BOREHOLE No.:** BH106 **TEST #:** 1
DATE: 16-Jan-15

HEAD RATIO (log scale) v. ELAPSED TIME



Basic Time Lag Factor T =	708.33 minutes

wt99

VARIABLE HEAD PERMEABILITY TEST (STANDPIPE PIEZOMETER)

CONTRACT: 14-1076: Drogheda Port BOREHOLE: BH107 TEST No: 1
DATE: 19-Jan-15

TYPE OF TEST: ***Falling*** HEAD

Diameter of standpipe (d):	*50*	(mm)
Height of TOP of standpipe above ground level:	*0.50*	(m) (use -ve values if BELOW g.l.)
Depth to centre of piezo. tip below ground level (m	*NA*	(m)
Depth to top of filter below ground level (m):	*0.00*	(m)
Depth to bottom of filter below ground level (m):	*7.50*	(m)
Diameter of filter (D):	*200*	(mm)
Standing ground water level SWL (mbgl):	*4.1*	(m) on: #######

DATUM:All depths to water level measured from top of casing. i.e.SWL 4.10 m below datum.

TIME ELAPSED (mins)	WATER LEVEL* (m)	HEAD H (m)	HEAD RATIO H/Ho
0	0.42	3.68	1.0000
0.5	0.42	3.68	1.0000
1	0.44	3.66	0.9946
1.5	0.46	3.64	0.9891
2	0.48	3.62	0.9837
2.5	0.49	3.61	0.9810
3	0.51	3.59	0.9755
3.5	0.52	3.58	0.9728
4	0.53	3.57	0.9701
4.5	0.55	3.55	0.9647
5	0.56	3.54	0.9620
6	0.58	3.52	0.9565
7	0.6	3.5	0.9511
8	0.62	3.48	0.9457
9	0.64	3.46	0.9402
10	0.66	3.44	0.9348
11	0.68	3.42	0.9293
12	0.7	3.4	0.9239
14	0.74	3.36	0.9130
16	0.75	3.35	0.9103
18	0.78	3.32	0.9022
20	0.81	3.29	0.8940
22	0.83	3.27	0.8886
24	0.88	3.22	0.8750
26	0.89	3.21	0.8723
28	0.92	3.18	0.8641
30	0.94	3.16	0.8587
32	0.96	3.14	0.8533
36	0.99	3.11	0.8451
40	1.02	3.08	0.8370
44	1.07	3.03	0.8234
48	1.1	3	0.8152
52	1.11	2.99	0.8125
56	1.13	2.97	0.8071
60	1.15	2.95	0.8016

CALCULATION OF PERMEABILITY OF SOIL:

Employing Hvorslev formula: k = A/FT
where:

k is the permeability of soil
A is the cross-section area of standpipe
F is the intake factor (see below)
T is the basic time lag factor as defined

in Figure 9 of BS 5930:1981 (page 38)

Values of intake factors (F/D) for various cylindrical intake zones of length to diameter ratio (L/D) are given in Figure 8 of BS 5930:1981 (p37); also Dunn and Razouki formula:
F/D = 2.32*PI*(L/D)/loge[1.1*(L/D)+{1+1.1*(L/D)^2}^0.5]

L/D ratio = 37.50 thus F/D= 62.27
i.e. F = 12.45 (m)
and A = 0.00196 (m^2)
and T = 248.65 mins

(see graph of log H/Ho v Time.)

hence, k = **1.1E-08 m/s**

i.e., k = 1.1 x 10^{-8} m/s

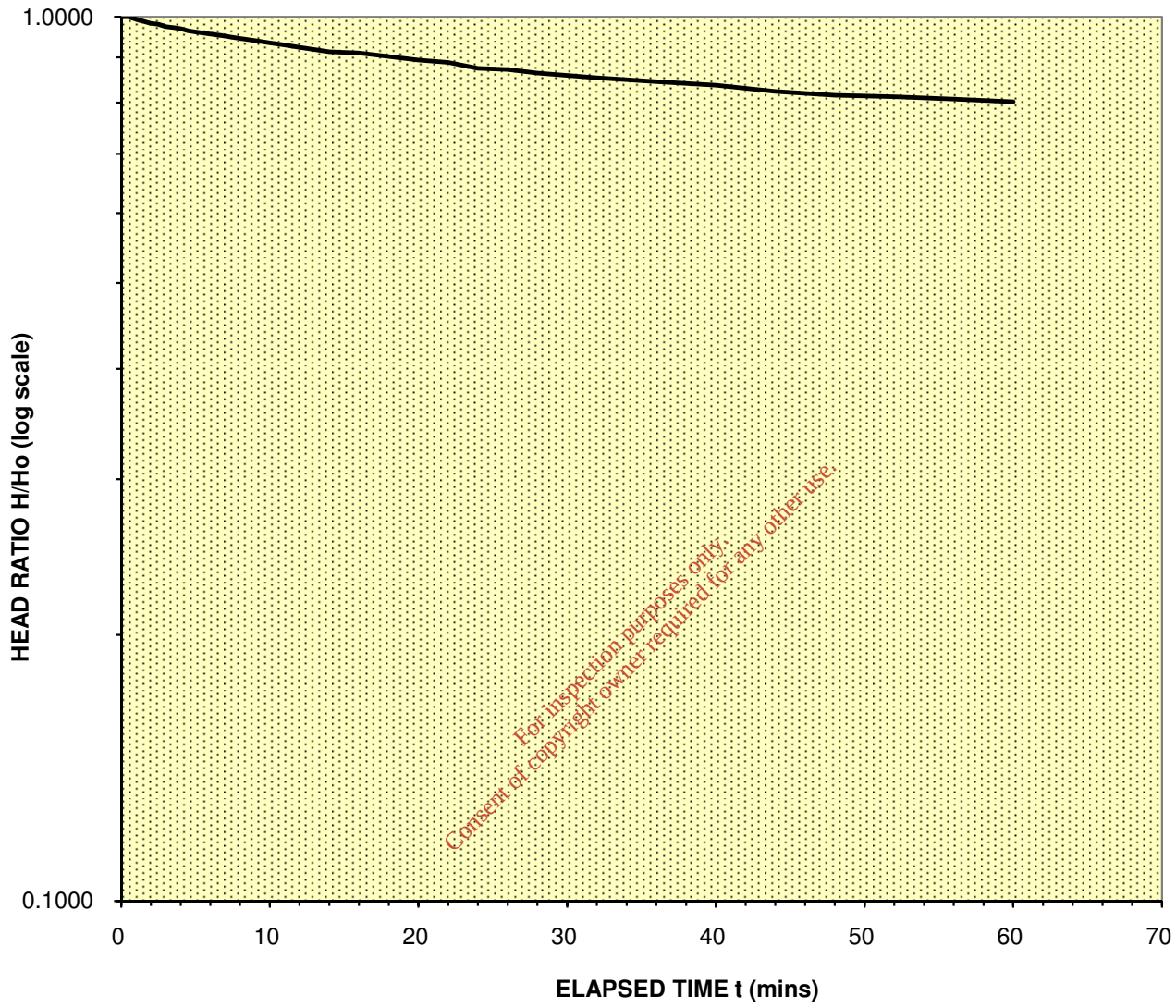
Causeway Geotech Ltd

VARIABLE HEAD PERMEABILITY TEST (STANDPIPE PIEZOMETER)

TYPE OF TEST: ***Falling*** **HEAD**

CONTRACT: 14-1076: Drogheda Port **BOREHOLE No.:** BH107 **TEST #:** 1
DATE: 19-Jan-15

HEAD RATIO (log scale) v. ELAPSED TIME



Basic Time Lag Factor T =	248.65 minutes

wt99

CAUSEWAY GEOTECH

Method	Plant Used	Top	Base
Cable Percussion	Dando 2500	0.00	8.00

Project No.: 19-0532

Project Name: Tom Roes Point, Drogheda Port

Borehole No.: BH01

Coordinates: E N

Client:

Client's Representative:

Sheet 1 of 1

Scale: 1:50

Driller: RN

Ground Level: mOD

Dates: 13/05/2019 - 13/05/2019

Logger: CH

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description
						(0.25) 0.25		BITMAC
								MADE GROUND: Lean mix concrete
						(1.05)		
1.20 - 1.65	SPT (C) N=29			N=29 (1,2/2,7,8,12)		1.30		
1.30 - 1.60	B1 D2					(0.30) 1.60		MADE GROUND: Soft brown slightly sandy CLAY with fragments of red brick, concrete and timber (Construction fill)
1.60 - 3.00	B3 D4							MADE GROUND: Stiff brown slightly sandy gravelly CLAY with low cobble content and large pieces of concrete. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
2.00 - 2.19	SPT (C)			N=30 (25 for 40mm/30 for 150mm)		(1.40)		
		2.20		13-05-2019				
		2.20		14-05-2019				
3.00 - 4.00	B5 D6					3.00		Firm grey SILT with low cobble conetent.
3.00 - 3.45	SPT (C) N=14			N=14 (1,1/2,3,5,4) Water strike at 3.20m				
4.00	U13	4.00		Ublow=33 100%		(2.00)		
4.00 - 5.00	B7 D8							
5.00 - 6.00	B9 D10					5.00		Stiff grey silty fine to coarse SAND
5.00 - 5.45	SPT (S) N=19			N=19 (1,1/2,5,6,6)				
6.00 - 7.50	B11 D12							
6.00 - 6.45	SPT (S) N=19			N=19 (1,2/1,4,7,7)		(3.00)		
7.50 - 8.00	B14 D15	7.50	0.40	14-05-2019				
		7.50	4.10	15-05-2019				
8.00 - 8.45	SPT (S) N=22	8.00	4.00	N=22 (1,2/2,7,6,7) 15-05-2019		8.00		End of Borehole at 8.00m

Water

Backfill

Remarks

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
3.20	3.00	20	2.90

Water Added

From (m)	To (m)
1.20	8.00

Casing Details

To (m)	Diam (mm)
8.00	200

Chiselling Details

From (m)	To (m)	Time (hh:mm)

CAUSEWAY GEOTECH

Method	Plant Used	Top	Base
Cable Percussion	Dando 25000	0.00	8.00

Project No.: 19-0532

Project Name: Tom Roes Point, Drogheda Port

Borehole No.: BH02

Coordinates: E N

Client:

Client's Representative:

Sheet 1 of 1

Scale: 1:50

Driller: RN

Ground Level: mOD

Dates: 15/05/2019 - 15/05/2019

Logger: SR

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description
						(0.25) 0.25		BITMAC
						(0.35) 0.60		MADE GROUND: Lean mix CONCRETE (804)
0.50 - 1.00	B1 B2					(0.40) 1.00		Sandy clayey subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse.
1.00 - 2.00	B3 B4							MADE GROUND: Green CEMENT with low cobble content.
1.20 - 1.65	SPT (C) N=27	1.20		N=27 (4,8/8,7,5,7)				
2.00 - 3.00	B5 D6					(2.00)		
2.00 - 2.45	SPT (C) N=38	2.00		N=38 (5,7/7,8,12,11)				
3.00 - 4.00	B7 D8					3.00		MADE GROUND: Pale pink old plaster
3.00 - 3.18	SPT (C)	3.00		0 (13 for 81mm/0 for 99mm)		(1.00)		
4.00 - 5.00	B9 D10					4.00		Medium dense silty fine to coarse SAND
4.00 - 4.45	SPT (C) N=10	4.00		N=10 (5,4/2,2,3,3) Water strike at 4.70m				
5.00	U17	5.00	4.9	Ublow=26 100%				
5.00 - 6.00	B11 D12					(3.00)		
6.00 - 7.00	B13 D14							
6.00 - 6.45	SPT (C) N=18	6.00		N=18 (2,2/4,5,4,5)				
7.00 - 8.00	B15 D16					7.00		Medium dense grey silty fine to coarse SAND with sea shells.
7.00 - 7.45	SPT (C) N=23	7.00	6.80	N=23 (1,3/6,5,6,6)		(1.00)		
8.00 - 8.45	SPT (C) N=27	8.00 8.00	7.00 6.00	N=27 (2,3/5,7,8,7) 15-05-2019		8.00		End of Borehole at 8.00m

Water

Backfill

Remarks
Sand piping from 5.00m to 8.00m

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
4.70	4.70	20	4.50

Chiselling Details

From (m)	To (m)	Time (hh:mm)
2.30	2.50	00:20

Water Added

From (m)	To (m)
1.20	8.00

Casing Details

To (m)	Diam (mm)

APPENDICES

Appendix B Laboratory Analytical Reports & Gas Monitoring

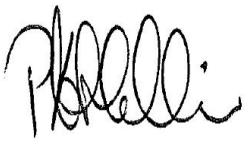
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

Final Report

Report Number:	15-01611 Issue-1
Initial Date of Issue:	09-Feb-2015
Client:	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Darren O'Mahony Paul Dunlop Stephen Franey
Project:	14-1076- Drogheda Port

Quotation No.:		**Date Received:**	26-Jan-2015
Order No.:		**Date Instructed:**	26-Jan-2015
No. of Samples:	34		
Turnaround: (Wkdays)	5	**Results Due Date:**	30-Jan-2015
Date Approved:	30-Jan-2015		

Approved By:



Details: Phil Hellier, Project Director

Chemtest
The right chemistry to deliver results

Results Summary - Soil

Project: 14-1076- Drogheda Port

Client: Causeway Geotech Ltd					Chemtest Job No.:	15-01611	15-01611	15-01611	15-01611	15-01611	15-01611	15-01611	15-01611	15-01611	15-01611
Quotation No.:					Chemtest Sample ID.:	93783	93791	93792	93793	93797	93798	93800	93802	93804	93806
Order No.:					Client Sample Ref.:										
					Client Sample ID.:	BH102	BH103	BH104	BH104	BH106	BH106	BH107	BH108	BH109	BH109
					Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	5.00	18.50	2.00	6.00	2.00	4.50	5.00	3.50	1.20	7.00
					Bottom Depth(m):										
					Date Sampled:										
Determinand	**Accred.**	**SOP**	**Units**	**LOD**											
ACM Type	U	2192				-	-	-	-	-	-	-	-	-	-
Asbestos Identification	U	2192	%	0.001		No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.02		42	15	32	19	34	24	27	28	13	12
pH	U	2010				11.4	9.3	10.1	9.9	9.3	8.9	8.8	10.1	8.6	9.5
Boron (Hot Water Soluble)	U	2120	mg/kg	0.4		1.7	0.84	1.6	0.65	5.5	3.0	8.5	7.2	0.79	0.74
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.01		2.3	0.13	1.1	0.39	1.5	0.77	0.97	1.2	0.080	0.081
Cyanide (Total)	U	2300	mg/kg	0.5		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Potassium (Available)	N	2400	mg/l	2		13000	420	8500	950	280	950	1600	3400	320	480
Sodium	N	2410	mg/l	2		16000	2800	3400	600	250	650	3100	4000	200	1300
Ammoniacal Nitrogen	U	2425	mg/kg	0.5		< 2.0	< 2.0	< 2.0	< 2.0	3.0	5.1	4.6	< 2.0	5.7	< 2.0
Aluminium (Total)	N	2430	mg/kg	100		6300	8600	9200	3600	6400	5400	3600	7000	5000	12000
Iron (Total)	N	2430	mg/kg	100		7600	14000	14000	10000	8800	12000	20000	14000	16000	19000
Magnesium (Total)	N	2430	mg/kg			1100	790.0	620.0	410.0	1200	610.0	2100	540.0	820.0	1500
Sulphate (Total)	U	2430	%	0.01		1.3	0.43	1.5	0.27	2.9	1.4	0.62	1.1	0.13	0.027
Arsenic	U	2450	mg/kg	1		24	16	21	8.4	24	8.7	24	16	21	10
Cadmium	U	2450	mg/kg	0.1		3.2	0.33	0.58	0.26	6.6	0.28	0.51	0.36	1.9	0.20
Chromium	U	2450	mg/kg	1		22	40	27	15	24	18	14	22	19	41
Copper	U	2450	mg/kg	0.5		50	26	24	6.6	36	9.5	9.0	18	23	26
Mercury	U	2450	mg/kg	0.1		< 0.10	< 0.10	0.15	< 0.10	< 0.10	< 0.10	< 0.10	0.14	< 0.10	< 0.10
Manganese	U	2450	mg/kg	5		540	740	440	290	530	330	1900	820	1700	720
Nickel	U	2450	mg/kg	0.5		23	51	25	15	23	18	37	22	44	51
Lead	U	2450	mg/kg	0.5		1000	23	59	11	170	20	32	62	72	17
Zinc	U	2450	mg/kg	0.5		57	55	65	29	55	38	73	77	88	55
Chromium (Hexavalent)	N	2490	mg/kg	0.5		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Mineral Oil	N	2670	mg/kg	10		A < 10	A < 10	A < 10	A < 10	A < 10	A < 10	A < 10	A < 10	A < 10	A < 10
Total TPH >C6-C40	U	2670	mg/kg	10		A < 10	A < 10	A < 10	A < 10	A < 10	A < 10	A < 10	A < 10	A < 10	A < 10
Naphthalene	U	2700	mg/kg	0.1		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.1		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.1		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2700	mg/kg	0.1		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.1		< 0.10	< 0.10	0.50	< 0.10	< 0.10	< 0.10	1.1	1.7	< 0.10	< 0.10
Anthracene	U	2700	mg/kg	0.1		< 0.10	< 0.10	1.5	< 0.10	< 0.10	< 0.10	0.65	0.64	< 0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.1		0.15	< 0.10	0.47	< 0.10	< 0.10	< 0.10	0.34	0.38	< 0.10	< 0.10
Pyrene	U	2700	mg/kg	0.1		0.28	< 0.10	0.45	< 0.10	< 0.10	< 0.10	0.43	0.31	< 0.10	< 0.10
Benzo[a]anthracene	U	2700	mg/kg	0.1		< 0.10	< 0.10	0.21	< 0.10	< 0.10	< 0.10	< 0.10	0.51	< 0.10	< 0.10

Chemtest
The right chemistry to deliver results

Results Summary - Soil

Project: 14-1076- Drogheda Port

Client: Causeway Geotech Ltd														
Quotation No.:				**Chemtest Job No.:**	15-01611	15-01611	15-01611	15-01611	15-01611	15-01611	15-01611	15-01611	15-01611	15-01611
Order No.:				**Chemtest Sample ID.:**	93783	93791	93792	93793	93797	93798	93800	93802	93804	93806
				Client Sample Ref.:										
				Client Sample ID.:	BH102	BH103	BH104	BH104	BH106	BH106	BH107	BH108	BH109	BH109
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	5.00	18.50	2.00	6.00	2.00	4.50	5.00	3.50	1.20	7.00
				Bottom Depth(m):										
				Date Sampled:										
Determinand	**Accred.**	**SOP**	**Units**	**LOD**										
Chrysene	U	2700	mg/kg	0.1	< 0.10	< 0.10	0.49	< 0.10	< 0.10	< 0.10	0.24	0.22	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2700	mg/kg	0.1	< 0.10	< 0.10	0.32	< 0.10	< 0.10	< 0.10	0.29	0.14	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2700	mg/kg	0.1	< 0.10	< 0.10	0.26	< 0.10	< 0.10	< 0.10	0.21	0.17	< 0.10	< 0.10
Benzo[a]pyrene	U	2700	mg/kg	0.1	< 0.10	< 0.10	0.42	< 0.10	< 0.10	< 0.10	0.25	0.22	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.1	< 0.10	< 0.10	0.16	< 0.10	< 0.10	< 0.10	< 0.10	0.17	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.1	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.20	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2700	mg/kg	0.1	< 0.10	< 0.10	0.30	< 0.10	< 0.10	< 0.10	< 0.10	0.47	< 0.10	< 0.10
Total Of 16 PAH's	U	2700	mg/kg	2	< 2.0	< 2.0	5.1	< 2.0	< 2.0	< 2.0	3.5	5.1	< 2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.3	0.55	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	1.3	< 0.30	< 0.30

Chemtest
The right chemistry to deliver results

Results Summary - Soil

Project: 14-1076- Drogheda Port

Client: Causeway Geotech Ltd			Chemtest Job No.:		15-01611
Quotation No.:			Chemtest Sample ID.:		93809
Order No.:			Client Sample Ref.:		
			Client Sample ID.:		BH111
			Sample Type:		SOIL
			Top Depth (m):		3.00
			Bottom Depth(m):		
			Date Sampled:		
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
ACM Type	U	2192			-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected
Moisture	N	2030	%	0.02	37
pH	U	2010			10.2
Boron (Hot Water Soluble)	U	2120	mg/kg	0.4	0.85
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.01	0.10
Cyanide (Total)	U	2300	mg/kg	0.5	< 0.50
Potassium (Available)	N	2400	mg/l	2	6500
Sodium	N	2410	mg/l	2	6500
Ammoniacal Nitrogen	U	2425	mg/kg	0.5	< 2.0
Aluminium (Total)	N	2430	mg/kg	100	11000
Iron (Total)	N	2430	mg/kg	100	19000
Magnesium (Total)	N	2430	mg/kg		440.0
Sulphate (Total)	U	2430	%	0.01	1.6
Arsenic	U	2450	mg/kg	1	17
Cadmium	U	2450	mg/kg	0.1	0.49
Chromium	U	2450	mg/kg	1	37
Copper	U	2450	mg/kg	0.5	24
Mercury	U	2450	mg/kg	0.1	0.21
Manganese	U	2450	mg/kg	5	500
Nickel	U	2450	mg/kg	0.5	34
Lead	U	2450	mg/kg	0.5	69
Zinc	U	2450	mg/kg	0.5	120
Chromium (Hexavalent)	N	2490	mg/kg	0.5	< 0.50
Mineral Oil	N	2670	mg/kg	10	A < 10
Total TPH >C6-C40	U	2670	mg/kg	10	A < 10
Naphthalene	U	2700	mg/kg	0.1	< 0.10
Acenaphthylene	U	2700	mg/kg	0.1	< 0.10
Acenaphthene	U	2700	mg/kg	0.1	< 0.10
Fluorene	U	2700	mg/kg	0.1	< 0.10
Phenanthrene	U	2700	mg/kg	0.1	< 0.10
Anthracene	U	2700	mg/kg	0.1	< 0.10
Fluoranthene	U	2700	mg/kg	0.1	0.56
Pyrene	U	2700	mg/kg	0.1	0.63
Benzo[a]anthracene	U	2700	mg/kg	0.1	0.26

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Results Summary - Soil

Project: 14-1076- Drogheda Port

Client: Causeway Geotech Ltd				**Chemtest Job No.:**	15-01611
Quotation No.:				**Chemtest Sample ID.:**	93809
Order No.:				Client Sample Ref.:	
				Client Sample ID.:	BH111
				Sample Type:	SOIL
				Top Depth (m):	3.00
				Bottom Depth(m):	
				Date Sampled:	
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Chrysene	U	2700	mg/kg	0.1	0.31
Benzo[b]fluoranthene	U	2700	mg/kg	0.1	0.64
Benzo[k]fluoranthene	U	2700	mg/kg	0.1	0.66
Benzo[a]pyrene	U	2700	mg/kg	0.1	0.41
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.1	0.27
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.1	0.20
Benzo[g,h,i]perylene	U	2700	mg/kg	0.1	0.62
Total Of 16 PAH's	U	2700	mg/kg	2	4.6
Total Phenols	U	2920	mg/kg	0.3	0.80

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Chemtest Sample ID:	Sample Ref:	Sample ID:	Sampled Date:	Containers Received:	Deviation Code(s):
93783		BH102	None Supplied	Amber Glass 250ml	A
93791		BH103	None Supplied	Amber Glass 250ml	A
93792		BH104	None Supplied	Amber Glass 250ml	A
93793		BH104	None Supplied	Amber Glass 250ml	A
93797		BH106	None Supplied	Amber Glass 250ml	A
93798		BH106	None Supplied	Amber Glass 250ml	A
93800		BH107	None Supplied	Amber Glass 250ml	A
93802		BH108	None Supplied	Amber Glass 250ml	A
93804		BH109	None Supplied	Amber Glass 250ml	A
93806		BH109	None Supplied	Amber Glass 250ml	A
93809		BH111	None Supplied	Amber Glass 250ml	A

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Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVCOs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at our Coventry laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container

Sample Retention and Disposal

All soil samples will be retained for a period of 60 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.co.uk

Ground Gas and Water Level Readings

Site: Drogheda Port

Project No: 14-1076

Date: 05/02/2015

Weather: Dry

Ambient Conditions	Barometric Pressure	CH_4 (%)	CO_2 (%)	O_2 (%)
Before Monitoring	1030	0	0.1	18.9
After Monitoring	1030	0	0.1	18.9

BH101D

Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	H_2S (ppm)	CO (ppm)	Flow (l/h)
30	0.0	0.1	18.8	0	0	0.0
60	0.0	0.1	18.8	0	0	0.0
90	0.0	0.1	18.8	0	0	0.0
120	0.0	0.1	18.8	0	0	0.0
180	0.0	0.1	18.8	0	0	0.0
240	0.0	0.1	18.8	0	0	0.0
300	0.0	0.1	18.8	0	0	0.0

Water	mbgl
Depth to top of water	2.68
Sample collected (Y/N)	N

BH102D

Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	H_2S (ppm)	CO (ppm)	Flow (l/h)
30	0.0	0.0	18.9	0	0	0.0
60	0.0	0.0	18.9	0	0	0.0
90	0.0	0.0	18.9	0	0	0.0
120	0.0	0.0	18.9	0	0	0.0
180	0.0	0.0	18.9	0	0	0.0
240	0.0	0.0	18.9	0	0	0.0
300	0.0	0.0	18.9	0	0	0.0

Water	mbgl
Depth to top of water	2.54
Sample collected (Y/N)	N

BH103D

Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	H_2S (ppm)	CO (ppm)	Flow (l/h)
30	0.0	0.1	18.8	0	0	0.1
60	0.0	0.1	18.7	0	0	0.1
90	0.0	0.1	18.7	0	0	0.1
120	0.0	0.1	18.7	0	0	0.1
180	0.0	0.1	18.7	0	0	0.1
240	0.0	0.1	18.7	0	0	0.1
300	0.0	0.1	18.7	0	0	0.1

Water	mbgl
Depth to top of water	2.41
Sample collected (Y/N)	N

BH104S

Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	H_2S (ppm)	CO (ppm)	Flow (l/h)
30	0.0	0.1	18.9	0	0	0.1
60	0.0	0.1	18.9	0	0	0.1
90	0.0	0.1	18.9	0	0	0.1
120	0.0	0.1	18.9	0	0	0.1
180	0.0	0.1	18.9	0	0	0.1
240	0.0	0.1	18.9	0	0	0.1
300	0.0	0.1	18.9	0	0	0.1

Water	mbgl
Depth to top of water	2.83
Sample collected (Y/N)	N

Ground Gas and Water Level Readings

Site: Drogheda Port

Project No: 14-1076

BH106S

Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	H_2S (ppm)	CO (ppm)	Flow (l/h)
30	0.0	0.0	18.9	0	0	0.0
60	0.0	0.0	18.9	0	0	0.0
90	0.0	0.0	18.9	0	0	0.0
120	0.0	0.1	18.8	0	0	0.0
180	0.0	0.1	18.8	0	0	0.0
240	0.0	0.1	18.8	0	0	0.0
300	0.0	0.1	18.8	0	0	0.0

Water	mbgl
Depth to top of water	2.51
Sample collected (Y/N)	N

BH108S

Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	H_2S (ppm)	CO (ppm)	Flow (l/h)
30	0.0	0.1	18.3	0	0	0.1
60	0.0	0.1	18.3	0	0	0.1
90	0.0	0.1	17.3	0	0	0.1
120	0.0	0.1	17.3	0	0	0.1
180	0.0	0.1	17.3	0	0	0.1
240	0.0	0.1	17.3	0	0	0.1
300	0.0	0.1	17.3	0	0	0.1

Water	mbgl
Depth to top of water	2.29
Sample collected (Y/N)	N

Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

Final Report

Report Number:	15-02079 Issue-1
Initial Date of Issue:	17-Feb-2015
Client:	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Darren O'Mahony Paul Dunlop Stephen Franey
Project:	14-1076 - Drogheda Port

Quotation No.:		**Date Received:**	02-Feb-2015
Order No.:		**Date Instructed:**	13-Feb-2015
No. of Samples:	3		
Turnaround: (Wkdays)	3	**Results Due Date:**	17-Feb-2015
Date Approved:	17-Feb-2015		

Approved By:

Details: Keith Jones, Technical Manager

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Results Summary - Water

Project: 14-1076 - Drogheda Port

Client: Causeway Geotech Ltd			Chemtest Job No.:		15-02079	15-02079	15-02079
Quotation No.:			Chemtest Sample ID.:		96507	96508	96509
Order No.:			Client Sample Ref.:				
			Client Sample ID.:		BH102	BH103	BH106
			Sample Type:		WATER	WATER	WATER
			Top Depth (m):		2.30	6.00	11.50
			Bottom Depth(m):				
			Date Sampled:				
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
pH	U	1010			8.0	10.0	9.1
Electrical Conductivity	U	1020	µS/cm	1	11000	2100	2000
Total Dissolved Solids	N	1040	mg/l	1	6800	1200	1200
Alkalinity (Total)	U	1220	mg CaCO3/l	10	110	70	66
Chloride	U	1220	mg/l	1	4000	480	350
Fluoride	U	1220	mg/l	0.05	< 0.050	0.18	0.32
Ammoniacal Nitrogen	U	1220	mg/l	0.01	1.3	0.29	6.5
Sulphate	U	1220	mg/l	1	610	130	510
Total Oxidised Nitrogen	U	1220	mg/l	0.2	< 0.20	4.1	0.32
Cyanide (Total)	U	1300	mg/l	0.05	< 0.050	< 0.050	< 0.050
Calcium	U	1415	mg/l	5	540	150	120
Potassium	U	1415	mg/l	0.5	41	79	78
Magnesium	U	1415	mg/l	0.5	110	79	4.2
Sodium	U	1415	mg/l	0.5	1100	1000	260
Boron (Dissolved)	U	1450	µg/l	20	760	520	180
Manganese (Dissolved)	U	1450	µg/l	1	510	9.5	< 1.0
Arsenic (Total)	U	1450	µg/l	1	58	12	7.4
Cadmium (Total)	U	1450	µg/l	0.08	1.5	< 0.080	0.091
Chromium (Total)	U	1450	µg/l	1	200	140	46
Copper (Total)	U	1450	µg/l	1	29	13	7.7
Mercury (Total)	U	1450	µg/l	0.5	< 0.50	< 0.50	< 0.50
Nickel (Total)	U	1450	µg/l	1	33	2.3	5.1
Lead (Total)	U	1450	µg/l	1	< 1.0	< 1.0	< 1.0
Zinc (Total)	U	1450	µg/l	1	41	12	20
Iron (Dissolved)	N	1470	µg/l	20	20	< 20	< 20
Chromium (Hexavalent)	U	1490	µg/l	20	A < 20	A 91	A < 20
Total Organic Carbon	N	1610	mg/l	1	3.8	7.2	7.6
Mineral Oil	U	1670	µg/l	10	A < 10	A < 10	A < 10
TPH >C6-C10	N	1670	µg/l	0.1	A < 0.10	A < 0.10	A < 0.10
TPH >C10-C21	N	1670	µg/l	0.1	A 1800	A < 0.10	A < 0.10
TPH >C21-C40	N	1670	µg/l	0.1	A 21	A < 0.10	A < 0.10
Total TPH >C6-C40	U	1670	µg/l	10	A 1800	A < 10	A < 10
Dichlorodifluoromethane	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
Chloromethane	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
Vinyl Chloride	N	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
Bromomethane	U	1760	µg/l	5	A < 5	A < 5	A < 5

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Results Summary - Water

Project: 14-1076 - Drogheda Port

Client: Causeway Geotech Ltd			Chemtest Job No.:		15-02079	15-02079	15-02079
Quotation No.:			Chemtest Sample ID.:		96507	96508	96509
Order No.:			Client Sample Ref.:				
			Client Sample ID.:		BH102	BH103	BH106
			Sample Type:		WATER	WATER	WATER
			Top Depth (m):		2.30	6.00	11.50
			Bottom Depth(m):				
			Date Sampled:				
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Chloroethane	U	1760	µg/l	2	A < 2.0	A < 2.0	A < 2.0
Trichlorofluoromethane	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
1,1-Dichloroethene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
Trans 1,2-Dichloroethene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
1,1-Dichloroethane	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
cis 1,2-Dichloroethene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
Bromochloromethane	U	1760	µg/l	5	A < 5.0	A < 5.0	A < 5.0
Trichloromethane	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
1,1,1-Trichloroethane	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
Tetrachloromethane	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
1,1-Dichloropropene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
Benzene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
1,2-Dichloroethane	U	1760	µg/l	2	A < 2.0	A < 2.0	A < 2.0
Trichloroethene	N	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
1,2-Dichloropropane	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
Dibromomethane	U	1760	µg/l	10	A < 10	A < 10	A < 10
Bromodichloromethane	U	1760	µg/l	5	A < 5.0	A < 5.0	A < 5.0
cis-1,3-Dichloropropene	N	1760	µg/l	10	A < 10	A < 10	A < 10
Toluene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
Trans-1,3-Dichloropropene	N	1760	µg/l	10	A < 10	A < 10	A < 10
1,1,2-Trichloroethane	U	1760	µg/l	10	A < 10	A < 10	A < 10
Tetrachloroethene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
1,3-Dichloropropane	U	1760	µg/l	2	A < 2.0	A < 2.0	A < 2.0
Dibromochloromethane	U	1760	µg/l	10	A < 10	A < 10	A < 10
1,2-Dibromoethane	U	1760	µg/l	5	A < 5.0	A < 5.0	A < 5.0
Chlorobenzene	N	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
1,1,1,2-Tetrachloroethane	U	1760	µg/l	2	A < 2.0	A < 2.0	A < 2.0
Ethylbenzene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
m & p-Xylene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
o-Xylene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
Styrene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
Tribromomethane	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
Isopropylbenzene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
Bromobenzene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
1,2,3-Trichloropropane	N	1760	µg/l	50	A < 50	A < 50	A < 50
N-Propylbenzene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0

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Results Summary - Water

Project: 14-1076 - Drogheda Port

Client: Causeway Geotech Ltd			Chemtest Job No.:		15-02079	15-02079	15-02079
Quotation No.:			Chemtest Sample ID.:		96507	96508	96509
Order No.:			Client Sample Ref.:				
			Client Sample ID.:		BH102	BH103	BH106
			Sample Type:		WATER	WATER	WATER
			Top Depth (m):		2.30	6.00	11.50
			Bottom Depth(m):				
			Date Sampled:				
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
2-Chlorotoluene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
1,3,5-Trimethylbenzene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
4-Chlorotoluene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
Tert-Butylbenzene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
1,2,4-Trimethylbenzene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
Sec-Butylbenzene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
1,3-Dichlorobenzene	N	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
4-Isopropyltoluene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
1,4-Dichlorobenzene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
N-Butylbenzene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
1,2-Dichlorobenzene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
1,2-Dibromo-3-Chloropropane	U	1760	µg/l	50	A < 50	A < 50	A < 50
1,2,4-Trichlorobenzene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
Hexachlorobutadiene	U	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
1,2,3-Trichlorobenzene	U	1760	µg/l	2	A < 2.0	A < 2.0	A < 2.0
Methyl Tert-Butyl Ether	N	1760	µg/l	1	A < 1.0	A < 1.0	A < 1.0
N-Nitrosodimethylamine	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Phenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2-Chlorophenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Bis-(2-Chloroethyl)Ether	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
1,3-Dichlorobenzene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
1,4-Dichlorobenzene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
1,2-Dichlorobenzene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2-Methylphenol (o-Cresol)	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Bis(2-Chloroisopropyl)Ether	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Hexachloroethane	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
N-Nitrosodi-n-propylamine	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
4-Methylphenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Nitrobenzene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Isophorone	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2-Nitrophenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2,4-Dimethylphenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Bis(2-Chloroethoxy)Methane	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2,4-Dichlorophenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
1,2,4-Trichlorobenzene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Naphthalene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50

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Results Summary - Water

Project: 14-1076 - Drogheda Port

Client: Causeway Geotech Ltd			Chemtest Job No.:		15-02079	15-02079	15-02079
Quotation No.:			Chemtest Sample ID.:		96507	96508	96509
Order No.:			Client Sample Ref.:				
			Client Sample ID.:		BH102	BH103	BH106
			Sample Type:		WATER	WATER	WATER
			Top Depth (m):		2.30	6.00	11.50
			Bottom Depth(m):				
			Date Sampled:				
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
4-Chloroaniline	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Hexachlorobutadiene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
4-Chloro-3-Methylphenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2-Methylnaphthalene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Hexachlorocyclopentadiene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2,4,6-Trichlorophenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2,4,5-Trichlorophenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2-Chloronaphthalene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2-Nitroaniline	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Acenaphthylene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Dimethylphthalate	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2,6-Dinitrotoluene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Acenaphthene	N	1790	µg/l	0.5	0.67	< 0.50	< 0.50
3-Nitroaniline	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Dibenzofuran	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
4-Chlorophenylphenylether	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2,4-Dinitrotoluene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Fluorene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Diethyl Phthalate	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
4-Nitroaniline	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2-Methyl-4,6-Dinitrophenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Azobenzene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
4-Bromophenylphenyl Ether	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Hexachlorobenzene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Pentachlorophenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Phenanthrene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Anthracene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Carbazole	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Di-N-Butyl Phthalate	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Fluoranthene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Pyrene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Butylbenzyl Phthalate	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Benzo[a]anthracene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Chrysene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Bis(2-Ethylhexyl)Phthalate	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Di-N-Octyl Phthalate	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50

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Results Summary - Water

Project: 14-1076 - Drogheda Port

Client: Causeway Geotech Ltd			Chemtest Job No.:		15-02079	15-02079	15-02079
Quotation No.:			Chemtest Sample ID.:		96507	96508	96509
Order No.:			Client Sample Ref.:				
			Client Sample ID.:		BH102	BH103	BH106
			Sample Type:		WATER	WATER	WATER
			Top Depth (m):		2.30	6.00	11.50
			Bottom Depth(m):				
			Date Sampled:				
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Benzo[b]fluoranthene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Benzo[k]fluoranthene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Benzo[a]pyrene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Indeno(1,2,3-c,d)Pyrene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Dibenz(a,h)Anthracene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Benzo[g,h,i]perylene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
4-Nitrophenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Demeton-O	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Phorate	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Demeton-S	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Disulfoton	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Fenthion	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Trichloronate	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Prothiofos	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Fensulphothion	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Sulprofos	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Azinphos-Methyl	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Coumaphos	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Atraton	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Prometon	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Simazine	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Atrazine	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Propazine	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Terbuthylazine	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Secbumeton	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Simetryn	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Ametryn	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Prometryn	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Terbutryn	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Alpha-Lindane	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Gamma-Lindane	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Beta-Lindane	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Delta-Lindane	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Heptachlor	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Aldrin	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Heptachlor Epoxide	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20

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Results Summary - Water

Project: 14-1076 - Drogheda Port

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		15-02079	15-02079	15-02079
Quotation No.:			**Chemtest Sample ID.:**		96507	96508	96509
Order No.:			Client Sample Ref.:				
			Client Sample ID.:		BH102	BH103	BH106
			Sample Type:		WATER	WATER	WATER
			Top Depth (m):		2.30	6.00	11.50
			Bottom Depth(m):				
			Date Sampled:				
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Gamma-Chlordane	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Alpha-Chlordane	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Endosulfan I	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
4,4-DDE	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Dieldrin	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Endrin	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
4,4-DDD	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Endosulfan II	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Endrin Aldehyde	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
4,4-DDT	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Endosulfan Sulphate	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Methoxychlor	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Endrin Ketone	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Total Phenols	U	1920	mg/l	0.03	0.060	0.040	0.080

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Chemtest Sample ID:	Sample Ref:	Sample ID:	Sampled Date:	Containers Received:	Deviation Code(s):
96507		BH102	None Supplied	Coloured Winchester 1000ml	A
96507		BH102	None Supplied	EPA Vial 40ml	A
96507		BH102	None Supplied	Plastic Bottle 1000ml	A
96508		BH103	None Supplied	Coloured Winchester 1000ml	A
96508		BH103	None Supplied	EPA Vial 40ml	A
96508		BH103	None Supplied	Plastic Bottle 1000ml	A
96509		BH106	None Supplied	Coloured Winchester 1000ml	A
96509		BH106	None Supplied	EPA Vial 40ml	A
96509		BH106	None Supplied	Plastic Bottle 1000ml	A

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Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVCOs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at our Coventry laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container

Sample Retention and Disposal

All soil samples will be retained for a period of 60 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.co.uk

UKAS TESTING
2183

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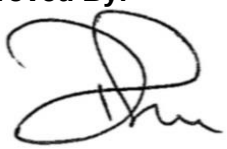
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

Final Report

Report Number:	15-02319 Issue-1
Initial Date of Issue:	12-Feb-2015
Client:	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Darren O'Mahony Paul Dunlop Stephen Franey
Project:	14-1076 Drogheda Port

Quotation No.:		**Date Received:**	04-Feb-2015
Order No.:		**Date Instructed:**	03-Feb-2015
No. of Samples:	3		
Turnaround: (Wkdays)	5	**Results Due Date:**	09-Feb-2015
Date Approved:	09-Feb-2015		

Approved By:



Details: Darrell Hall, Laboratory Director

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Results Summary - Water

Project: 14-1076 Drogheda Port

Client: Causeway Geotech Ltd			Chemtest Job No.:		15-02319	15-02319	15-02319
Quotation No.:			Chemtest Sample ID.:		97771	97772	97773
Order No.:			Client Sample Ref.:				
			Client Sample ID.:		BH101	BH104	BH108
			Sample Type:		WATER	WATER	WATER
			Top Depth (m):		2.30	6.00	11.50
			Bottom Depth(m):				
			Date Sampled:		30-Jan-15	30-Jan-15	30-Jan-15
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
pH	U	1010			7.9	9.6	12.0
Electrical Conductivity	U	1020	µS/cm	1	13000	2700	7900
Total Dissolved Solids	N	1040	mg/l	1	7900	1600	4800
Alkalinity (Total)	U	1220	mg CaCO3/l	10	89	240	1600
Chloride	U	1220	mg/l	1	4200	640	730
Fluoride	U	1220	mg/l	0.05	0.25	3.1	1.3
Ammoniacal Nitrogen	U	1220	mg/l	0.01	1.4	16	0.61
Sulphate	U	1220	mg/l	1	830	2300	67
Total Oxidised Nitrogen	U	1220	mg/l	0.2	1.0	< 0.20	1.6
Cyanide (Total)	U	1300	mg/l	0.05	< 0.050	0.060	< 0.050
Calcium	U	1415	mg/l	5	410	79	19
Potassium	U	1415	mg/l	0.5	120	180	1100
Magnesium	U	1415	mg/l	0.5	150	15	0.80
Sodium	U	1415	mg/l	0.5	3100	500	910
Boron (Dissolved)	U	1450	µg/l	20	1400	430	73
Manganese (Dissolved)	U	1450	µg/l	1	600	130	19
Arsenic (Total)	U	1450	µg/l	1	19	18	11
Cadmium (Total)	U	1450	µg/l	0.08	0.27	0.20	0.18
Chromium (Total)	U	1450	µg/l	1	49	31	14
Copper (Total)	U	1450	µg/l	1	46	5.3	8.0
Mercury (Total)	U	1450	µg/l	0.5	< 0.50	< 0.50	< 0.50
Nickel (Total)	U	1450	µg/l	1	9.2	19	17
Lead (Total)	U	1450	µg/l	1	37	8.1	1.6
Zinc (Total)	U	1450	µg/l	1	170	170	46
Iron (Dissolved)	N	1470	µg/l	20	< 20	130	70
Chromium (Hexavalent)	U	1490	µg/l	20	< 20	< 20	< 20
Total Organic Carbon	N	1610	mg/l	1	2.5	36	74
Mineral Oil	U	1670	µg/l	10	< 10	460	960
TPH >C6-C10	N	1670	µg/l	0.1	< 0.10	< 0.10	< 0.10
TPH >C10-C21	N	1670	µg/l	0.1	< 0.10	180	7.2
TPH >C21-C40	N	1670	µg/l	0.1	< 0.10	480	1200
Total TPH >C6-C40	U	1670	µg/l	10	< 10	660	1200
Dichlorodifluoromethane	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0

Chemtest
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Results Summary - Water

Project: 14-1076 Drogheda Port

Client: Causeway Geotech Ltd			Chemtest Job No.:		15-02319	15-02319	15-02319
Quotation No.:			Chemtest Sample ID.:		97771	97772	97773
Order No.:			Client Sample Ref.:				
			Client Sample ID.:		BH101	BH104	BH108
			Sample Type:		WATER	WATER	WATER
			Top Depth (m):		2.30	6.00	11.50
			Bottom Depth(m):				
			Date Sampled:		30-Jan-15	30-Jan-15	30-Jan-15
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Chloromethane	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
Vinyl Chloride	N	1760	µg/l	1	< 1.0	< 1.0	< 1.0
Bromomethane	U	1760	µg/l	5	< 5	< 5	< 5
Chloroethane	U	1760	µg/l	2	< 2.0	< 2.0	< 2.0
Trichlorofluoromethane	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
Trans 1,2-Dichloroethene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
cis 1,2-Dichloroethene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
Bromochloromethane	U	1760	µg/l	5	< 5.0	< 5.0	< 5.0
Trichloromethane	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
Tetrachloromethane	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
Benzene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	U	1760	µg/l	2	< 2.0	< 2.0	< 2.0
Trichloroethene	N	1760	µg/l	1	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
Dibromomethane	U	1760	µg/l	10	< 10	< 10	< 10
Bromodichloromethane	U	1760	µg/l	5	< 5.0	< 5.0	< 5.0
cis-1,3-Dichloropropene	N	1760	µg/l	10	< 10	< 10	< 10
Toluene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	N	1760	µg/l	10	< 10	< 10	< 10
1,1,2-Trichloroethane	U	1760	µg/l	10	< 10	< 10	< 10
Tetrachloroethene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	U	1760	µg/l	2	< 2.0	< 2.0	< 2.0
Dibromochloromethane	U	1760	µg/l	10	< 10	< 10	< 10
1,2-Dibromoethane	U	1760	µg/l	5	< 5.0	< 5.0	< 5.0
Chlorobenzene	N	1760	µg/l	1	< 1.0	< 1.0	< 1.0
1,1,1,2-Tetrachloroethane	U	1760	µg/l	2	< 2.0	< 2.0	< 2.0
Ethylbenzene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
o-Xylene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0

Chemtest
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Results Summary - Water

Project: 14-1076 Drogheda Port

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		15-02319	15-02319	15-02319
Quotation No.:			**Chemtest Sample ID.:**		97771	97772	97773
Order No.:			Client Sample Ref.:				
			Client Sample ID.:		BH101	BH104	BH108
			Sample Type:		WATER	WATER	WATER
			Top Depth (m):		2.30	6.00	11.50
			Bottom Depth(m):				
			Date Sampled:		30-Jan-15	30-Jan-15	30-Jan-15
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Styrene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
Tribromomethane	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
Isopropylbenzene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
Bromobenzene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
1,2,3-Trichloropropane	N	1760	µg/l	50	< 50	< 50	< 50
N-Propylbenzene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
2-Chlorotoluene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
4-Chlorotoluene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
Tert-Butylbenzene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
Sec-Butylbenzene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	N	1760	µg/l	1	< 1.0	< 1.0	< 1.0
4-Isopropyltoluene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
N-Butylbenzene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-Chloropropane	U	1760	µg/l	50	< 50	< 50	< 50
1,2,4-Trichlorobenzene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	U	1760	µg/l	1	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	U	1760	µg/l	2	< 2.0	< 2.0	< 2.0
Methyl Tert-Butyl Ether	N	1760	µg/l	1	< 1.0	< 1.0	< 1.0
N-Nitrosodimethylamine	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Phenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2-Chlorophenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Bis-(2-Chloroethyl)Ether	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
1,3-Dichlorobenzene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
1,4-Dichlorobenzene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
1,2-Dichlorobenzene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2-Methylphenol (o-Cresol)	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Bis(2-Chloroisopropyl)Ether	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Hexachloroethane	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
N-Nitrosodi-n-propylamine	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50

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Results Summary - Water

Project: 14-1076 Drogheda Port

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		15-02319	15-02319	15-02319
Quotation No.:			**Chemtest Sample ID.:**		97771	97772	97773
Order No.:			Client Sample Ref.:				
			Client Sample ID.:		BH101	BH104	BH108
			Sample Type:		WATER	WATER	WATER
			Top Depth (m):		2.30	6.00	11.50
			Bottom Depth(m):				
			Date Sampled:		30-Jan-15	30-Jan-15	30-Jan-15
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
4-Methylphenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Nitrobenzene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Isophorone	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2-Nitrophenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2,4-Dimethylphenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Bis(2-Chloroethoxy)Methane	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2,4-Dichlorophenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
1,2,4-Trichlorobenzene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Naphthalene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
4-Chloroaniline	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Hexachlorobutadiene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
4-Chloro-3-Methylphenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2-Methylnaphthalene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Hexachlorocyclopentadiene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2,4,6-Trichlorophenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2,4,5-Trichlorophenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2-Chloronaphthalene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2-Nitroaniline	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Acenaphthylene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Dimethylphthalate	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2,6-Dinitrotoluene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Acenaphthene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
3-Nitroaniline	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Dibenzofuran	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
4-Chlorophenylphenylether	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2,4-Dinitrotoluene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Fluorene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Diethyl Phthalate	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
4-Nitroaniline	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
2-Methyl-4,6-Dinitrophenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Azobenzene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
4-Bromophenylphenyl Ether	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Hexachlorobenzene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50

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Results Summary - Water

Project: 14-1076 Drogheda Port

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		15-02319	15-02319	15-02319
Quotation No.:			**Chemtest Sample ID.:**		97771	97772	97773
Order No.:			Client Sample Ref.:				
			Client Sample ID.:		BH101	BH104	BH108
			Sample Type:		WATER	WATER	WATER
			Top Depth (m):		2.30	6.00	11.50
			Bottom Depth(m):				
			Date Sampled:		30-Jan-15	30-Jan-15	30-Jan-15
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Pentachlorophenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Phenanthrene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Anthracene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Carbazole	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Di-N-Butyl Phthalate	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Fluoranthene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Pyrene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Butylbenzyl Phthalate	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Benzo[a]anthracene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Chrysene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Bis(2-Ethylhexyl)Phthalate	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Di-N-Octyl Phthalate	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Benzo[b]fluoranthene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Benzo[k]fluoranthene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Benzo[a]pyrene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Indeno(1,2,3-c,d)Pyrene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Dibenz(a,h)Anthracene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Benzo[g,h,i]perylene	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
4-Nitrophenol	N	1790	µg/l	0.5	< 0.50	< 0.50	< 0.50
Demeton-O	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Phorate	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Demeton-S	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Disulfoton	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Fenthion	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Trichloronate	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Prothiofos	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Fensulphothion	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Sulprofos	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Azinphos-Methyl	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Coumaphos	N	1820	µg/l	0.2	< 0.20	< 0.20	< 0.20
Atraton	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Prometon	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Simazine	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20

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Results Summary - Water

Project: 14-1076 Drogheda Port

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		15-02319	15-02319	15-02319
Quotation No.:			**Chemtest Sample ID.:**		97771	97772	97773
Order No.:			Client Sample Ref.:				
			Client Sample ID.:		BH101	BH104	BH108
			Sample Type:		WATER	WATER	WATER
			Top Depth (m):		2.30	6.00	11.50
			Bottom Depth(m):				
			Date Sampled:		30-Jan-15	30-Jan-15	30-Jan-15
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Atrazine	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Propazine	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Terbuthylazine	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Secbumeton	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Simetryn	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Ametryn	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Prometryn	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Terbutryn	N	1830	µg/l	0.2	< 0.20	< 0.20	< 0.20
Alpha-Lindane	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Gamma-Lindane	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Beta-Lindane	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Delta-Lindane	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Heptachlor	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Aldrin	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Heptachlor Epoxide	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Gamma-Chlordane	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Alpha-Chlordane	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Endosulfan I	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
4,4-DDE	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Dieldrin	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Endrin	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
4,4-DDD	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Endosulfan II	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Endrin Aldehyde	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
4,4-DDT	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Endosulfan Sulphate	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Methoxychlor	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Endrin Ketone	N	1840	µg/l	0.2	< 0.20	< 0.20	< 0.20
Total Phenols	U	1920	mg/l	0.03	< 0.030	0.31	0.38

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Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVCOs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at our Coventry laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container

Sample Retention and Disposal

All soil samples will be retained for a period of 60 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.co.uk

Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.: 19-18081-1

Initial Date of Issue: 05-Jun-2019

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road
Balnamore
Ballymoney
County Antrim
BT53 7QL

Contact(s): Carin Cornwall
Colm Hurley
Darren O'Mahony
Gabriella Horan
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John Cameron
Lucy Newland
Matthew Gilbert
Neil Haggan
Paul Dunlop
Paul McNamara
Sean Ross
Stephen Franey
Stephen McCracken
Stephen Watson
Stuart Abraham

Project 19-0532 Tom Roes Point

Quotation No.:		**Date Received:**	29-May-2019
Order No.:		**Date Instructed:**	29-May-2019
No. of Samples:	8		
Turnaround (Wkdays):	5	**Results Due:**	04-Jun-2019
Date Approved:	05-Jun-2019		

Approved By:

Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

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Results - Soil

Project: 19-0532 Tom Roes Point

Client: Causeway Geotech Ltd					Chemtest Job No.:	19-18081	19-18081	19-18081	19-18081	19-18081	19-18081	19-18081	19-18081
Quotation No.:					Chemtest Sample ID.:	834035	834036	834037	834039	834042	834043	834044	834046
					Sample Location:	BH01	BH01	BH01	BH01	BH02	BH02	BH02	BH02
					Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	0.50	1.50	2.00	4.00	0.50	1.00	2.00	4.00
					Date Sampled:	15-May-2019	15-May-2019	15-May-2019	15-May-2019	15-May-2019	15-May-2019	15-May-2019	15-May-2019
					Asbestos Lab:	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
ACM Type	U	2192		N/A		Fibres/Clumps	Fibres/Clumps	-	-	-	-	-	-
Asbestos Identification	U	2192	%	0.001		Chrysotile	Chrysotile Crocidolite	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage	U	2192		N/A		Stereo Microscopy	Stereo Microscopy	-	-	-	-	-	-
Moisture	N	2030	%	0.020		15	19	6.8	24	11	38	40	43
pH	U	2010		N/A		9.3	9.7	9.7	9.3	9.3	12.3	12.1	11.8
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40		1.5	1.6	0.87	0.61	0.88	1.2	1.7	1.6
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010		0.80	0.48	0.034	0.13	0.39	2.0	2.2	2.0
Cyanide (Free)	U	2300	mg/kg	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Cyanide (Total)	U	2300	mg/kg	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Thiocyanate	U	2300	mg/kg	5.0		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50		18	13	4.5	5.8	4.7	9.8	7.7	7.7
Sulphate (Total)	U	2430	%	0.010		0.47	0.37	0.040	0.17	0.25	2.8	2.4	2.5
Arsenic	U	2450	mg/kg	1.0		27	25	30	4.8	23	42	40	40
Cadmium	U	2450	mg/kg	0.10		1.8	6.4	0.36	< 0.10	0.78	1.9	1.9	1.7
Chromium	U	2450	mg/kg	1.0		28	99	13	10	16	37	34	35
Copper	U	2450	mg/kg	0.50		27	44	8.5	2.0	14	48	44	44
Mercury	U	2450	mg/kg	0.10		0.13	0.14	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Nickel	U	2450	mg/kg	0.50		24	39	9.2	10	24	37	32	32
Lead	U	2450	mg/kg	0.50		130	170	6.4	2.8	15	170	140	120
Selenium	U	2450	mg/kg	0.20		< 0.20	0.87	< 0.20	< 0.20	0.20	0.83	0.75	0.77
Zinc	U	2450	mg/kg	0.50		58	80	11	19	29	140	120	97
Chromium (Hexavalent)	N	2490	mg/kg	0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40		1.2	1.1	< 0.40	< 0.40	0.59	< 0.40	0.41	< 0.40
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0		< 1.0	5.4	4.6	4.2	< 1.0	1.3	1.8	1.8
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0		< 1.0	5.5	8.3	5.4	2.0	4.0	4.5	5.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0		< 1.0	28	88	24	14	17	15	27
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0		< 1.0	< 1.0	2.8	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0		< 5.0	39	100	33	16	22	22	34
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0		< 1.0	< 1.0	1.0	1.1	< 1.0	1.5	1.4	1.6

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Results - Soil

Project: 19-0532 Tom Roes Point

Client: Causeway Geotech Ltd					**Chemtest Job No.:**	19-18081	19-18081	19-18081	19-18081	19-18081	19-18081	19-18081	19-18081
Quotation No.:					**Chemtest Sample ID.:**	834035	834036	834037	834039	834042	834043	834044	834046
					Sample Location:	BH01	BH01	BH01	BH01	BH02	BH02	BH02	BH02
					Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	0.50	1.50	2.00	4.00	0.50	1.00	2.00	4.00
					Date Sampled:	15-May-2019	15-May-2019	15-May-2019	15-May-2019	15-May-2019	15-May-2019	15-May-2019	15-May-2019
					Asbestos Lab:	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0		< 1.0	1.5	2.3	1.5	< 1.0	8.3	2.1	2.8
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0		< 1.0	51	130	48	25	59	64	58
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0		< 5.0	53	130	51	25	68	68	62
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0		< 10	92	240	84	41	90	89	96
Naphthalene	U	2700	mg/kg	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2700	mg/kg	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	2700	mg/kg	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.10		0.37	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	U	2700	mg/kg	0.10		0.36	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	2700	mg/kg	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	2700	mg/kg	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2700	mg/kg	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2700	mg/kg	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2700	mg/kg	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	U	2700	mg/kg	2.0		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Benzene	U	2760	µg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Phenols	U	2920	mg/kg	0.30		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Site:	TOM ROES RD, DROGHEDA PORT
Project No.:	19-0532
Date:	12/07/2019
Weather:	Dry

Gas Monitoring

Equipment:		Geotechnical Instruments GA5000				
Ambient Conditions	Barometric Pressure	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
Before:	1017	0	0	21.1	0	0
After:	1017	0	0	21.1	0	0

BH02	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.1	0.3	19.7	0	0
60	0.1	0.3	19.5	0	0
90	0.1	0.3	19.4	0	0
120	0.1	0.3	19.4	0	0
150	0.1	0.3	19.4	0	0
180	0.1	0.3	19.4	0	0
240	0.1	0.3	19.5	0	0
300	0.1	0.2	19.4	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	3.5
Depth to bottom of BH	6.85
Sample collected (Y/N)	Y
Sample depth	3.5

BH01	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0	0.8	12	0	0
60	0	0.7	12.6	0	0
90	0	0.5	15.8	0	0
120	0	0.8	11	0	0
150	0	0.4	14.8	0	0
180	0	0.7	12.6	0	0
240	0	0.5	14.3	0	0
300	0	0.5	15.4	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0
60	0.1
90	0.1
120	0.1
150	0.2
180	0.1
240	0.2
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	3.71
Depth to bottom of BH	7.54
Sample collected (Y/N)	Y
Sample depth	

BHxxx	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30					
60					
90					
120					
150					
180					
240					
300					

Flow rates	
Time (sec)	Flow (l/h)
30	
60	
90	
120	
150	
180	
240	
300	

Groundwater monitoring	mbgl
Depth to top of water	
Depth to bottom of BH	
Sample collected (Y/N)	
Sample depth	

Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	19-23723-1
Initial Date of Issue:	18-Jul-2019
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Colm Hurley
Project	19-0532 Drogheda
Quotation No.:	Q19-17585
Order No.:	
No. of Samples:	2
Turnaround (Wkdays):	3
Date Approved:	18-Jul-2019
Approved By:	
Details:	Robert Monk, Technical Manager

Date Received:	15-Jul-2019
Date Instructed:	15-Jul-2019
Results Due:	17-Jul-2019

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Results - Water

Project: 19-0532 Drogheda

Client: Causeway Geotech Ltd					**Chemtest Job No.:**	19-23723	19-23723
Quotation No.: Q19-17585					**Chemtest Sample ID.:**	858068	858069
					Client Sample ID.:	WS	WS
					Sample Location:	BH01	BH02
					Sample Type:	WATER	WATER
					Date Sampled:	12-Jul-2019	12-Jul-2019
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
pH	U	1010		N/A		8.5	8.6
Electrical Conductivity	U	1020	µS/cm	1.0		1900	3800
Total Dissolved Solids	N	1020	mg/l	1.0		1200	2500
Alkalinity (Total)	U	1220	mg/l	10		43	240
Chloride	U	1220	mg/l	1.0		290	990
Fluoride	U	1220	mg/l	0.050		0.38	0.83
Ammoniacal Nitrogen	U	1220	mg/l	0.050		3.6	6.1
Sulphate	U	1220	mg/l	1.0		470	280
Total Oxidised Nitrogen	U	1220	mg/l	0.20		0.29	< 0.20
Cyanide (Total)	U	1300	mg/l	0.050		< 0.050	< 0.050
Calcium	U	1415	mg/l	5.0		120	27
Potassium	U	1415	mg/l	0.50		93	310
Magnesium	U	1415	mg/l	0.50		0.95	3.1
Sodium	U	1415	mg/l	0.50		210	630
Boron (Dissolved)	U	1450	µg/l	20		210	470
Iron (Dissolved)	N	1450	µg/l	20		560	520
Manganese (Dissolved)	U	1450	µg/l	1.0		7.2	22
Arsenic (Total)	N	1450	µg/l	1.0		8.8	18
Cadmium (Total)	N	1450	µg/l	0.080		< 0.080	0.11
Chromium (Total)	N	1450	µg/l	1.0		8.3	32
Copper (Total)	N	1450	µg/l	1.0		7.5	55
Mercury (Total)	N	1450	µg/l	0.50		< 0.50	< 0.50
Nickel (Total)	N	1450	µg/l	1.0		3.8	8.6
Lead (Total)	N	1450	µg/l	1.0		< 1.0	1.8
Zinc (Total)	N	1450	µg/l	1.0		5.4	7.9
Chromium (Hexavalent)	U	1490	µg/l	20		< 20	< 20
Total Organic Carbon	U	1610	mg/l	2.0		16	41
Mineral Oil	N	1670	µg/l	10		< 10	< 10
TPH >C6-C10	N	1670	µg/l	0.10		< 0.10	< 0.10
TPH >C10-C21	N	1670	µg/l	0.10		< 0.10	< 0.10
TPH >C21-C40	N	1670	µg/l	0.10		< 0.10	< 0.10
Total TPH >C6-C40	U	1670	µg/l	10		< 10	< 10
Dichlorodifluoromethane	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0
Chloromethane	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0
Vinyl Chloride	N	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0
Bromomethane	U	1760	µg/l	5.0		[C] < 5.0	[C] < 5.0
Chloroethane	U	1760	µg/l	2.0		[C] < 2.0	[C] < 2.0
Trichlorofluoromethane	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0
1,1-Dichloroethene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0
Trans 1,2-Dichloroethene	U	1760	µg/l	1.0		[C] < 1.0	[C] < 1.0

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Results - Water

Project: 19-0532 Drogheda

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		19-23723	19-23723
Quotation No.: Q19-17585			**Chemtest Sample ID.:**		858068	858069
			Client Sample ID.:		WS	WS
			Sample Location:		BH01	BH02
			Sample Type:		WATER	WATER
			Date Sampled:		12-Jul-2019	12-Jul-2019
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
1,1-Dichloroethane	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
cis 1,2-Dichloroethene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
Bromochloromethane	U	1760	µg/l	5.0	[C] < 5.0	[C] < 5.0
Trichloromethane	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
1,1,1-Trichloroethane	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
Tetrachloromethane	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
1,1-Dichloropropene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
Benzene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
1,2-Dichloroethane	U	1760	µg/l	2.0	[C] < 2.0	[C] < 2.0
Trichloroethene	N	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
1,2-Dichloropropane	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
Dibromomethane	U	1760	µg/l	10	[C] < 10	[C] < 10
Bromodichloromethane	U	1760	µg/l	5.0	[C] < 5.0	[C] < 5.0
cis-1,3-Dichloropropene	N	1760	µg/l	10	[C] < 10	[C] < 10
Toluene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
Trans-1,3-Dichloropropene	N	1760	µg/l	10	[C] < 10	[C] < 10
1,1,2-Trichloroethane	U	1760	µg/l	10	[C] < 10	[C] < 10
Tetrachloroethene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
1,3-Dichloropropane	U	1760	µg/l	2.0	[C] < 2.0	[C] < 2.0
Dibromochloromethane	U	1760	µg/l	10	[C] < 10	[C] < 10
1,2-Dibromoethane	U	1760	µg/l	5.0	[C] < 5.0	[C] < 5.0
Chlorobenzene	N	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
1,1,1,2-Tetrachloroethane	U	1760	µg/l	2.0	[C] < 2.0	[C] < 2.0
Ethylbenzene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
m & p-Xylene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
o-Xylene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
Styrene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
Tribromomethane	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
Isopropylbenzene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
Bromobenzene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
1,2,3-Trichloropropane	N	1760	µg/l	50	[C] < 50	[C] < 50
N-Propylbenzene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
2-Chlorotoluene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
1,3,5-Trimethylbenzene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
4-Chlorotoluene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
Tert-Butylbenzene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
1,2,4-Trimethylbenzene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
Sec-Butylbenzene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
1,3-Dichlorobenzene	N	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
4-Isopropyltoluene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0

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Results - Water

Project: 19-0532 Drogheda

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		19-23723	19-23723
Quotation No.: Q19-17585			**Chemtest Sample ID.:**		858068	858069
			Client Sample ID.:		WS	WS
			Sample Location:		BH01	BH02
			Sample Type:		WATER	WATER
			Date Sampled:		12-Jul-2019	12-Jul-2019
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
1,4-Dichlorobenzene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
N-Butylbenzene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
1,2-Dichlorobenzene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
1,2-Dibromo-3-Chloropropane	U	1760	µg/l	50	[C] < 50	[C] < 50
1,2,4-Trichlorobenzene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
Hexachlorobutadiene	U	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
1,2,3-Trichlorobenzene	U	1760	µg/l	2.0	[C] < 2.0	[C] < 2.0
Methyl Tert-Butyl Ether	N	1760	µg/l	1.0	[C] < 1.0	[C] < 1.0
N-Nitrosodimethylamine	N	1790	µg/l	0.50	< 0.50	< 0.50
Phenol	N	1790	µg/l	0.50	< 0.50	< 0.50
2-Chlorophenol	N	1790	µg/l	0.50	< 0.50	< 0.50
Bis-(2-Chloroethyl)Ether	N	1790	µg/l	0.50	< 0.50	< 0.50
1,3-Dichlorobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50
1,4-Dichlorobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50
1,2-Dichlorobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50
2-Methylphenol (o-Cresol)	N	1790	µg/l	0.50	< 0.50	< 0.50
Bis(2-Chloroisopropyl)Ether	N	1790	µg/l	0.50	< 0.50	< 0.50
Hexachloroethane	N	1790	µg/l	0.50	< 0.50	< 0.50
N-Nitrosodi-n-propylamine	N	1790	µg/l	0.50	< 0.50	< 0.50
4-Methylphenol	N	1790	µg/l	0.50	< 0.50	< 0.50
Nitrobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50
Isophorone	N	1790	µg/l	0.50	< 0.50	< 0.50
2-Nitrophenol	N	1790	µg/l	0.50	< 0.50	< 0.50
2,4-Dimethylphenol	N	1790	µg/l	0.50	< 0.50	< 0.50
Bis(2-Chloroethoxy)Methane	N	1790	µg/l	0.50	< 0.50	< 0.50
2,4-Dichlorophenol	N	1790	µg/l	0.50	< 0.50	< 0.50
1,2,4-Trichlorobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50
Naphthalene	N	1790	µg/l	0.50	< 0.50	< 0.50
4-Chloroaniline	N	1790	µg/l	0.50	< 0.50	< 0.50
Hexachlorobutadiene	N	1790	µg/l	0.50	< 0.50	< 0.50
4-Chloro-3-Methylphenol	N	1790	µg/l	0.50	< 0.50	< 0.50
2-Methylnaphthalene	N	1790	µg/l	0.50	< 0.50	< 0.50
Hexachlorocyclopentadiene	N	1790	µg/l	0.50	< 0.50	< 0.50
2,4,6-Trichlorophenol	N	1790	µg/l	0.50	< 0.50	< 0.50
2,4,5-Trichlorophenol	N	1790	µg/l	0.50	< 0.50	< 0.50
2-Chloronaphthalene	N	1790	µg/l	0.50	< 0.50	< 0.50
2-Nitroaniline	N	1790	µg/l	0.50	< 0.50	< 0.50
Acenaphthylene	N	1790	µg/l	0.50	< 0.50	< 0.50
Dimethylphthalate	N	1790	µg/l	0.50	< 0.50	< 0.50
2,6-Dinitrotoluene	N	1790	µg/l	0.50	< 0.50	< 0.50

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Results - Water

Project: 19-0532 Drogheda

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		19-23723	19-23723
Quotation No.: Q19-17585			**Chemtest Sample ID.:**		858068	858069
			Client Sample ID.:		WS	WS
			Sample Location:		BH01	BH02
			Sample Type:		WATER	WATER
			Date Sampled:		12-Jul-2019	12-Jul-2019
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Acenaphthene	N	1790	µg/l	0.50	< 0.50	< 0.50
3-Nitroaniline	N	1790	µg/l	0.50	< 0.50	< 0.50
Dibenzofuran	N	1790	µg/l	0.50	< 0.50	< 0.50
4-Chlorophenylphenylether	N	1790	µg/l	0.50	< 0.50	< 0.50
2,4-Dinitrotoluene	N	1790	µg/l	0.50	< 0.50	< 0.50
Fluorene	N	1790	µg/l	0.50	< 0.50	< 0.50
Diethyl Phthalate	N	1790	µg/l	0.50	< 0.50	< 0.50
4-Nitroaniline	N	1790	µg/l	0.50	< 0.50	< 0.50
2-Methyl-4,6-Dinitrophenol	N	1790	µg/l	0.50	< 0.50	< 0.50
Azobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50
4-Bromophenylphenyl Ether	N	1790	µg/l	0.50	< 0.50	< 0.50
Hexachlorobenzene	N	1790	µg/l	0.50	< 0.50	< 0.50
Pentachlorophenol	N	1790	µg/l	0.50	< 0.50	< 0.50
Phenanthrene	N	1790	µg/l	0.50	< 0.50	< 0.50
Anthracene	N	1790	µg/l	0.50	< 0.50	< 0.50
Carbazole	N	1790	µg/l	0.50	< 0.50	< 0.50
Di-N-Butyl Phthalate	N	1790	µg/l	0.50	< 0.50	< 0.50
Fluoranthene	N	1790	µg/l	0.50	< 0.50	< 0.50
Pyrene	N	1790	µg/l	0.50	< 0.50	< 0.50
Butylbenzyl Phthalate	N	1790	µg/l	0.50	< 0.50	< 0.50
Benzo[a]anthracene	N	1790	µg/l	0.50	< 0.50	< 0.50
Chrysene	N	1790	µg/l	0.50	< 0.50	< 0.50
Bis(2-Ethylhexyl)Phthalate	N	1790	µg/l	0.50	< 0.50	< 0.50
Di-N-Octyl Phthalate	N	1790	µg/l	0.50	< 0.50	< 0.50
Benzo[b]fluoranthene	N	1790	µg/l	0.50	< 0.50	< 0.50
Benzo[k]fluoranthene	N	1790	µg/l	0.50	< 0.50	< 0.50
Benzo[a]pyrene	N	1790	µg/l	0.50	< 0.50	< 0.50
Indeno(1,2,3-c,d)Pyrene	N	1790	µg/l	0.50	< 0.50	< 0.50
Dibenz(a,h)Anthracene	N	1790	µg/l	0.50	< 0.50	< 0.50
Benzo[g,h,i]perylene	N	1790	µg/l	0.50	< 0.50	< 0.50
4-Nitrophenol	N	1790	µg/l	0.50	< 0.50	< 0.50
Demeton-O	N	1820	µg/l	0.20	< 0.20	< 0.20
Phorate	N	1820	µg/l	0.20	< 0.20	< 0.20
Demeton-S	N	1820	µg/l	0.20	< 0.20	< 0.20
Disulfoton	N	1820	µg/l	0.20	< 0.20	< 0.20
Fenthion	N	1820	µg/l	0.20	< 0.20	< 0.20
Trichloronate	N	1820	µg/l	0.20	< 0.20	< 0.20
Prothiofos	N	1820	µg/l	0.20	< 0.20	< 0.20
Fensulphothion	N	1820	µg/l	0.20	< 0.20	< 0.20
Sulprofos	N	1820	µg/l	0.20	< 0.20	< 0.20

Chemtest
The right chemistry to deliver results

Results - Water

Project: 19-0532 Drogheda

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		19-23723	19-23723
Quotation No.: Q19-17585			**Chemtest Sample ID.:**		858068	858069
			Client Sample ID.:		WS	WS
			Sample Location:		BH01	BH02
			Sample Type:		WATER	WATER
			Date Sampled:		12-Jul-2019	12-Jul-2019
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Azinphos-Methyl	N	1820	µg/l	0.20	< 0.20	< 0.20
Coumaphos	N	1820	µg/l	0.20	< 0.20	< 0.20
Atraton	N	1830	µg/l	0.20	< 0.20	< 0.20
Prometon	N	1830	µg/l	0.20	< 0.20	< 0.20
Simazine	N	1830	µg/l	0.20	< 0.20	< 0.20
Atrazine	N	1830	µg/l	0.20	< 0.20	< 0.20
Propazine	N	1830	µg/l	0.20	< 0.20	< 0.20
Terbuthylazine	N	1830	µg/l	0.20	< 0.20	< 0.20
Secbumeton	N	1830	µg/l	0.20	< 0.20	< 0.20
Simetryn	N	1830	µg/l	0.20	< 0.20	< 0.20
Ametryn	N	1830	µg/l	0.20	< 0.20	< 0.20
Prometryn	N	1830	µg/l	0.20	< 0.20	< 0.20
Terbutryn	N	1830	µg/l	0.20	< 0.20	< 0.20
Alpha-HCH	N	1840	µg/l	0.20	< 0.20	< 0.20
Gamma-HCH (Lindane)	N	1840	µg/l	0.20	< 0.20	< 0.20
Beta-HCH	N	1840	µg/l	0.20	< 0.20	< 0.20
Delta-HCH	N	1840	µg/l	0.20	< 0.20	< 0.20
Heptachlor	N	1840	µg/l	0.20	< 0.20	< 0.20
Aldrin	N	1840	µg/l	0.20	< 0.20	< 0.20
Heptachlor Epoxide	N	1840	µg/l	0.20	< 0.20	< 0.20
Gamma-Chlordane	N	1840	µg/l	0.20	< 0.20	< 0.20
Alpha-Chlordane	N	1840	µg/l	0.20	< 0.20	< 0.20
Endosulfan I	N	1840	µg/l	0.20	< 0.20	< 0.20
4,4-DDE	N	1840	µg/l	0.20	< 0.20	< 0.20
Dieldrin	N	1840	µg/l	0.20	< 0.20	< 0.20
Endrin	N	1840	µg/l	0.20	< 0.20	< 0.20
4,4-DDD	N	1840	µg/l	0.20	< 0.20	< 0.20
Endosulfan II	N	1840	µg/l	0.20	< 0.20	< 0.20
Endrin Aldehyde	N	1840	µg/l	0.20	< 0.20	< 0.20
4,4-DDT	N	1840	µg/l	0.20	< 0.20	< 0.20
Endosulfan Sulphate	N	1840	µg/l	0.20	< 0.20	< 0.20
Methoxychlor	N	1840	µg/l	0.20	< 0.20	< 0.20
Endrin Ketone	N	1840	µg/l	0.20	< 0.20	< 0.20
Total Phenols	U	1920	mg/l	0.030	< 0.030	< 0.030

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request.The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
858068		WS	BH01	12-Jul-2019	C	Coloured Winchester 1000ml
858068		WS	BH01	12-Jul-2019	C	Plastic Bottle 1000ml
858069		WS	BH02	12-Jul-2019	C	Coloured Winchester 1000ml
858069		WS	BH02	12-Jul-2019	C	Plastic Bottle 1000ml

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com