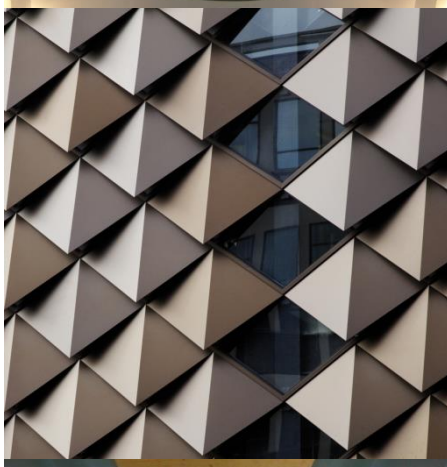

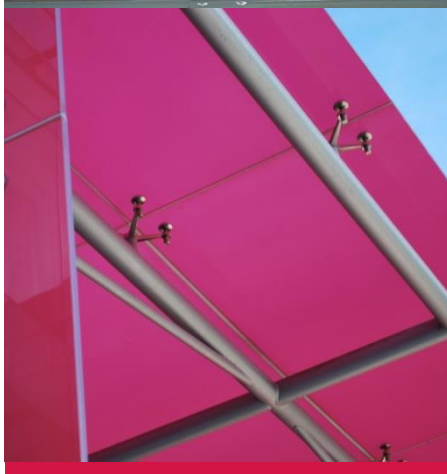

EMR Gladstone Dock, Liverpool

Ground Investigation

Curtins Ref: 068331-CUR-00-XX-RP-GE-001

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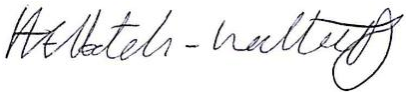
Author	Signature	Date
A Hatch-Walling BSc (Hons) Geo-Environmental Engineer		09 October 2019

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Executive Summary

Appointment	In May 2019 Curtins were instructed by European Metal Recycling to undertake a Ground Investigation on the EMR site on Gladstone Dock in Liverpool (approximately centred on NGR SJ327956) that covers an area of approximately 4.4Ha. Development plans comprise the construction of two new electric ship-to-shore 600-tonne tracked cranes, to be located in the north west and north east of the site, to move across from the east to west of the site with an approximate 126m range from the power source.
Site Summary	The site entrance is located off Regent Road, Gladstone Dock, Bootle, Liverpool L20 1BX. The site is part of the European Metal Recycling site which stockpiles scrap metal for cargo ship loading for export. The site is relatively flat, with three existing travelling cranes; two located in the north of the site and one in the south. The stockpiles of scrap metal take up most of the north east area with the remaining centre and west of the site left empty. The whole of the site is covered in hard standing. A conveyor belt runs from the central point in the north of the site along the northern boundary to the west where it reaches the end of the site and diverts to the south along the western boundary. This conveyor belt sits on top of the dock wall. In the very east of the site is the site entrance with weigh bridge, cabins containing EMR's office and workshop. The site is bounded to the north and west by Gladstone Dock. To the south is Peel ports warehouse and hardstanding. Regent Road runs north to south along the east of the site. Made Ground deposits are not indicated to be present onsite according to BGS, however given the reclaimed dockland, are anticipated to be present. Superficial soils are indicated as Tidal Flat Deposits of Quaternary Age, overlying sandstone of the Wilmslow Sandstone Formation, of Early Triassic Age. Environment Agency data indicates that the site, corresponding with the underlying bedrock geology, overlies a Principal Aquifer. The Tidal Flat deposits aquifer designation is undefined. The site is not located within a Source Protection Zone (SPZ). The nearest surface water feature is Gladstone Dock directly adjacent to the north and western site boundary.
Fieldworks Undertaken	Fieldworks were carried out between 6th and 21st June 2019, comprising six cable percussive boreholes, five window sample boreholes, three rotary cored boreholes, nine rotary open hole boreholes and one machine excavated trial pit. Ground gas and groundwater monitoring standpipes were installed within three of the cable percussive boreholes (CP01, CP05 and CP06). Selected groundwater and soil samples were subjected to laboratory analysis. No ground gas monitoring visits have been undertaken.
Encountered Ground Conditions	Made Ground was encountered underlying concrete and tarmacadam in all exploratory hole locations. Granular Made Ground was encountered at depths of between 0.00m to 14.10m bgl. This comprised brownish grey GRAVEL, sandy GRAVEL, sandy silty GRAVEL, gravelly fine to coarse SAND, gravelly clayey SAND, sandy COBBLES. Gravel is fine to coarse, sub-rounded to angular of mixed lithologies, including brick, concrete, ash, coal, limestone, sandstone, mudstone, siltstone, flint, and quartzite. Cohesive Made Ground was encountered at depths of between 0.60m to 5.20m bgl. This comprised brown sandy gravelly CLAY, slightly sandy SILT, sandy CLAY, silty CLAY, with fine to coarse, rounded to angular gravel of mixed lithologies, including brick, concrete, sandstone, mudstone, quartzite, slate and siltstone. The Made Ground was underlain by Tidal Flat Deposits which were encountered from depths of 1.10m bgl to a proven depth of 20.00m bgl. It comprised granular deposits to a depth of 14.10m bgl, overlying cohesive deposits to a depth of 20.00m bgl. The top of the back of the dock wall was encountered within RO01B to RO07 at varied depths creating an indicative profile. The depths the dock wall was encountered at were, 5.30m bgl in RO01B, 8.30m bgl in RO02, 9.30m bgl in RO03, 11.10m bgl in RO04, 13.10m bgl in RO05 and RO06 and 14.10m bgl in RO07. Each borehole was drilled 0.50m away from the previous location. Rotary open holed boreholes, RO01 and RO01A did not hit the top of the back of the dock wall and instead were terminated due to metal re bar obstructions. The cohesive superficial deposits encountered, generally comprised firm to stiff brown sandy gravelly CLAY, stiff brown slightly gravelly sandy CLAY, soft brown sandy CLAY, soft bluish grey silty organic CLAY with occasional shell fragments, soft dark blueish grey very sandy silty CLAY, including sub-rounded to angular, fine to coarse gravel of mudstone, siltstone, sandstone and quartzite with occasional fragments of shell. The granular superficial deposits encountered within the boreholes (CP01-CP05 and WS04) comprised loose brown slightly gravelly slightly silty fine to coarse SAND, dense brownish grey sandy rounded to sub-angular fine to coarse GRAVEL, loose to medium dense reddish brown gravelly medium SAND, dense brown silty fine SAND, dense brown sandy SILT, dense greyish brown mottled dark grey, slightly silty, fine to medium SAND, loose to dense dark grey mottled greyish brown slightly silty fine to medium SAND, including fine to coarse, sub-rounded to angular gravel of siltstone, mudstone, sandstone, quartzite and various igneous lithologies and occasional fragments of shell. Dark brown sandy pseudo-fibrous PEAT was noted within exploratory hole WS04 at 1.90m to 2.20m bgl, with soft brown slightly sandy slightly gravelly clay. Gravel is sub-rounded to sub-angular, fine to coarse including sandstone, siltstone and mudstone at 2.10m to 2.20m bgl within the peat layer. Dark brown sandy slightly silty amorphous PEAT is recorded at 2.50m to 2.70m bgl within the same borehole.

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	Sandstone bedrock (Wilmslow Sandstone Formation) was encountered from 15.00m to a maximum depth of 24.00m bgl and the thickness of the bedrock was not proved in any of the borehole locations. The sandstone was recovered as slightly gravelly fine to coarse sand and angular to subangular gravel of sandstone. Intact bedrock was encountered within the rotary cored boreholes from 21.05m to a maximum death of 24.00m bgl. Several groundwater strikes were recorded during the investigation ranging from 1.10m bgl to a maximum depth of 21.20m bgl. During one return visit, monitored levels were between 2.35m to 3.45m (6.02m to 4.60m AOD) within CP01, CP05 and CP06.
Environmental Laboratory Testing	With respect to the proposed end-use of the site, no exceedances were noted in selected soil samples when compared against Commercial GAC thresholds. Soil samples were also screened for asbestos. 0.002% Asbestos Chrysotile Loose Fibres were identified within CP06 at 0.50m bgl. No suspected asbestos containing materials (ACMs) were identified within CP06 at 0.50m bgl, nor in any of the other exploratory hole logs. Some of the samples tested are noted to have exceeded holding times between being collected and tested for, cyanide, PAH-16MS, VPHCWG, 2:1 water soluble sulphates and organic content. These deviations are not affecting the integrity of the results as they appear quite similar to that of the non-deviating samples. A limite number of exceedances are identified in the three groundwater samples taken from CP01, CP05 and CP06 when compared against adopted Tier 1 thresholds (UK/EU Drinking Water Standards, EQS (Freshwater) and EQS (Saltwater)) for Arsenic, Boron, Chromium, Mercury and Nickel.
Assessment	This assessment has been written according to the previous design of two travelling cranes on rails across the north and south of the site. However, this has since changed to two electric/diesel tracked cranes located in the north of the site with the ability to move within a 126m range east and west across the site. The results obtained and analysed can therefore be used for any future piling on the site. Loadings are currently unknown and are likely to pre-determine the suitability of the foundations to be adopted at the site. Due to the thickness of Made Ground (0.90 – 14.10m), the variability in consistency and composition of the underlying Tidal Flat deposits and the likely loads from the proposed travelling cranes, it is considered shallow spread foundations are unlikely to be suitable at the site. It is considered that a piled foundation solution be adopted, transferring loads to the underlying Sandstone bedrock. As piled foundations are anticipated, a reinforced suspended ground floor slab is recommended to bear on the pile caps by a network of beams which will minimise any differential settlement between the floor and the piled structure. Based on the laboratory test results it is considered that a Design Sulphate Class may be taken as DS-1 with an ACEC class of AC-1 within Made Ground and a Design Sulphate Class of DS-2 with an ACEC class of AC-2 within superficial deposits being appropriate.
Recommendations	Based on the findings of the ground investigation, the following recommendations are made: 1. Relevant contractors should undertake their own UXO Risk Assessment in respect to their works; 2. Consideration should be made to UXO if deep excavations or piling foundations are to be implemented; 3. It is recommended that specialist piling contractors are to be consulted to establish suitable pile design.

Table of Contents

1.0 Introduction 1
1.1 Project Background 1
1.2 Scope of Services 1
2.0 Site Summary 2
2.1 Current Setting 2
2.2 Published Geology 3
2.2.1 Made Ground Deposits 3
2.2.2 Superficial Deposits 3
2.2.3 Bedrock Deposits 3
2.3 Hydrogeology and Hydrology 3
2.4 Unexploded Ordnance (UXO) Risk Assessment 4
3.0 Ground Investigation Scope of Works 5
3.1 Soil Logging and Sampling 6
3.2 Monitoring Well Installations 6
3.3 Post-Investigation Monitoring 6
3.3.1 Groundwater and Ground Gas Monitoring 6
4.0 Laboratory Testing 7
4.1 Geo-environmental Analysis 7
4.1.1 Soil Analysis 7
4.1.2 Groundwater Analysis 8
4.1.3 Quality Assurance and Quality Control 8
4.2 Geotechnical Testing 8
5.0 Ground Model 10
5.1 Encountered Ground Conditions 10
5.1.1 General 10
5.1.2 Made Ground (Dock Wall) 11

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5.1.3 Indicative Dock Wall Profile 11
5.1.4 Made Ground 12
5.1.5 Superficial Deposits 12
5.1.6 Bedrock Deposits 23
5.1.7 Intact Bedrock 24
5.1.8 Obstructions Encountered 24
5.1.9 Groundwater 25
5.2 Observed Potential Contamination 25
5.3 Groundwater 25
5.4 Aggressive Ground Conditions 25
6.0 Ground and Groundwater Contamination Assessment 27
6.1 Human Health 27
6.1.1 Adopted Soil Human Health GACs Screening Methodology 27
6.1.2 Generic Assessment Criteria Screening of Soil Laboratory Results 28
6.1.3 Adopted Vapours within Groundwater Human Health GACs Screening Methodology. 28
6.1.4 General Assessment Criteria Screening of Vapours from Groundwater 29
6.2 Controlled Waters 29
6.2.1 Adopted Controlled Waters Tier 1 Screening Values and Methodology 29
6.2.2 Tier 1 Screening of Groundwater Laboratory Results 30
7.0 Engineering Assessment and Recommendations 31
7.1 Introduction 31
7.2 Summary of Ground Conditions 31
7.3 Foundation Solution 33
7.4 Ground Floor Slabs 33
7.5 Chemical Attack on Buried Concrete 33
7.6 Excavation and Support 33
8.0 Conclusions & Recommendations 35
8.1 Conclusions 35

8.1.1 Ground and Groundwater Contamination 35
8.1.2 Geotechnical Assessment 35
8.1.3 Recommendations 36
9.0 References 37

Appendices

Appendix A **Drawings**

Appendix B **Exploratory Hole Logs**

Appendix C **Chemical Laboratory Testing Results**

Appendix D **Geotechnical Laboratory Testing Results**

Appendix E **GAC Screening Thresholds**

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1.0 Introduction

1.1 Project Background

In May 2019 Curtins were instructed by European Metal Recycling to undertake a Ground Investigation on the EMR site on Gladstone Dock in Liverpool. The site is centred on National Grid Reference (NGR) SJ327956 and covers an area of approximately 4.4Ha. The site location plan is presented as *Figure 2.1*.

1.2 Scope of Services

The Ground Investigation Report will characterise the geo-environmental and geotechnical conditions prior to locating two new electric ship-to-shore, circa 600-tonne, tracked cranes to the north east and north west areas of the site. The cranes will have the freedom to move across the northern section of the site from east to west, for approximately 126m, from the power source with an overlap between the two cranes which means they are able to work close together. The cranes will be used to move scrap metal into stockpiles and onto cargo ships.

The Ground Investigation Report is intended to determine:

a) Likelihood of potential shallow site soils contamination, due to site's current and historic land use, adversely impacting the end-user.
b) Likelihood of potential of groundwater contamination, due to site's current and historic land use, adversely impacting the end-user.
c) Likelihood of the proposed works being adversely impacted by potential geo-hazards across the site.

In addition to identification of risks and hazards across the site, recommendations on foundation solutions for the proposed structures will be provided.

Detailed flood risk assessment, ecology, archaeological studies and waste classification for off-site disposal are outside of the scope of this report.

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2.0 Site Summary

This section presents a summary of the existing site setting and ground/groundwater conditions. This information will feed into the geo-environmental (refer to Section) and geotechnical (refer to Section 9.0) risk assessment.

2.1 Current Setting

The site entrance is located off Regent Road, Gladstone Dock, Bootle, Liverpool L20 1BX, as shown on *Figure 2.1*. The site is part of the European Metal Recycling site which stockpiles scrap metal, waiting to be loaded onto cargo ships for export.

The site is relatively flat, with three existing travelling cranes, two located in the north of the site and one in the south. The stockpiles of scrap metal take up the majority of the north east area of the site. The remaining sections of the site to centre and west of the site are left empty. The site is covered by hard standing. A conveyor belt runs from the central point in the north of the site to west, along the northern boundary, where it reaches the end of the site and diverts to the south along the western boundary. This conveyor belt sits on top of the dock wall. To the far east of the site is the site entrance with weigh bridge, cabins containing EMR's office and workshop.

The site is bounded to the north and west by Gladstone Branch Dock No 1 and to the south by Peel Ports Warehouse and hardstanding. Regent Road runs from north to south to the east.

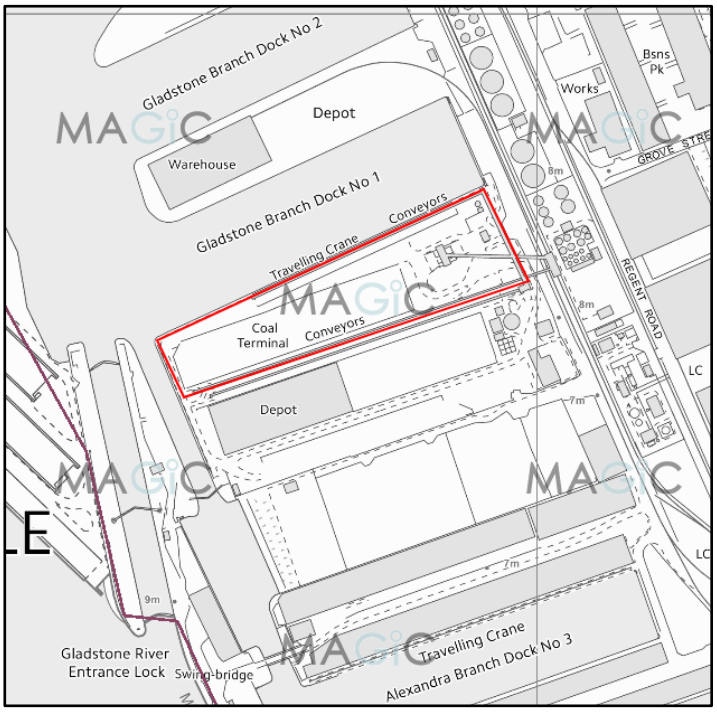

Figure 2.1 – Site Location Plan, site boundary shown in red.
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2.2 Published Geology

A study of the historic BGS borehole records (Ref.29) and BGS 1:50,000 mapping (Solid and Drift) for Formby (Sheet 083), 1976 (Ref.30), indicates the following geological sequence underlying the site:

- **Superficial Deposits**: Tidal Flat Deposits *Quaternary Age*
- **Solid Geology:** Wilmslow Sandstone Formation of *Early Triassic Age*

2.2.1 Made Ground Deposits

Made Ground deposits are not indicated on the online BGS map viewer (Ref.29), however it is understood that the site and surrounding area were reclaimed from the sea, therefore made ground deposits are anticipated to be present. A review of the historic BGS borehole records off site confirms presence of Made Ground, between 3.00m and 5.23m thick.

2.2.2 Superficial Deposits

According to the BGS mapping (Ref.29) superficial deposits are recorded as Tidal Flat Deposits *Quaternary Age,* typically recorded as medium dense, medium sand with occasional shell fragments, silty sandy clay with stones and red sand.

2.2.3 Bedrock Deposits

According to the BGS mapping (Ref.29) the underlying solid geology of the site is Wilmslow Sandstone Formation of Early Triassic Age, typically recorded as red-brown and light grey, fine to medium grained, generally pebble-free, very closely to closely spaced sandstone, with sporadic mudstones and siltstones.

2.3 Hydrogeology and Hydrology

Environment Agency data indicates that the site, corresponding with the underlying bedrock geology, overlies a Principal Aquifer, which is described as:

> *"Layers of rock or drift deposits that have high intergranular and/or fracture permeability meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, Principal Aquifers are aquifers previously designated as Major Aquifers."*

The Tidal Flat deposits aquifer designation is undefined according to magic map (Ref.29).

The site is not located within a Source Protection Zone (SPZ). The nearest surface water feature is Gladstone dock directly adjacent to the north and western site boundary.

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2.4 Unexploded Ordnance (UXO) Risk Assessment

The site of interest is in Liverpool City Centre. Risk mapping for UXOs has placed the site a high-risk area. High-risk areas are those that show a high density of bombing hits (>50 bombs per 1000 acres) and abundant potential WWII targets. However, after WWII the site had been extensively developed with the additional consideration of the site being present on reclaimed dockland.

Curtins did not deem it necessary for our scope of works to obtain a detailed UXO Threat and Risk Assessment or have UXO supervision on site. However, any relevant contractors should carry out their own UXO Risk Assessment in respect to their works.

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3.0 Ground Investigation Scope of Works

Site investigation works were undertaken by Ian Farmer Associates Ltd between the 6th and 21st June 2019.

The scope of the ground investigation was designed in general accordance with current UK guidance including:

- CLR11 (Ref.1);
- British Standard (BS) 10175:2011+A2:2017 (Ref.2);
- BS5930:2015 (Ref.3);
- and BSEN1997: Part 2:2007 Eurocode 7 (Ref.4).

A summary of the scope and rationale are summarised in *Table 3.0*.

Table 3.0 – *Scope and Rationale of Fieldwork Undertaken*

Exploratory Hole Type	Exploratory Hole Ref.	Exploratory Hole Depth (m bgl)	Rationale
Rotary Core Exploratory Holes	**RC01** **RC02** **RC03**	**22.20** **24.00** **22.20**	Confirm the ground and groundwater conditions Coring of the dock wall retaining structure in the north of the site Collect rock core samples for geotechnical testing
Rotary Open Hole Exploratory Holes	**RO01** **RO01A** **RO01B** **RO02** **RO03** **RO04** **RO05** **RO06** **RO07**	**0.40** **1.40** **5.30** **8.30** **9.10** **11.10** **13.10** **13.10** **14.10**	Confirm the ground conditions Confirm the profile of the back of the dock wall
Cable Percussive Exploratory Holes	**CP01** **CP02** **CP03** **CP04** **CP05** **CP06**	**18.90** **16.01** **17.92** **18.76** **18.33** **21.00**	Confirm the ground and groundwater conditions Collect soil & water samples for chemical & geotechnical testing Undertake in-situ testing Groundwater level monitoring
Window Sample Exploratory Holes	**WS01** **WS02** **WS03** **WS04** **WS05**	**0.71** **0.75** **5.45** **7.45** **0.54**	Confirm the ground and groundwater conditions Collect soil samples for chemical & geotechnical testing
Machine Excavated Trial Pit	**TP01**	**3.25**	To find the edge of the dock wall

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For information about the location of the exploratory holes refer to Curtins drawing refs. 068331-CUR-00-XX-DR-GE-001-V01, 068331-CUR-00-XX-DR-GE-002-V01, 068331-CUR-00-XX-DR-GE-003-V01 and 068331-CUR-00-XX-DR-GE-004-V01, *Appendix A*.

3.1 Soil Logging and Sampling

Exploratory hole arisings were logged onsite by a qualified Engineer from Ian Farmer Associates and in accordance with the requirements of BS5930 (Ref.3), including recording of any observed visual contamination. Exploratory hole logs are provided in *Appendix B*.

3.2 Monitoring Well Installations

Groundwater monitoring 50mm diameter slotted pipes were installed within CP01, CP05 and CP06. A bentonite seal was placed at the top and bottom of each of the exploratory holes. A gravel surround was installed in the annulus between the sides of the borehole and the slotted sections of the pipe.

The monitoring wells were primarily installed for groundwater monitoring purposes.

A summary of the response zone is presented in *Table 3.2*.

Table 3.2 – *Monitoring Well Response Zones*

Borehole Ref.	Response Zone(s) (m bgl)	Strata Description(s) (Principal strata in capitals)
CP01	11.00 – 16.00	CLAY and GRAVEL
CP05	11.00 – 17.00	CLAY
CP06	7.00 – 15.00	CLAY

A copy of the borehole logs can be referred to in *Appendix B* of this report.

3.3 Post-Investigation Monitoring

3.3.1 Groundwater and Ground Gas Monitoring

No ground gas monitoring was carried out on site as the proposed development does not include any buildings or confined spaces that would present a risk to site end users from the build-up of ground gases.

One post-investigation site visit was undertaken on the 16th of September 2019, with groundwater levels in the installed cable percussive boreholes (CP01, CP05 and CP06) recorded and groundwater samples collected and subsequently chemically tested.

The results of the groundwater level monitoring are detailed in *Section 5.1.8,* the results of the groundwater testing are discussed in *Section 6.0.*

4.0 Laboratory Testing

4.1 Geo-environmental Analysis

Representative soil samples were selected for laboratory chemical analysis, based on field observations and to provide a characterisation of the Made Ground and natural strata encountered. Selected soil samples were placed in laboratory provided containers and stored in cool boxes prior to being transported to the nominated laboratory under the laboratory's chain of custody documentation. The laboratory selected by Curtins for chemical analysis was Envirolab (UKAS and MCERTS accredited) and for geotechnical analysis was Structural Soils (UKAS accredited).

Given the potential site wide source of contamination (Made Ground) the sampling positions (boreholes) were generally located in a non-targeted, systematic array to give adequate and representative coverage of the site accounting for the historical site use, proposed end-use and the immediate environmental setting.

4.1.1 Soil Analysis

The source material of contaminants of concern potentially present on the site was considered to include, amongst others; organic matter, ash and fill, hydrocarbons (e.g. fuel/oils), heavy metals and asbestos the extent of which is captured by the broad environmental testing suite listed in *Table 4.1.1* below.

Table 4.1.1 – *Environmental Chemistry Analysis Suite: Soils*

Suite Ref.	Analyte	LOD
Soils Suite A	Asbestos Screen, pH, 2;1 Water Soluble Sulphate & Soil Organic Matter (SOM)	-
	Arsenic, Chromium, Chromium VI, Copper, Lead, Selenium, Nickel	1 mg/kg
	Zinc	5 mg/kg
	Boron (water soluble)	1 mg/kg
	Cadmium	0.5 mg/kg
	Mercury	0.17 mg/kg
	Cyanide (total)	1 mg/kg
	Phenols (screen)	0.2 mg/kg
	PAHs (USEPA 16)	0.01 to 0.08 mg/kg
	TPH (Aro/Ali Split)	0.01 to 1.0 mg/kg

Soil samples were taken from within Made Ground from eleven exploratory hole locations (CP01-CP06 and WS01-WS05) and six natural soil samples from CP01, CP03-CP06; all were tested for Suite A.

Copies of the environmental chemistry testing certificates are presented in *Appendix C*.

4.1.2 Groundwater Analysis

The source material of the contaminants of concern potentially present on the site was considered to include, amongst others; organic matter, ash and fill, hydrocarbons (e.g. fuel/oils) and heavy metals the extent of which is captured by the broad environmental testing suite listed in *Table 4.1.2* below.

***Table 4.1.2** – Environmental Chemistry Analysis Suite: Waters*

Suite Ref.	Analyte	LOD
Water Suite A	pH	-
	Total Hardness	2 mg/l
	Arsenic, Lead, Nickel, Selenium, Zinc, Chromium, Copper, Cadmium	1 µg/l
	Mercury, Phenols (screen)	0.1 µg/l
	Boron (dissolved)	10 µg/l
	Cyanide	0.005 mg/l
	Sulphide	0.1 mg/l
	Sulphate	1 mg/l
	PAHs (USEPA16)	0.01 µg/l
	TPH (Aro/Ali Split)	1 & 5 µg/l

Three groundwater samples were taken from boreholes CP01, CP05 and CP06 and tested for the above suite.

Copies of the environmental chemistry testing certificates are presented in *Appendix C*.

4.1.3 Quality Assurance and Quality Control

Soil and groundwater chemical analysis was conducted by Envirolab Laboratories, a UKAS and MCERTS accredited laboratory. All samples were delivered in appropriate containers for the suites tested and analysed within designated holding times. Three soil samples (CP01 at 1.20m, CP02 at 0.50-0.60m and WS02 at 0.40m) were recorded to have exceeded maximum holding time between sampling date and analysis for Cyanide, PAH-16MS and VPHCWG.

4.2 Geotechnical Testing

Soil samples for testing were prepared in accordance with BS1377: Part 1:2016 (Ref.5). The geotechnical testing undertaken on samples obtained is summarised in *Table 4.2.*

Table 4.2 – *Geotechnical Testing*

Test Type	Quantity	Standard
In Situ Testing		
Standard Penetration Testing	86	BS 5930: 2015, Clause 41
Laboratory Testing		
Atterberg Limit	24	BS1377 1990, Part 2 (clause 4.5, 5.3 & 5.4)
Multistage Triaxial compression test	3	BS1377 1990, Part 7 (clause 9.0)
Water Soluble Sulphate	25	IS0 17025 MCERTS
pH Value	25	IS0 17025 MCERTS
Moisture Content	24	BS1377 1990, Part 2
Organic Content	2	BS1377 1990, Part 3

The results of the geotechnical testing are summarised in *Section 5.0* of this report.

Copies of the geotechnical testing certificates are presented in *Appendix D*.

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5.0 Ground Model

5.1 Encountered Ground Conditions

5.1.1 General

A summary of the ground conditions encountered during the site investigation works is presented below, with detailed information presented on the exploratory hole logs included in *Appendix B*.

Table 5.1.1 – *Summary of Ground Conditions Encountered*

Stratum	Depth to top of strata, m bgl	Thickness (m)		Description
		Min	Max	
MADE GROUND (DOCK WALL)[1]	0.00	8.30*	21.25	TARMACADAM *Overlying* Brown to grey CONCRETE, brown SAND and GRAVEL, TIMBER, strong grey CONCRETE, very strong very dark gey mottled yellowish brown CONCRETE.
MADE GROUND	0.00	0.90	14.10	CONCRETE/APHALT *Overlying* Grey to brown, GRAVEL, clayey gravelly SAND, sandy SILT, sandy gravelly CLAY, sandy CLAY, sandy COBBLES, SAND and GRAVEL. Gravel is fine to coarse, sub-rounded to angular of mixed lithologies. Anthropogenic constituents include brick, concrete, limestone, coal, ash, sandstone, siltstone, mudstone and quartzite, slate and flint.
SUPERFICIAL DEPOSITS (Tidal Flat Deposits)	1.10	15.00	20.00	Brown gravelly, silty SAND, stiff brown sandy gravelly CLAY, brownish grey sandy GRAVEL, reddish brown gravelly SAND, soft brown sandy CLAY, sandy SILT, soft blueish grey silty organic CLAY with occasional shell fragments, And dark brown sandy pseudofibrous PEAT and Dark brown sandy slightly silty amorphous PEAT.
SANDSTONE BEDROCK (Wilmslow Sandstone Formation)	15.00	0.10	2.75*	Description from cable rig log: Orangish brown, reddish brown and red SANDSTONE, recovered as slightly gravelly, fine to coarse sand and angular and subangular coarse gravel of sandstone. Description from Rotary log: very weak to weak orangish red mottled black, red mottled greenish grey and brownish orange fine and medium SANDSTONE. Fractures are 0-10 degrees planar and undulating and close to medium spaced, stepped, rough and smooth partially infilled with fine and medium silty sand.

* Thickness not proved
1) Rotary cored boreholes through the retaining dock wall in the north of the site.

5.1.2 Made Ground (Dock Wall)

The dock wall was investigated within specific exploratory holes (RC01 to RC03) and it was encountered from ground level to a maximum depth of 21.25m bgl (RC02). It comprised of medium strong to extremely strong grey, brownish grey, reddish orange, dark grey mottled yellowish brown, CONCRETE with 20-30%, 50-60%, 60-70%, 70-80% aggregate of subangular to rounded, irregular and elongate fine to coarse gravel and cobbles including mudstone, quartzite, flint, sandstone, granite, dolerite and various igneous lithologies. Low cobble content. <5% small to large voids and 5-25% rough and crystalline small honeycomb voids.

Before the dock wall was encountered within RC01 at 13.20m bgl, from ground level to 13.20m bgl Made Ground consisted of TARMACADAM, brown SAND and GRAVEL with wood pieces, CONCRETE, TIMBER and Weak red sandstone COBBLE. Within RC02 and RC03 the dock wall was encountered from ground level.

5.1.3 Indicative Dock Wall Profile

In total nine open holed rotary boreholes were carried out along the rear of the dock wall. Boreholes RO01 and RO01A hit obstructions at 0.40m bgl and 1.40m bgl and therefore the next borehole position (RO01B) was moved approximately 7m west. Boreholes RO01B to RO07 encountered the top of the rear profile of the dock wall at varied depths.

A summary of the depths the back of the dock wall was encountered during the ground investigation is presented below and can be referred to in the exploratory logs included in Appendix B.

Table 5.1.3 – *Summary of the depth the dock wall was encountered*

Borehole Ref	Depth to top of the back of the Dock Wall, m bgl
RO01	0.40
RO01A	1.40
RO01B	5.30
RO02	8.30
RO03	9.10
RO04	11.10
RO05	13.10
RO06	13.10
RO07	14.10

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An indicative cross-section of the dock wall is included within Appendix A (Curtins drawing ref. 068331-CUR-00-XX-DR-GE-005-V01). Boreholes RO01 and RO1A have not been included due to encountering shallow metal obstructions.

5.1.4 Made Ground

Made Ground was encountered from ground level to a maximum depth of 14.10m bgl (RO07). It comprised concrete and tarmacadam overlying grey to brown GRAVEL, clayey gravelly SAND, sandy SILT, sandy gravelly CLAY, sandy CLAY, sandy COBBLES and SAND/GRAVEL, including anthropogenic constituents of concrete, brick, limestone, coal, ash, sandstone, siltstone, mudstone, quartzite, slate and flint.

Granular Made Ground was encountered within majority of the boreholes (CP01-CP06, WS01, WS03 – WS05, RO01B – RO07 and TP01) from ground level to 14.10m bgl. This comprised brownish grey GRAVEL, sandy GRAVEL, sandy silty GRAVEL, gravelly fine to coarse SAND, gravelly clayey SAND, sandy COBBLES. Gravel is fine to coarse, sub-rounded to angular of mixed lithologies, including brick, concrete, ash, coal, limestone, sandstone, mudstone, siltstone, flint, and quartzite.

The cohesive Made Ground was encountered in some exploratory holes (CP01-CP02, CP04-CP06, WS03 and TP01) at depths of between 0.60m to 5.20m bgl. The cohesive Made Ground comprised brown sandy gravelly CLAY, slightly sandy SILT, sandy CLAY, silty CLAY, with fine to coarse, rounded to angular gravel of mixed lithologies, including brick, concrete, sandstone, mudstone, quartzite, slate and siltstone. This differed slightly in CP01 from 1.70m to 2.80m bgl, with Possible Made Ground consisting of very soft, dark greyish blue, slightly sandy SILT with clay laminations.

5.1.5 Superficial Deposits

Cohesive and granular Tidal Flat Deposits were encountered underlying the Made Ground.

Tidal Flat Deposits were encountered from minimum depths of 1.10m bgl to a proven depth of 20.00m bgl. It comprised granular deposits to a depth of 14.10m bgl, locally overlying cohesive deposits to a maximum depth of 20.00m bgl.

The granular deposits encountered (CP01-CP05 and WS04) comprised loose brown slightly gravelly slightly silty fine to coarse SAND, dense brownish grey sandy rounded to sub-angular fine to coarse GRAVEL, loose to medium dense reddish brown gravelly medium SAND, dense brown silty fine SAND, dense brown sandy SILT, dense greyish brown mottled dark grey, slightly silty, fine to medium SAND, loose to dense dark grey mottled grayish brown slightly silty fine to medium SAND, including fine to coarse, sub-rounded to angular gravel of siltstone, mudstone, sandstone, quartzite and various igneous lithologies and occasional fragments of shell.

The cohesive deposits encountered (CP01-CP06, WS03-WS04), generally comprised firm to stiff brown sandy gravelly CLAY, stiff brown slightly gravelly sandy CLAY, soft brown sandy CLAY, soft bluish grey silty organic CLAY with occasional shell fragments, soft dark blueish grey very sandy silty CLAY, including sub-rounded to angular, fine to coarse gravel of mudstone, siltstone, sandstone and quartzite with occasional fragments of shell.

Dark brown sandy pseudofibrous **PEAT** was noted within exploratory hole WS04 between 1.90m and 2.20m bgl, with soft brown slightly sandy slightly gravelly clay. Gravel is sub-rounded to sub-angular, fine to coarse including sandstone, siltstone and mudstone from 2.10m to 2.20m bgl within the peat layer. Dark brown sandy slightly silty amorphous PEAT is recorded between 2.50m and 2.70m bgl within the same borehole.

A summary of the geotechnical test results recorded within the superficial deposits are presented in *Table 5.1.5*. Full details of the geotechnical results can be found in *Appendix D*.

Table 5.1.5 – *Summary of geotechnical test results – superficial deposits*

Parameter		No. of Tests	Minimum
In-Situ Test			
SPT 'N' Value (2) Granular		11	Min:3 Max:35 Average:17
SPT 'N' Value (2) Cohesive		44	Min:4 Max:50 Average:22
Laboratory Test			
Atterberg Test	Moisture Content (%)	25	Min: 4.7% Max: 46.7% Average: 17.6%
	Liquid Limit (%)	24	Min: 20% Max: 85% Average: 33.4%
Atterberg Test	Plastic Limit (%)	24	Min: 10% Max: 45% Average: 17.5%
	Plasticity Index (%)	24	Min: 6% Max: 40%(4) Average 14%
	Modified Plasticity Index (%) (1)	24	Min: 4% Max: 35%(4) Average: 11%
Multi Stage Triaxial Compression Test (3)		3	Cu: 119, 17 & 29 kPa
pH		11	Min: 8.32 Max: 9.57 Average: 8.89
Water Soluble Sulphate (mg/l)		11	Min: 60 Max: 1140 Average: 238
Organic Content (%)		2	Min: 0.5% Max: 1.2%

Parameter	No. of Tests	Minimum
		Average: 0.85%

(1) Modified plasticity index is the plasticity of components <425µm.
(2) Only includes SPTs tests in which full penetration was achieved.
(3) Used the average CU from each test.
(4) Only two values were recorded at higher >21%. These values were omitted for the purposes of deriving an average.

SPT 'N' value of 0 was recorded within the layer of **PEAT** (WS04 between 1.90m bgl and 2.20m bgl) and it has not been included within *Table 5.1.4*. The SPT 'N' value of has been recorded following sinking of the SPT Cone within the soil. This value demonstrates highly compressible soft material, as generally anticipated for Peat.

Fifty-five SPT 'N' values were recorded. Forty-five SPT 'N's we recorded on cohesive deposits ranging between 4 and 50, predominantly increasing with depth. Eleven SPT 'N' values were recorded on the granular deposits ranging between 3 and 35, predominantly increasing with depth. The results are shown on *Table 5.1.5* and *Figure 5.1.5a.*

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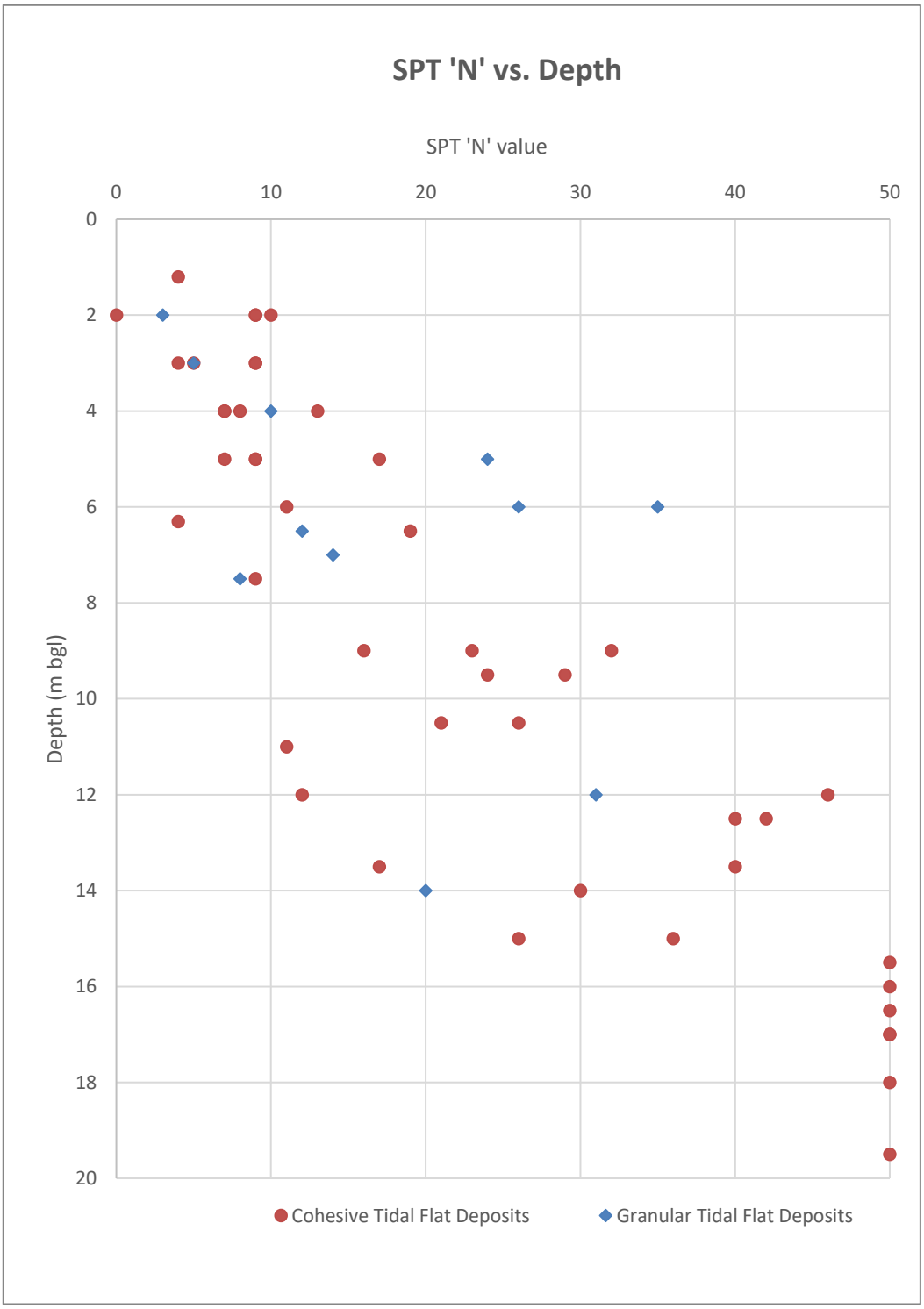

Figure 5.1.5a – *SPT 'N' Values vs Depth.*

The Undrained Shear Strength (Cu) of the Tidal Flat Deposits (Cohesive) has been determined from the relationship between SPT N values and the Plasticity Indices (PI), after Stroud, 1975, as presented in *Equation 1:*

$$Cu = SPT\ N.\ f_1 \qquad \textbf{[Equation 1]}$$

Where:

Cu is the Undrained Shear Strength

N is SPT N values

f_1 *is the Stroud factor*

A f_1 value of 6.2 is deemed suitable for the average PI of 14, determined from Atterberg test results. Therefore, Cu values of between 25 kPa to 310 kPa are calculated, corresponding with the borehole log description of soft to stiff clay.

The Cu values for the SPT 'N' recorded as 0 within the layer of peat is not demonstrated on *Figure 5.1.5a*. The SPT N value of 0 indicates extremely low strength material and it appears to have been only locally encountered within WS04 at 2.0m bgl.

The results of the undrained shear strength calculated from the correlation between SPT N and PI (Stroud, 1975) and the Multi Stage Triaxial tests are presented against depth on *Figure 5.1.5b.*

The results of the Cu values derived from correlation between Plasticity Indices and SPT 'N' values are shown to be in line with the Multistage Triaxial test results.

The equations demonstrating the linear relationship for determination of a moderately conservative value is demonstrated on *Figure 5.1.5b.*

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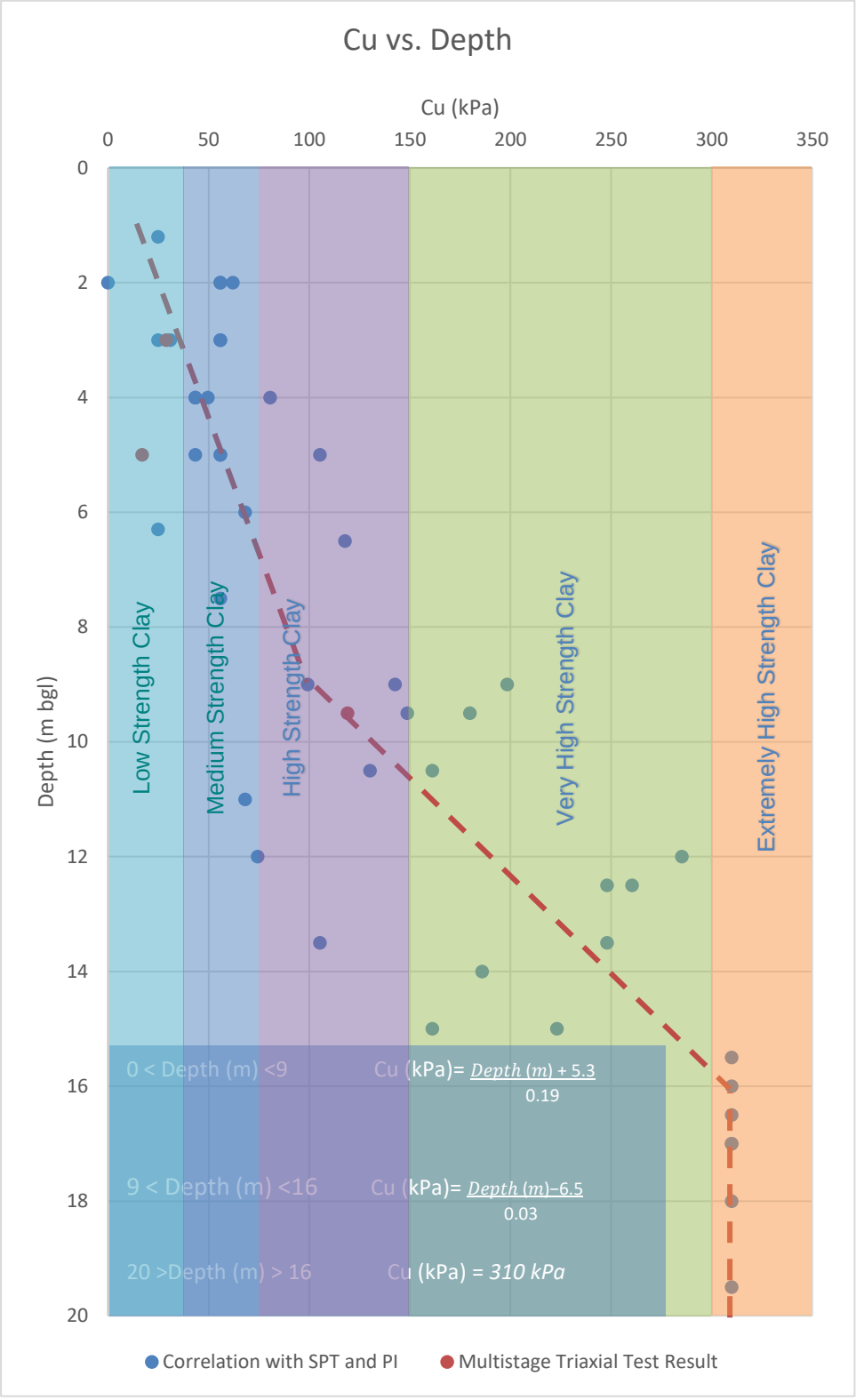

Figure 5.1.5b – *Undrained Shear Strength, Cu vs Depth.*

The Coefficient of Volume Compressibility (Mv) of Glacial Till has been determined from the relationship between SPT N values and the Plasticity Indices (PI), after Stroud, 1975, as presented in *Equation 2:*

$$Mv = 1/(SPT\ N.\ f_2) \qquad \textbf{[Equation 2]}$$

Where:

Mv is Coefficient of Volume Compressibility $\frac{Depth\ (m)+3.4}{0.057}$

N is SPT N values,

f_2 *is the Stroud factor*

A f_2 value of 0.72 is deemed suitable for average PI of 14. Mv values ranging between 0.03 m^2/MN to 0.35 m^2/MN are determined. The results are plotted against depth, *Figure 5.1.5c*. The equations demonstrating the linear relationship for determination of a moderately conservative value is demonstrated on *Figure 5.1.5c.*

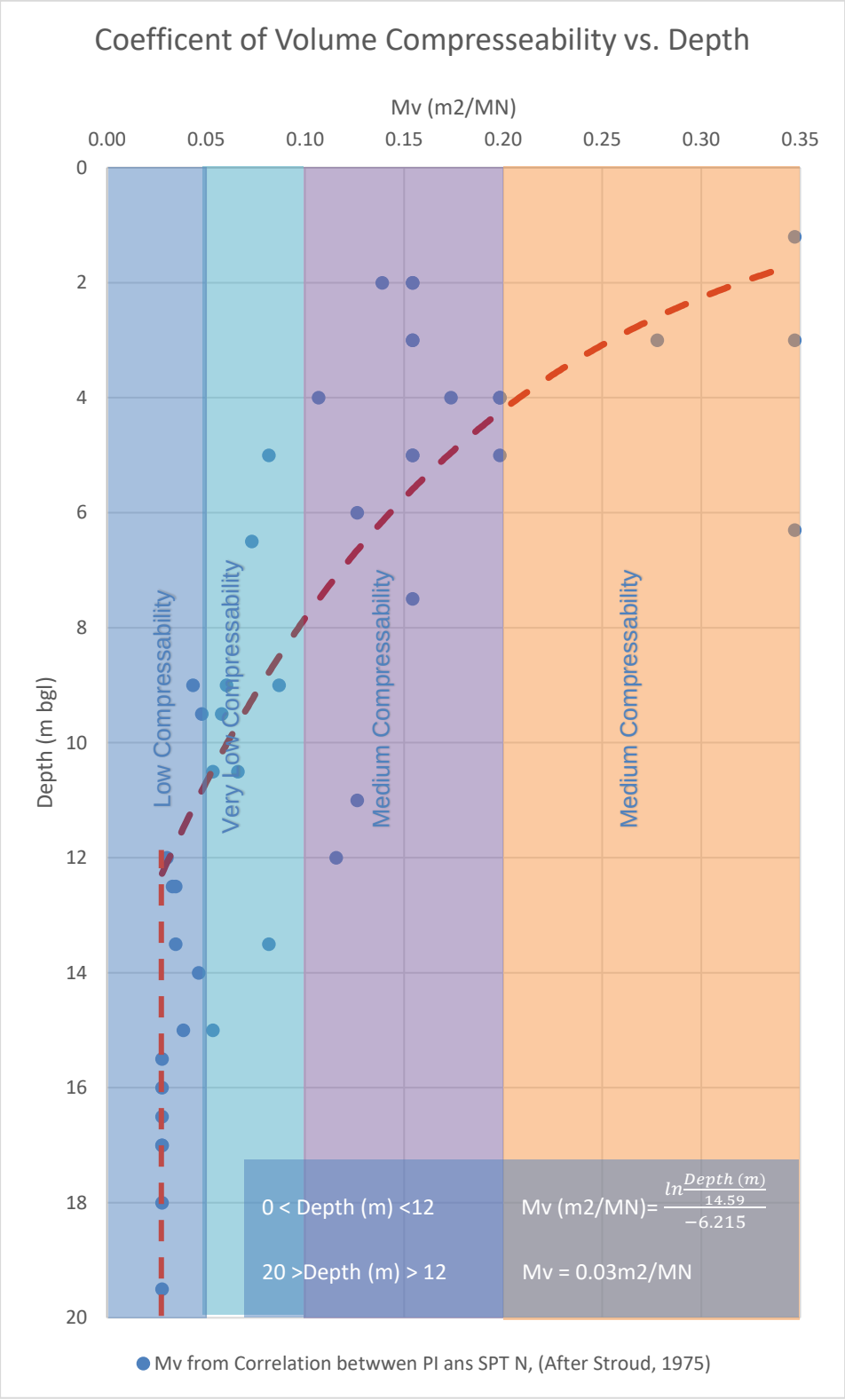

Figure 5.1.5c – *Coefficient of Compressibility, Mv vs Depth*

The Angle of Shearing Resistance, ϕ', for cohesive soils has been derived from the correlation with Plasticity Indices, after Gibson. 1953 and can be seen in *Figure 5.1.5d.* This figure shows that the angle of shearing resistance overall increases with depth.

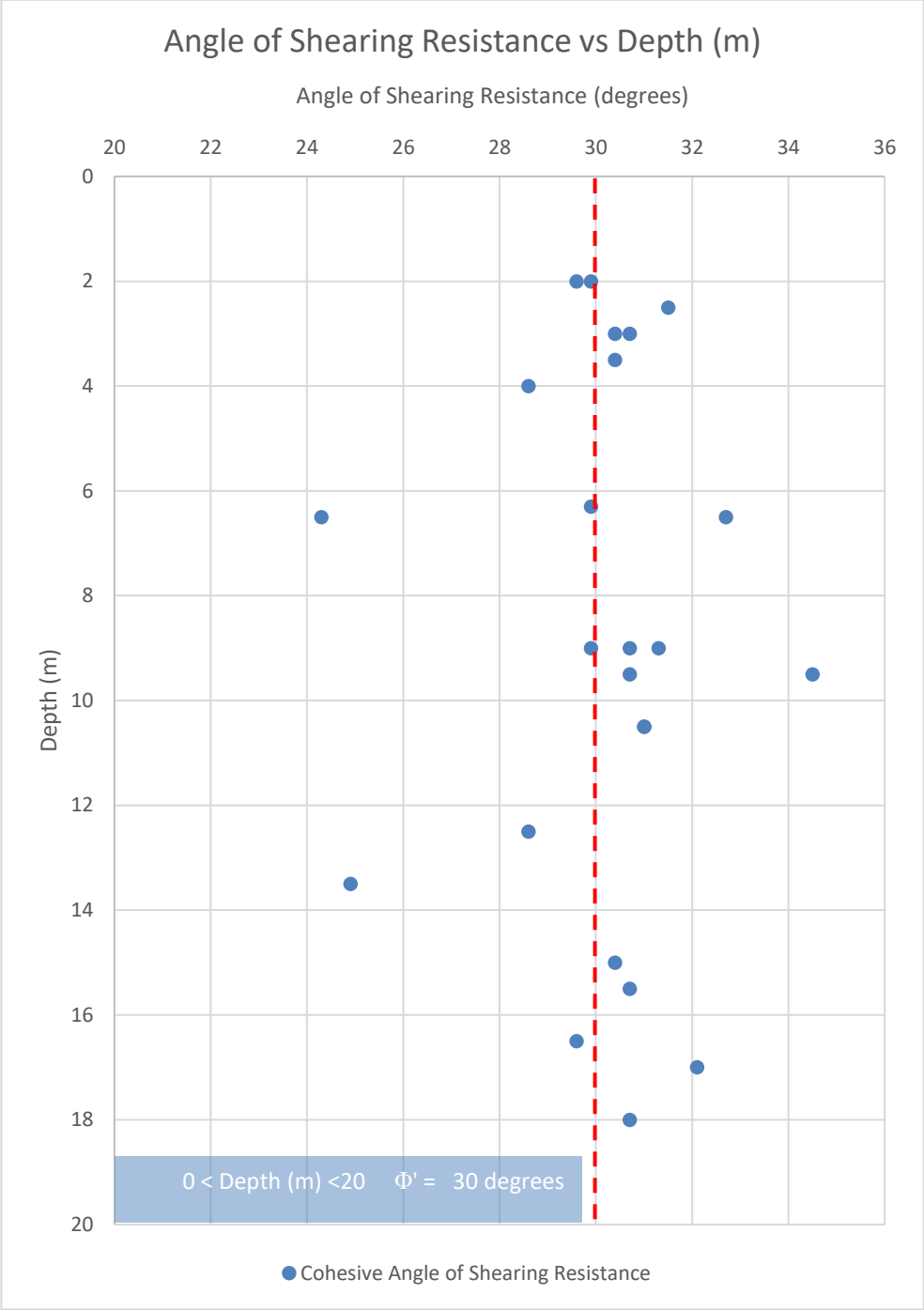

Figure 5.1.5d – *Cohesive Angle of Shearing Resistance ϕ' vs Depth*

The Angle of Shearing Resistance ϕ', for granular soils has been derived from the correlation with SPT 'N' values after Tomlinson 2001 as seen in *Figure 5.1.5e*. The figure shows an overall increase in angle of shearing resistance for depth.

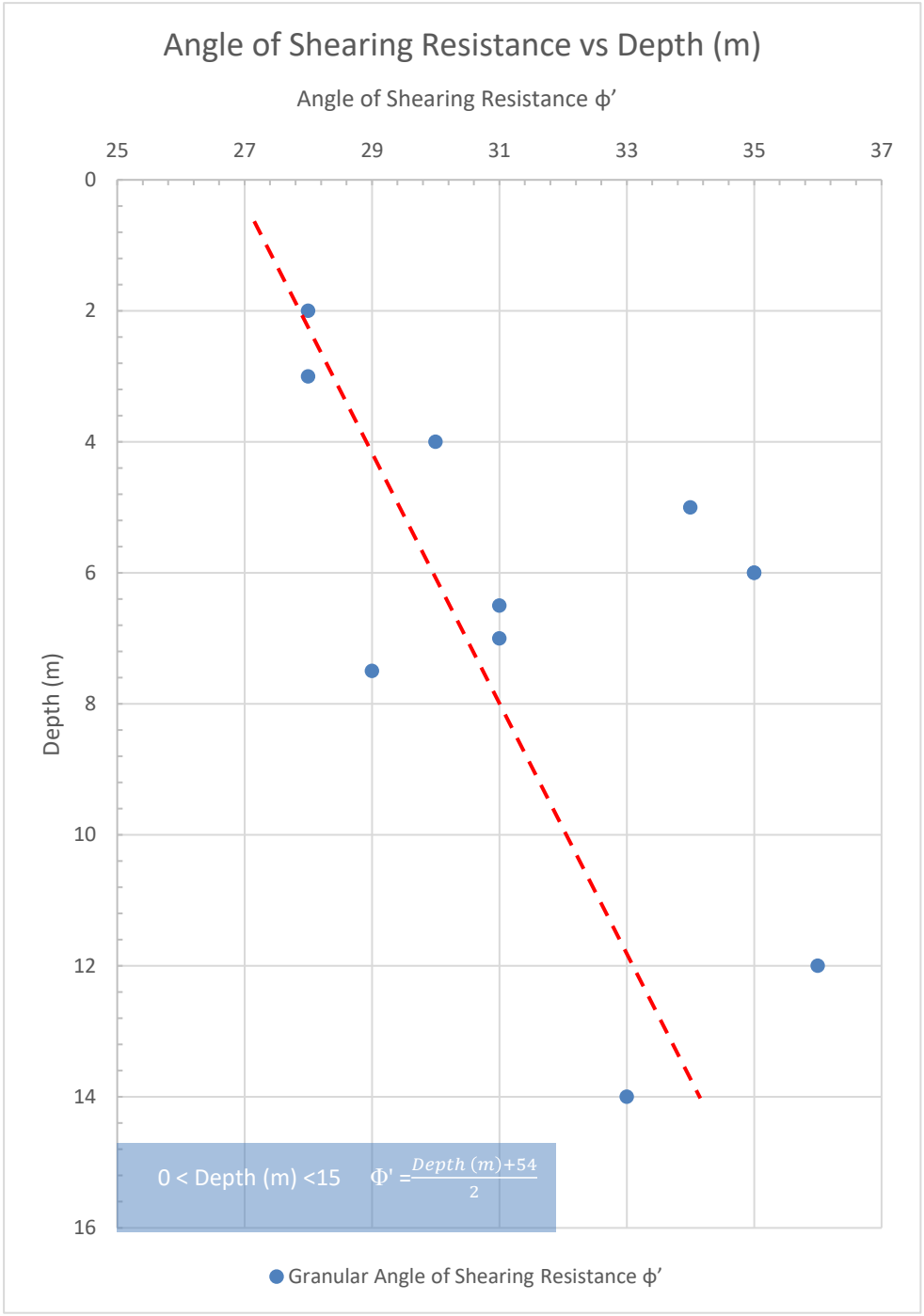

Figure 5.1.5e – *Granular Angle of Shearing Resistance ϕ' vs Depth*

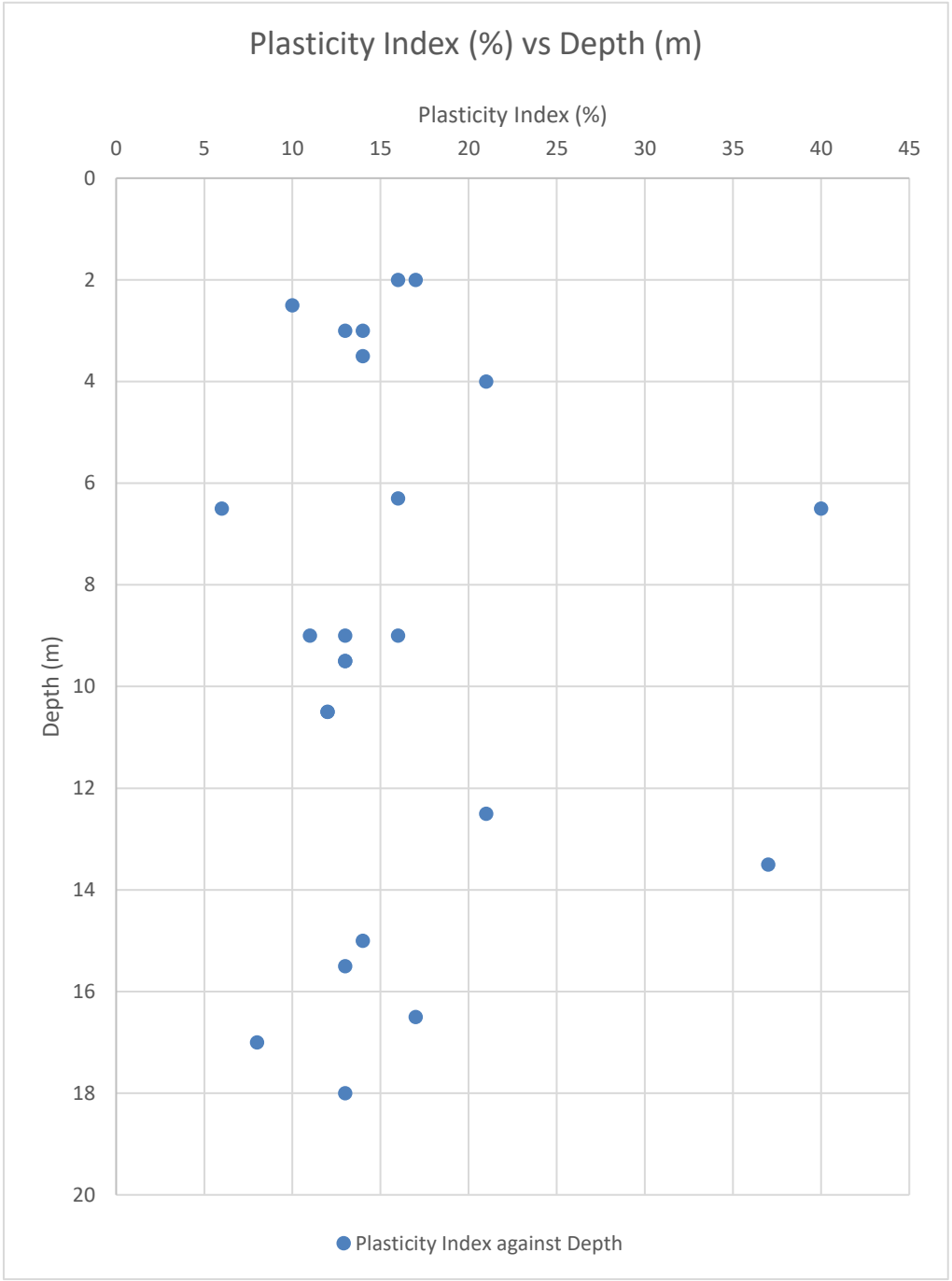

Figure 5.1.5f – *Plasticity Index (5) vs Depth (m)*

Figure 5.1.5f above shows the correlation between Plasticity index against depth. All of the results range from between 6% to 40% with only two plasticity index numbers above 25%. These are shown on the graph as 37% and 40%. These two values were omitted for the purpose of deriving an average as seen in *Table 5.1.5.* The average of these PI values is 14%. Overall the graph shows reduced plasticity index with depth.

The Parameters derived for the Tidal Flat deposits are summarised in *Table 5.1.5g.*

Table 5.1.5g – *Superficial Deposits Geotechnical Parameters*

Parameter	Value	Reference
Cohesive Tidal Flat Deposits		
Unit Weight, γ (kN/m^3)	19	Published Values (Barnes, 2000)
Undrained Shear Strength, Cu (kPa) (1)	0 < Depth (m) <9 $Cu = \frac{Depth\ (m)-(-5.3)}{0.19}$ 9 < Depth (m) <16 $Cu = \frac{Depth\ (m)-6.5}{0.03}$ 20 > Depth (m) > 16 $Cu\ (kPa) = 310\ kPa$	SPT N correlation with Plasticity Index (Stroud 1997), Multi Stage Triaxial Test
Angle of Shearing Resistance, ϕ' (°)	0 < Depth (m) <20 $Angle\ of\ Shearing\ Resistance = 30\ degrees$	Correlation with Plasticity Index (Gibson. 1953) Published values (Waltham, 2009)
Coefficient of volume compressibility, mv (m^2/MN)	*0<Depth (m) < 12* $Mv\ (m2/MN) = \frac{ln\frac{Depth\ (m)}{14.59}}{-6.215}$ *20 >Depth (m) > 12* *Mv = 0.03 m2/MN*	SPT N correlation with Plasticity Index (Stroud 1997)
Drained Cohesion, c' (kPa)	0	Based on engineering judgment
Granular Tidal Flat Deposits		
Unit Weight, γ (kN/m^3)	16.5 – 18.5	Published Values (Barnes, 2001)
Angle of Shearing Resistance, ϕ' (°)	0 < Depth (m) <15 $Angle\ of\ Shearing\ Resistance = \frac{Depth\ (m)+54}{2.0}$	Correlation with SPT 'N' (Tomlinson. 2000)
Drained Cohesion, c' (kPa)	0	Based on engineering judgment
Peat		
Unit Weight, γ (kN/m^3)	12	Published Values (Barnes, 2000) and based on engineering judgment
Undrained Shear Strength, Cu (kPa) (1)	0	Assumption based on SPT results and on engineering judgment
Coefficient of volume compressibility, mv (m^2/MN)	>1.5	Published Values (Tomlinson, 2000) and based on engineering judgment
Drained Cohesion, c' (kPa)	0	Based on engineering judgment

5.1.6 Bedrock Deposits

Sandstone bedrock (Wilmslow Sandstone Formation) was encountered within the rotary cored boreholes RC01 – RC03 and cable percussive boreholes CP01-CP06 from 15.00m bgl to a max depth of 24.00m bgl.

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This sandstone bedrock was recovered as orangish brown, reddish brown and red SANDSTONE, recovered as slightly gravelly, fine to coarse sand and angular and subangular coarse gravel of sandstone.

It is described in detail within the rotary core logs (*Appendix B*) to be very weak to weak orangish red mottled black, red mottled greenish grey and brownish orange fine and medium SANDSTONE. Fractures are 0-10 degrees planar and undulating and close to medium spaced, stepped, rough and smooth partially infilled with fine and medium silty sand.

5.1.7 Intact Bedrock

Intact bedrock was encountered within the rotary cored boreholes from 21.05m bgl to a maximum depth of 24.00m bgl encountered during drilling.

Table 5.1.7 – *Bedrock Geotechnical Parameters*

Parameter	Value	Reference
Unit Weight, γ (kN/m^3) Clay	22	Barnes, 2000
Angle of Shearing Resistance Φ (°)	40	Published Values (Waltham, 2009)
Unconfined Compressive Strength (MPa)	20	Published Values (Waltham, 2009)

5.1.8 Obstructions Encountered

An obstruction was encountered within WS01 at 0.60m bgl thought to be concrete, the exploratory hole position was terminated at 0.71m bgl.

WS02 encountered concrete from ground level to 0.75m bgl, with the borehole terminated at 0.75m bgl due to SPT refusal.

A concrete obstruction was encountered from 0.33m bgl in WS05. A void is noted within this stratum of concrete between 0.34m to 0.40m bgl. The borehole was terminated at 0.64m bgl due to deviation of SPT rods in the concrete.

An obstruction was encountered within RO01 at 0.40m bgl, with the hole terminated due to metal re bar.

A metal obstruction was encountered within RO01A at 1.40m bgl and borehole location was terminated.

Exploratory holes RO01B to RO07 encountered concrete obstructions at varied depths (5.30m to 14.10m bgl) indicating the top of the dock walls profile.

5.1.9 Groundwater

There were several groundwater strikes recorded within the cable percussive boreholes, rotary cored boreholes and the window sample boreholes. These range from 1.10m to a max depth of 21.20m bgl and are detailed on the exploratory hole logs within *Appendix B*.

Subsequently, one post-investigation round of groundwater level monitoring was undertaken on the 16th September 2019, the results of which is presented in *Table 5.1.9*

Table 5.1.9 – *Monitored Groundwater Noted After Site Investigation*

Borehole Ref.	Installation Strata	16/09/19
		Depth (m bgl)
CP01	Clay and gravel	3.45
CP05	Clay	3.00
CP06	Clay	2.35

5.2 Observed Potential Contamination

No potential visual or olfactory contamination was observed during the intrusive investigation works.

5.3 Groundwater

Due to the site's location on Liverpool Docks, with Gladstone Dock directly north and west of the site, groundwater is assumed at relatively shallow depths as a worst case. It is therefore suggested that the design groundwater level is assumed at ground level, for the purposes of design.

5.4 Aggressive Ground Conditions

The classification of the site in terms of concrete in aggressive ground is based on the guidance provided in Table C2 of the Building Research Establishment (BRE) Special Digest 1, 3rd edition of 2005 (Ref.7). A summary of the results obtained as a part of the ground investigation are summarised in *Table 5.4a*, and *Table 5.4b* details the classification.

Table 5.4a – *Aggressive Chemical Environment for Concrete (ACEC) Site Classification*

Stratum	Test Type	Range
Made Ground	pH	8.06 – 12.83
	Water Soluble Sulphate (mg/l)	10 – 507
Superficial deposits	pH	8.32 – 9.57
	Water Soluble Sulphate (mg/l)	60 – 1140

Table 5.4b – *Aggressive Chemical Environment for Concrete (ACEC) Site Classification*

Stratum	Design Sulphate Class	ACEC Class (1)
Made Ground	DS-1	AC-1
Superficial deposits	DS-2	AC-2

(1) ACEC assessment was based on the *mobile* groundwater condition in a *brownfield* scheme area

6.0 Ground and Groundwater Contamination Assessment

This section outlines the environmental exceedances within the site soils and groundwater on site.

6.1 Human Health

The soil results will be screened against the relevant Generic Assessment Criteria (GAC) where available, including:

i) **Soil Guideline Values (SGVs):** These have been published by the Environment Agency and are trigger values for screening out low risk areas of land contamination. SGV's give an indication of representative average concentrations of chemicals in soil, below which long-term health risks are likely to be minimal. SGVs have been published for several contaminants including arsenic, cadmium, mercury, nickel, selenium, BTEX, phenols and dioxins, furans and dioxin-like PCB substances for land uses including residential, allotments and commercial. The SGVs have been developed for a sandy loam soil with 6% soil organic matter (SOM) content;

ii) **Supplementary Screening Values (SSVs):** In addition to the SGVs developed by the EA, other third party organisations have derived SSVs for a wider range of contaminants and land uses using the CLEA Model. Curtins have adopted these numbers where applicable, including those developed by Atkins AtriskSoil™, the LQM/CIEH Suitable for Use Levels (S4UL) and EIC/AGS/CL:AIRE published thresholds;

iii) **Category 4 Screening Levels (C4SLs):** In March 2014 Defra published C4SLs for arsenic, benzene, benzo(a)pyrene, cadmium, hexavalent chromium and lead. These values were derived to support the revised Part 2A Statutory Guidance issued in 2012 (Ref.12) in which four categories of contaminated land are included, ranging from Category 1 (significant/high risk) to Category 4 (low risk). C4SLs are not representative of significant possibility of significant harm (SPoSH) and are low risk levels which, and therefore where the C4SLs are not exceeded, land can be demonstrated to be in Category 4 and cannot be determined as contaminated land.

6.1.1 Adopted Soil Human Health GACs Screening Methodology

The current use of the site is noted as a Metal Recycling storage area, with the proposed development comprising the construction of two new tracked cranes. This land use is most analogous with a *Commercial* end-use scenario and so assessment has been undertaken against the following GACs, in order of preference:

1. Environment Agency Soil Guideline Values,
2. CL:AIRE, AGS, EIC. Soil Generic Assessment Criteria for Human Health Risk Assessments,
3. LQM/CIEH 2015 S4ULs for Human Health Risk Assessment, and
4. DEFRA Category 4 Screening Levels.

The soil organic matter (SOM) content has an influence on the volatilisation of organic contaminants (i.e. the higher the SOM, the lower the volatilisation rate and therefore inhalation exposure risk). Soil organic matter (SOM) values for the site soils ranged from 0.2% to 5.1%. The high organic content encountered in the soils is representative of the Made Ground.

With consideration for a calculated geometric average, Made Ground soils determine a SOM of 1.28% while natural soils maintain a lower valuation of 0.79%. As such, a comparison against Generic Assessment Criteria (GAC) thresholds for a conservative SOM of 1.0% for *Commercial* end-use has been adopted for Made Ground and natural soil features. The adopted GAC's are listed in *Appendix E*.

6.1.2 Generic Assessment Criteria Screening of Soil Laboratory Results

The results of the environmental testing can be referred to in *Appendix C*.

There are no exceedances noted within any of the Made Ground or natural soil samples tested when compared to the *Commercial* GACs.

Selected soil samples were screened for asbestos. Asbestos 0.002% Chrysotile Loose Fibres were identified within CP06 at 0.50m bgl. No suspected asbestos containing materials (ACMs) were identified within CP06 at 0.50m bgl, nor in any of the other exploratory hole logs. No asbestos was positively identified in either of the two deeper soil samples from BH06 at 1.80m and 4.30m bgl.

Some of the samples tested are noted to have exceeded holding times between being collected and tested for, cyanide, PAH-16MS, VPHCWG, 2:1 water soluble sulphates and organic content. These deviations are not affecting the integrity of the results as they appear quite similar to that of the non-deviating samples. These sample results can be referred to in Appendix C and D.

6.1.3 Adopted Vapours within Groundwater Human Health GACs Screening Methodology.

Volatile contaminants in groundwater have the potential to present a risk to human health through the volatilisation and mobilisation of vapours into overlying buildings, followed by inhalation. Detailed guidance for assessing risk presented to human health from volatile contaminants in groundwater is available within The Society of Brownfield Risk Assessment (SOBRA), Development of Generic Assessment Criteria for Assessing Vapour Risks to Human Health from Volatile Contaminants in Groundwater (Ref.11).

A generic quantitative risk assessment (GQRA) has been carried out for the potential for the vaporisation of volatile contaminants within the groundwater, rising through porous superficial

soils to cause potential chronic risk to human health. The Sora document is intended as a conservative screening tool and presents Generic Assessment Criteria (GAC_{gwvap}) for two site end use scenarios, Residential and Commercial, for volatile compounds.

The current use of the site is noted as a Metal Recycling storage area, is most analogous with a *Commercial* end-use scenario; assessment has been undertaken in accordance with this against the GACs outlined in the SoBRA guidance (Ref.13).

6.1.4 General Assessment Criteria Screening of Vapours from Groundwater

The results of the environmental (groundwater) testing can be referred to in *Appendix C*.

With respect to the proposed end-use of the site, no exceedances were noted against thresholds for the proposed end use (commercial).

6.2 Controlled Waters

A model for assessing the potential for pollution of controlled waters and for deriving a safe concentration in ground and groundwater is the Environment Agency's publication "Remedial Targets Methodology - Hydrogeological Risk Assessment for Land Contamination' (Ref.14).

In relation to the standards for controlled waters, there are currently no generic groundwater standards or surface water standards that are necessarily applicable to all sites.

However, dependant on the receptor identified as being at risk, see *Section 6.2.1*, the EU Drinking Water Standards (Ref.15) and/or Water Framework Directive Ecology Quality Standards (WFD EQS) (Ref.16) can be utilised as primary screening values in a Tier 1 assessment. These can also be supplemented by World Health Organisation (WHO) guidelines (Ref.17), where WFD or DWS do not exist.

In addition to surface and groundwater samples a soil leaching test can be undertaken to provide a preliminary, conservative, assessment of the potential for contaminants in the soil to pollute ground or surface water. Leachate test results are screened in the same way as for groundwater above.

6.2.1 Adopted Controlled Waters Tier 1 Screening Values and Methodology

The results of laboratory analysis of groundwater samples taken from CP01, CP05 and CP06 have been assessed against UK/EU Drinking Water Standards as the site is underlain by a Principal Aquifer, associated with the Wilmslow Sandstone Formation and also assessed against Environmental Quality Standards (EQS) (Freshwater and Saltwater) as the site is in close proximity to a surface water feature (the sea) as the site is located on the Liverpool docks. The adopted Tier 1 Screening Values are listed in *Appendix E*.

6.2.2 Tier 1 Screening of Groundwater Laboratory Results

The results of the environmental testing can be referred to in *Appendix C*. The groundwater samples were collected from installations targeting the Tidal Flat Deposits.

With respect to the adopted thresholds detailed in *Section 6.2.1,* several exceedances are noted within the recovered groundwater samples as detailed below in *Table 6.2.2.*

Table 6.2.2 – *Groundwater Exceedances*

Determinand	Concentration (µg/l)				
	EQS (Saltwater)	EU DWS	CP01 (4.40m – 5.30m bgl)	CP05 (4.70m – 5.90m bgl)	CP06 (5.17m – 5.30m bgl)
Arsenic	**25**	10	-	***43***	15
Boron	**7000**	1000	-	1150	-
Chromium VI	**0.6**	50	**1**	**2**	**1**
Mercury	**0.07**	1	-	-	***1.6***

7.0 Engineering Assessment and Recommendations

7.1 Introduction

This section will discuss geo-hazards identified based on the ground and groundwater conditions encountered across the site and assess their associated risks for the proposed scope of the works. The proposed development plan is contained within *Appendix A*.

It must be noted that at the time of writing this report, the structural details and loadings have not been provided. As such, any changes in the development of designs beyond the issue of this Ground Investigation Report to the client, should be further investigated by the Construction Designer.

7.2 Summary of Ground Conditions

The ground conditions at the site generally comprised Made Ground, overlying granular Tidal flat deposits (Sand) and cohesive Tidal Flat deposits. The superficial deposits are underlain by a solid geology of sandstone of Wilmslow Sandstone Formation. Groundwater levels are generally considered to be deeper than 1.10m bgl.

The geotechnical parameters recommended for use in the design based on the ground conditions encountered are discussed in Section 5 and are summarised in *Table 7.2*.

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Table 7.2 – *Geotechnical Parameters*

Parameter	Value	Reference
Cohesive Tidal Flat Deposits		
Unit Weight, γ (kN/m^3)	19	Published Values (Barnes, 2000)
Undrained Shear Strength, Cu (kPa) (1)	0 < Depth (m) <9 $Cu = \frac{Depth\ (m)-(-5.3)}{0.19}$ 9 < Depth (m) <16 $Cu = \frac{Depth\ (m)-6.5}{0.03}$ 20 > Depth (m) > 16 $Cu\ (kPa) = 310\ kPa$	SPT N correlation with Plasticity Index (Stroud 1997), Multi Stage Triaxial Test
Angle of Shearing Resistance, ϕ' (°)	0 < Depth (m) <20 $Angle\ of\ Shearing\ Resistance = 30\ degrees$	Correlation with Plasticity Index (Gibson. 1953) Published values (Waltham, 2009)
Coefficient of volume compressibility, mv (m^2/MN)	*0<Depth (m) < 12* $Mv\ (m2/MN) = \frac{ln^{\frac{Depth\ (m)}{14.59}}}{-6.215}$ *20 >Depth (m) > 12* *Mv = 0.03 m2/MN*	SPT N correlation with Plasticity Index (Stroud 1997)
Drained Cohesion, c' (kPa)	0	Based on engineering judgment
Granular Tidal Flat Deposits		
Unit Weight, γ (kN/m^3)	16.5 – 18.5	Published Values (Barnes, 2001)
Angle of Shearing Resistance, ϕ' (°)	0 < Depth (m) <15 $\Phi' = \frac{Depth\ (m)+54}{2.0}$	Correlation with SPT 'N' (Tomlinson. 2000)
Drained Cohesion, c' (kPa)	0	Based on engineering judgment
Peat		
Unit Weight, γ (kN/m^3)	12	Published Values (Barnes, 2000) and based on engineering judgment
Undrained Shear Strength, Cu (kPa) (1)	0	Assumption based on SPT results and on engineering judgment
Coefficient of volume compressibility, mv (m^2/MN)	>1.5	Published Values (Tomlinson, 2000) and based on engineering judgment
Drained Cohesion, c' (kPa)	0	Based on engineering judgment
Bedrock		
Unit Weight, γ (kN/m3) Clay	22	Barnes, 2000
Angle of Shearing Resistance Φ (°)	10	Published Values (Waltham, 2009)
Unconfined Compressive Strength (MPa)	20	Published Values (Waltham, 2009)

(1) Cu estimated from SPT N value correlation with average Plasticity Index using a factor of 5.5 (Stroud and Butler, 1975) and published values.
(2) mv estimated from published values (Tomlinson, 2001).
(3) Estimated from the relationship between typical SPT 'N' Value and angle of shearing resistance (Peck et al, 1976)
(4) From published sources (BS8002 & Barnes 2000).

(5) From published sources (Waltham, 2009)
(6) Based on Engineering Judgement

7.3 Foundation Solution

The foundation solution is written according to the previous design of two travelling cranes on rails across the north and south of the site. However, this has since changed to two electric/diesel tracked cranes located in the north of the site with the ability to move within a 126m range east and west across the site. The results obtained and analysed can therefore be used for any future piling on the site.

Removal and replacement of the made ground and the underlying superficial deposits with a suitably compacted granular material is not considered a cost-effective solution, given the thickness of these strata.

Pile design with suitable embedment into the intact bedrock is considered to be the most suitable solution. It is recommended that to establish suitable pile design, specialist piling contractors are consulted. A piling risk assessment may be required.

7.4 Ground Floor Slabs

Following an assessment of the ground conditions, it is anticipated that due to presence of the thick layer of Made Ground of variable nature, intolerable total/differential settlement are likely. As such reinforced suspended ground floor slab are recommended to be adopted for the ground floor slabs. As piled foundations are anticipated, a suspended slab is recommended to bear on the pile caps by a network of beams which will minimise any differential settlement between the floor and the piled structure.

7.5 Chemical Attack on Buried Concrete

The site has been classified in accordance with BRE Special Digest 1 (Ref.7) and laboratory testing undertaken accordingly in *Section 6.0*. Based on the laboratory test results it is considered that a Design Sulphate Class may be taken as DS-1 with an ACEC class of AC-1 within Made Ground, a Design Sulphate Class of DS-2 with an ACEC class of AC-2 being appropriate for the Superficial deposits.

7.6 Excavation and Support

It is anticipated likely that excavations will be required during the construction phase.

Shallow excavations (<1.20m bgl deep) for the purposes of dig and replacement of surface materials are likely to be relatively stable, as such, in general it is not anticipated that ground support for short term excavations within these regions would be required. Local instability should be expected where greater proportions of degradable or unsuitable material are encountered. Attention should be given to

limiting the duration over which excavations remain exposed to water ingress as both the residual soils and bedrock deposits may undergo rapid loss of strength and possible heave if wetted excessively.

In accordance with Health and Safety Regulations, side support for safety purposes should be provided to all excavations which appear unstable and those more than 1.20m deep. Excavations shallower than 1.20m deep, requiring personnel access, will require closed side support.

Where slopes are required as a part of the temporary works, a specialist temporary works designer must be consulted to advise on suitable battering angles.

Excavation through layers of Made Ground and superficial deposits should be feasible using conventional site plant following breaking out of the initial concrete surface.

Based on the foundation solution and only shallow excavations likely to be required, significant volumes of groundwater are not likely to be encountered within these shallow excavations (<1.10m bgl), however likelihood of encountering perched groundwater cannot be discounted. It is considered that groundwater inflows, if encountered, may be controlled by pumping from sumps.

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8.0 Conclusions & Recommendations

8.1 Conclusions

8.1.1 Ground and Groundwater Contamination

The environmental chemistry soil results have been compared with the Generic Assessment Criteria (GAC) for soils with respect to human health against '*Commercial*' thresholds.

With respect to the proposed end-use of the site GAC thresholds have not been exceeded in the Made Ground or Natural soil samples taken from exploratory holes CP01-CP06 and WS01-WS05.

GAC thresholds have been exceed in the water samples taken from CP01, CP05 and CP06 relating to heavy metals (Arsenic, Boron, Chromium VI and Mercury). CP01 has one exceedance relating to EQS Saltwater. CP05 has three exceedances relating to EQS Saltwater and EU DWS and CP06 has three exceedances relating to EU DWS and EQS Saltwater.

8.1.2 Geotechnical Assessment

Due to the thickness of Made Ground (maximum thickness of 14.10m), the variability in strength of the underlying Tidal Flat deposits (GRAVEL, clayey gravelly SAND, sandy SILT, sandy gravelly CLAY, sandy CLAY sandy Cobbles and Sand and GRAVEL to a maximum depth 14.10m bgl) and the anticipated loads from the proposed development, it is considered that shallow spread foundations are unlikely to be a suitable solution for the proposed new travelling cranes. A piled foundation is considered as a suitable solution, in order to transfer the loads to the underlying competent solid geology. It is recommended that for the purposes of design, specialist piling contractors are consulted.

Due to thickness and variable nature of the Made Ground, intolerable ground movements are anticipated highly likely; as such suspended slabs are recommended to bear on the pile caps by a network of beams which will minimise the associated risks.

Based on the laboratory test results it is considered that a Design Sulphate Class of DS-1 and an ACEC class of AC-1 would be appropriate for the Made Ground with a design Sulphate Class of DS-2 with an ACEC class of AC-2 would be appropriate for the natural superficial deposits.

Consideration should be made to UXO if deep excavations or piling foundations are to be implemented.

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8.1.3 Recommendations

Based on the findings of the ground investigation, the following recommendations are made:

1) Relevant contractors should undertake their own UXO Risk Assessment in respect to their works;
2) Consideration should be made to UXO if deep excavations or piling foundations are to be implemented;
3) It is recommended that specialist piling contractors are to be consulted to establish suitable pile design.

9.0 References

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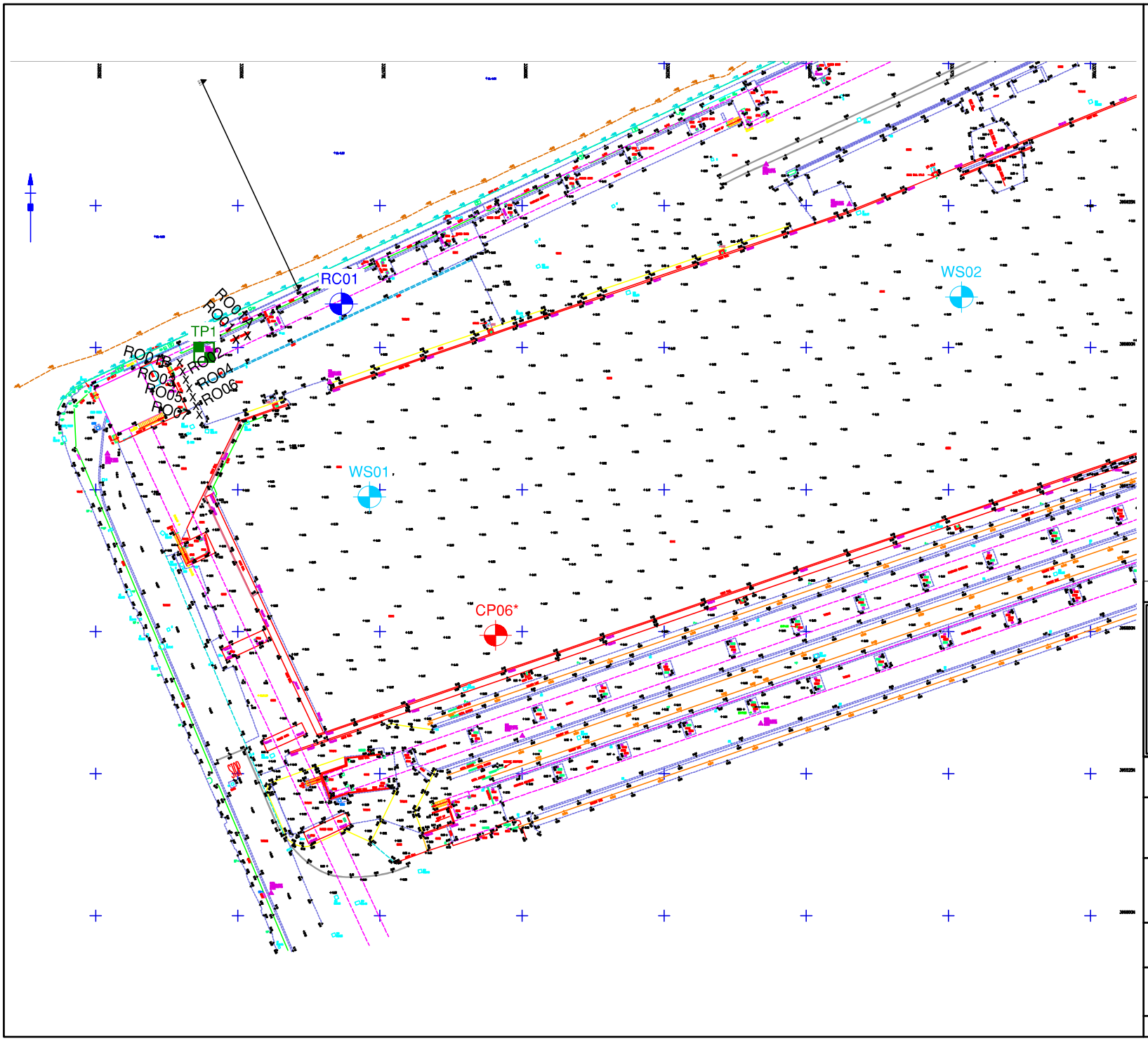
Appendix A Drawings

- Curtins (2019) Exploratory Hole Location Plan, EMR Gladstone Docks, Liverpool (drawing ref. 068331-CUR-00-XX-DR-GE-001-V01).
- Curtins (2019) Exploratory Hole Location Plan, EMR Gladstone Docks, Liverpool (drawing ref. 068331-CUR-00-XX-DR-GE-002-V01).
- Curtins (2019) Exploratory Hole Location Plan, EMR Gladstone Docks, Liverpool (drawing ref. 068331-CUR-00-XX-DR-GE-003-V01).
- Curtins (2019) Exploratory Hole Location Plan, EMR Gladstone Docks, Liverpool (drawing ref. 068331-CUR-00-XX-DR-GE-004-V01).
- Curtins (2019) Indicative Dock Wall Cross Section (drawing ref. 068331-CUR-00-XX-DR-GE-005-V01).
- Curtins (2019) Exploratory Hole Location Plan Index, EMR Gladstone Docks, Liverpool (drawing ref. 068331-CUR-00-XX-DR-GE-006-V01).



- Rotary Core borehole locations
- Cable Percussive borehole locations
- Window sample borehole locations
- Trial Pit locations
- X Rotary Open Hole borehole locations
- * Installed locations

Rev:	Description:	Date:	By:	Chkd:

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Project: EMR GLADSTONE DOCK, LIVERPOOL

Drg Title: EXPLORATORY HOLE LOCATION PLAN

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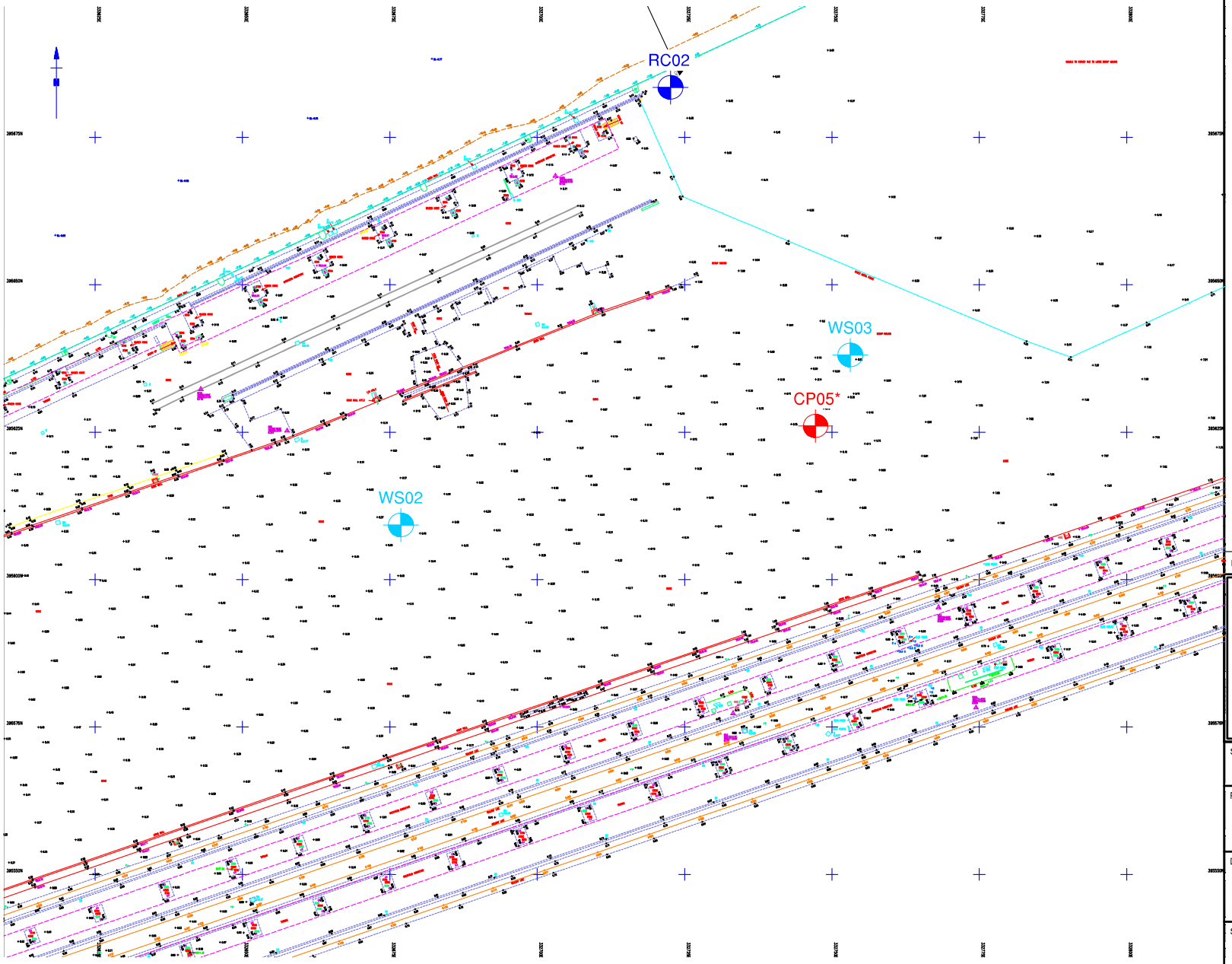

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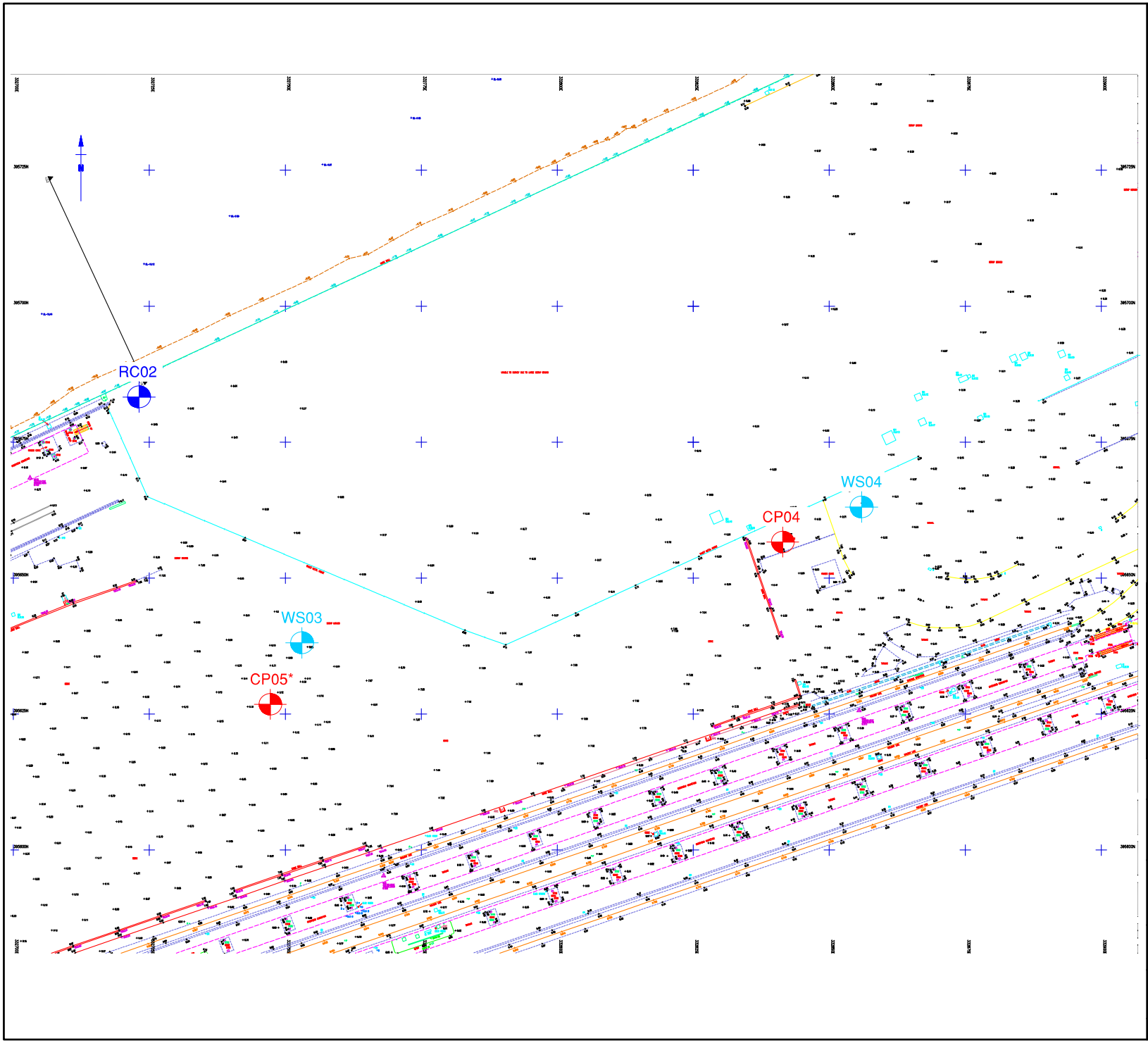

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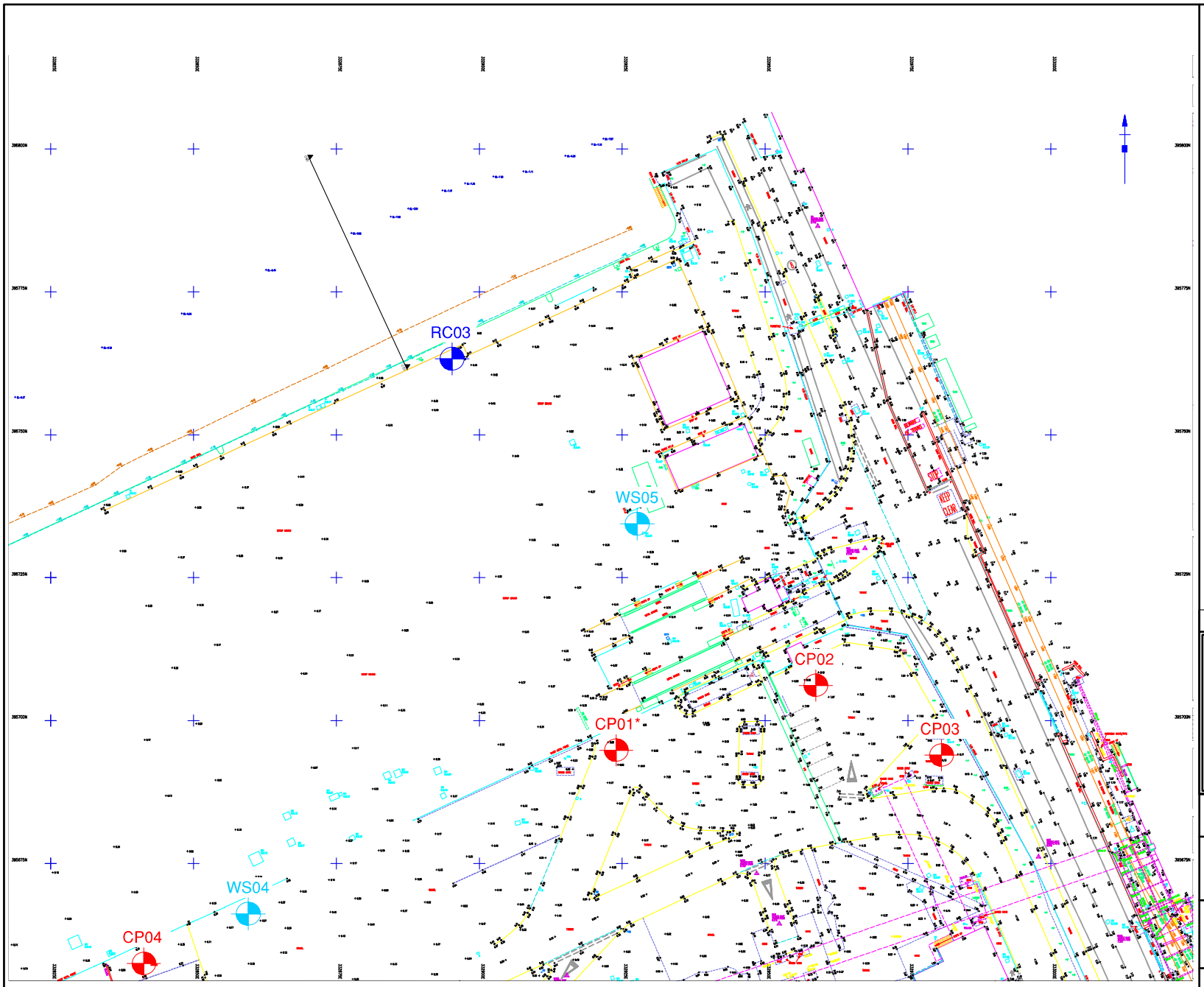

Rotary Core borehole locations

Cable Percussive borehole locations

Window sample borehole locations

Trial Pit locations

X Rotary Open Hole borehole locations

* Installed locations

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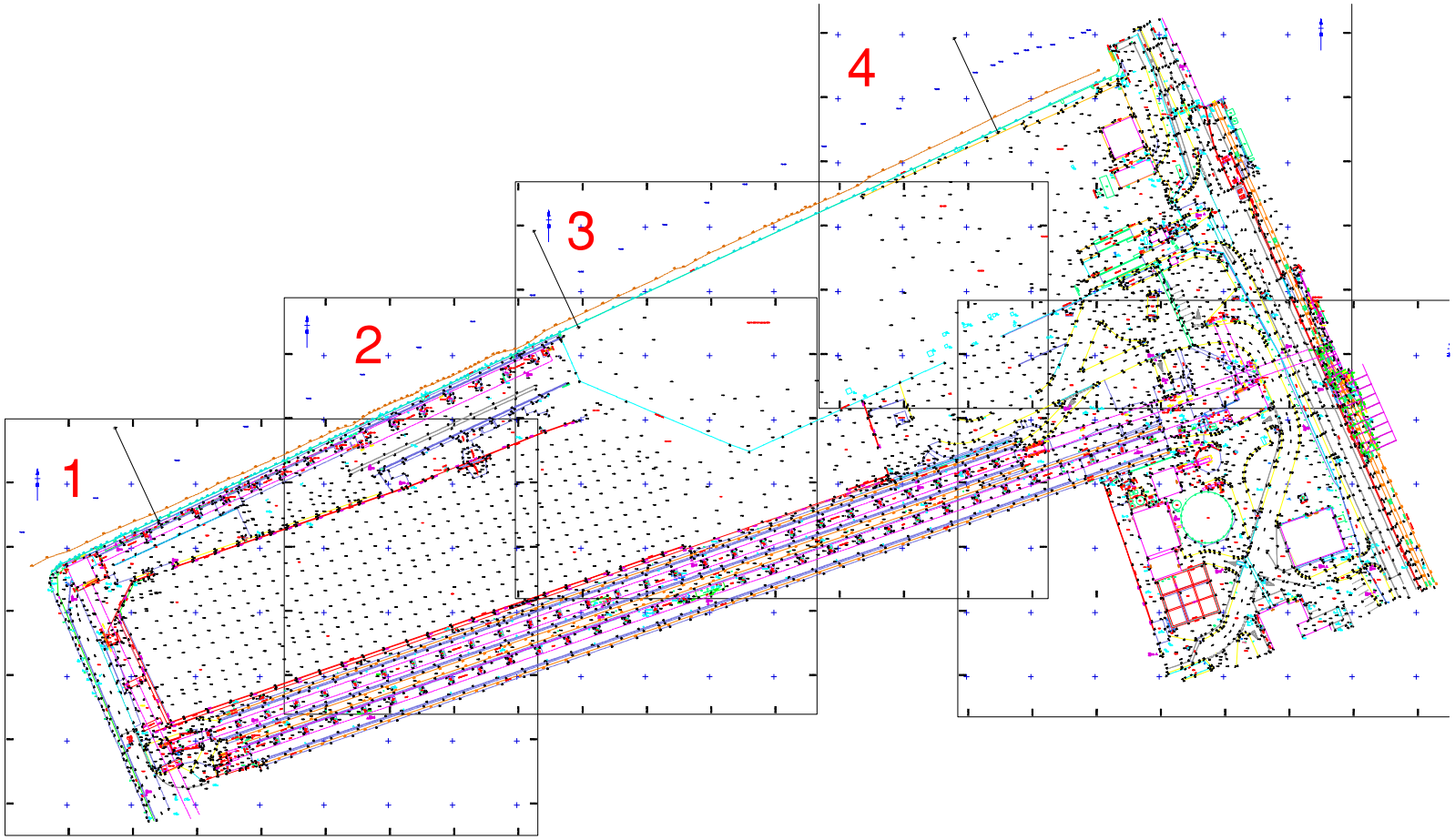

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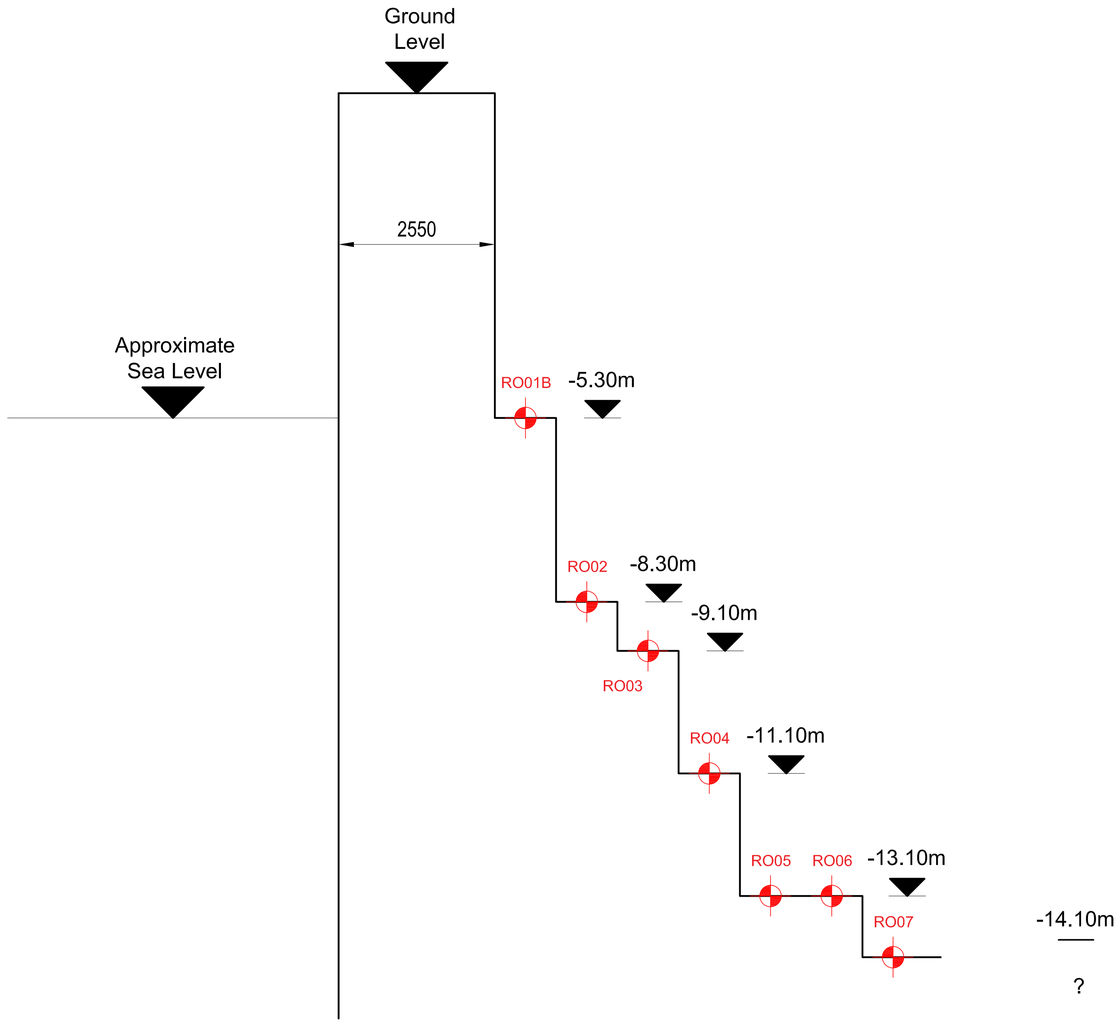

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
2. DO NOT SCALE THIS DRAWING. ALL DETAILS AND DIMENSIONS ARE TO BE CHECKED BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF CONSTRUCTION. ANY DISCREPANCIES TO BE REPORTED TO THE ENGINEER.
3. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
4. ALL LEVELS IN mAOD UNLESS SPECIFIED OTHERWISE..
5. EXISTING UTILITIES INFORMATION TO BE SUPPLIED BY OTHERS.
6. THE CONTRACTOR IS RESPONSIBLE FOR VERIFYING THE ACCURACY OF THE TOPOGRAPHICAL SURVEY AND UNDERTAKING ADDITIONAL SURVEYS FOR VALIDATION PURPOSES.
7. ALL WORKS TO BE AGREED PRIOR TO COMMENCING ON SITE.
8. FOR RETAINING WALL DETAILS REFER TO CURTINS STRUCTURES DRAWINGS.

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Project:
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Drg Title:
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DOCK WALL CROSS SECTION

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Appendix B Exploratory Hole Logs

- Rotary Core Logs
- Rotary Open Hole Logs
- Cable Percussive Logs
- Window Sample Logs
- Trial Pit Log

IAN FARMER ASSOCIATES

Plant used: Dando 2000	Project: Gladstone Dock		Location ID: **CP01**
Dates: 11/06/2019 - 12/06/2019	Client: Curtins Consulting		Sheet 1 of 2
Cable Percussion Borehole Log	Location:	Ground level:	Logged by: TB / Vertical scale: 1:50 / Project ID: 42334

Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Groundwater: Water Strike / Backfill/ Installation
				0.20	MADE GROUND: CONCRETE		
				(0.40)	MADE GROUND: Light brownish grey, angular and subangular, fine to coarse GRAVEL, including brick and granite.		
				0.60	MADE GROUND: Orangish brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is angular to subrounded, fine to coarse including brick, sandstone and quartzite.		
1.20		SPT(C) N=4 (1,1/1,1,1,1)		(1.10)			
1.20	ES1						
1.20 - 1.65	D2						
1.70	D3			1.70	POSSIBLE MADE GROUND: Very soft, dark greyish blue, slightly sandy SILT, with clay laminations.		
2.00		SPT(S) N=4 (1,0/2,1,0,1)					
2.00 - 2.45	D4			(1.10)			
2.50	D5						
				2.80	POSSIBLE MADE GROUND: Firm, brown, slightly sandy, slightly gravelly CLAY, with dark grey sandy bands. Gravel is subangular to rounded, fine to coarse including sandstone, mudstone and siltstone.		
3.00		SPT(S) N=7 (1,2/2,1,2,2)					
3.00 - 3.45	D6						
3.50	D7						
					Below 3.80m: occasional lenses of peat.		
4.00 - 4.45	U8	37 blows. 80% recovery		(2.40)			
4.60	D9						
5.00		SPT(S) N=22 (2,4/4,5,6,7)					
5.00 - 5.45	D10			5.20	POSSIBLE MADE GROUND: Dark brown, sandy, angular and subangular, fine to coarse GRAVEL, including brick and sandstone.		
5.40	D11				*At 5.40m: gravel of brick and sandstone in SPT split spoon.*		
6.00		SPT(S) N=6 (2,1/1,1,2,2)		(1.40)			
6.00 - 6.45	D12						
6.60	D14			6.60	Brown, slightly gravelly, slightly silty, fine to coarse SAND. Gravel is subangular and subrounded, fine to coarse including sandstone, siltstone and mudstone.		
6.60	ES13			(0.50)			
				7.10	Stiff, brown, sandy, gravelly CLAY, with low cobble content and occasional sand bands. Gravel is subangular and subrounded, fine to coarse including sandstone, siltstone and mudstone. Cobbles are subangular including granite.		
7.50 - 7.95	B15						
7.50 - 7.95	U	41 blows. No recovery					
9.00	B16						
9.00	D18						
9.00 - 9.45	B17						
9.00 - 9.45	U	46 blows. No recovery					
9.50		SPT(S) N=29 (3,4/4,7,9,9)					
9.50 - 9.95	D19						
10.00	D20				Continued next sheet		

Chiselling

From (m)	To (m)	Time (mins)	Remarks
16.00	16.50	60	Cobble.
18.20	18.60	60	

Borehole Diameter

Depth (m)	Dia (mm)
9.00	200
18.90	150

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
11/06	16:30	9.95	9.50	Dry
12/06	08:00	9.95	9.50	Dry
12/06	16:00	18.90	18.90	7.50

Remarks: Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter

Depth (m)	Dia (mm)
9.00	200
18.90	150

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
4.20	4.00		20	3.70	
5.20	4.50	7.10	20	4.00	
13.70	13.50		20	8.90	
17.40	17.40		20	6.90	

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	11.00	Plain	
11.00	16.00	Slotted	

Checked by:	JT	IFA CP v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Dando 2000	Project: Gladstone Dock		Location ID: **CP01**
Dates: 11/06/2019 - 12/06/2019	Client: Curtins Consulting		Sheet 2 of 2
Cable Percussion Borehole Log	Location:	Ground level: / Logged by: TB / Vertical scale: 1:50	Project ID: 42334

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
					Stiff, brown, sandy, gravelly CLAY, with low cobble content and occasional sand bands. Gravel is subangular and subrounded, fine to coarse including sandstone, siltstone and mudstone. Cobbles are subangular including granite.			
11.00 11.00 - 11.45	D21	SPT(S) N=30 (3,4/5,7,9,9)						
				(6.60)				
12.00	D22				*Below 12.00m: very stiff.*			
12.50 12.50 - 12.95	D23	SPT(S) N=40 (2,4/7,9,12,12)						
				13.70				
				(0.40)	Brownish grey, sandy, subangular to rounded, fine to coarse GRAVEL, including siltstone, quartzite and various igneous lithologies.			
14.00	D24			14.10				
14.50 - 14.95	U25	100 blows. 50% recovery			Stiff, brown, slightly gravelly, sandy CLAY. Gravel is subangular and subrounded, fine to coarse, including sandstone, siltstone and mudstone.			
15.00 15.00 - 15.50	D27 B26							
				(3.30)				
16.00		SPT(S) 50 (25 for 125mm/50 for 20mm)			*At 16.00m: SPT taken on cobble.*			
16.00 - 16.45	D28							
17.00	D29							
				17.40				
17.50		SPT(S) 50 (8,12/50 for 5mm)			Orangish brown SANDTSONE, recovered as slightly gravelly, fine to coarse sand. Gravel is angular, fine to coarse of sandstone.			
17.50 - 17.95	D30							
				(1.50)				
18.60		SPT(S) 50 (25 for 20mm/50 for 20mm)						
18.60 - 18.90	D31			18.90	End of Borehole at 18.90m			

Chiselling				Borehole Diameter		Boring Progress					Remarks:
From (m)	To (m)	Time (mins)	Remarks	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	
											SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA CP v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Dando 2000	Project: Gladstone Dock		Location ID: **CP02**
Dates: 10/06/2019 - 13/06/2019	Client: Curtins Consulting		Sheet 1 of 2
Cable Percussion Borehole Log	Location:	Ground level: / Logged by: BL / Vertical scale: 1:50	Project ID: 42334

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
				0.20	MADE GROUND: CONCRETE				
0.50	D2			(0.40)	MADE GROUND: Brown, gravelly, fine and medium SAND. Gravel is angular and subangular, fine to coarse including brick, concrete and sandstone.				
0.50 - 0.60	ES1			0.60					
				(0.30)	MADE GROUND: Firm, brown, slightly sandy CLAY.				
				0.90	MADE GROUND: Firm, light brown, sandy CLAY.		1		
1.20		SPT(S) N=12 (1,2/2,3,3,4)							
1.20 - 1.65	B3								
1.20 - 1.65	D4								
2.00		SPT(S) N=2 (1,1/1,0,0,1)		(2.10)			2		
2.00 - 2.45	B5								
3.00		SPT(S) N=5 (1,1/1,0,1,3)		3.00			3		
3.00 - 3.45	B6				Reddish brown, gravelly, medium SAND. Gravel is angular and subangular, coarse including sandstone. Driller noted sandstone cobbles.				
3.00 - 3.45	D7								
4.00		SPT(S) N=10 (2,2/2,2,3,3)					4		
4.00 - 4.45	B8								
4.00 - 4.45	D9								
				(3.30)					
5.00		SPT(S) N=24 (4,5/5,6,6,7)					5		
5.00 - 5.45	B10								
5.00 - 5.45	D11								
							6		
				6.30					
6.50		SPT(S) N=19 (3,3/4,4,5,6)			Soft, brown, sandy CLAY.				
6.50 - 6.95	D12								
					At 7.00m: firm		7		
8.00 - 8.45	U	30 blows. No recovery		(5.50)			8		
8.45	D13								
							9		
9.50 - 9.95	U14	39 blows. 100% recovery							
9.95	D15						10		
					Continued next sheet				

Chiselling

From (m)	To (m)	Time (mins)	Remarks
5.60	5.80	45	
13.70	14.00	90	
14.30	14.50	45	
15.20	15.40	45	
15.90	16.00	30	

Borehole Diameter

Depth (m)	Dia (mm)
10.50	200
16.01	150

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
10/06	16:30	8.00	7.80	4.00
11/06	08:00	8.00	7.80	4.00
11/06	16:30	10.50	10.50	6.00
12/06	08:00	10.50	10.50	5.50

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter

Depth (m)	Dia (mm)
10.50	200
16.01	150

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
6.30	6.30		20	4.00	

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA CP v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Dando 2000	Project: Gladstone Dock		Location ID: **CP02**
Dates: 10/06/2019 - 13/06/2019	Client: Curtins Consulting		Sheet 2 of 2
Cable Percussion Borehole Log	Location:	Ground level: / Logged by: BL / Vertical scale: 1:50	Project ID: 42334

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
					Soft, brown, sandy CLAY.			
10.50		SPT(S) N=21 (4,5/5,5,5,6)						
10.50 - 10.95	D16							
				11.80				
					Brown, silty, fine SAND.			
12.00		SPT(S) N=31 (6,7/7,7,8,9)						
12.00 - 12.45	D17							
				(1.20)				
13.00 - 13.10	D18			13.00				
					Firm, brown, sandy SILT.			
				(0.50)				
13.50		SPT(S) N=40 (7,10/10,10,20,0)		13.50				
13.50 - 13.95	D19				Stiff, brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular and subrounded, fine to coarse including sandstone and mudstone.			
14.00 - 14.30	B20				*At 14.00m: very stiff*			
				(1.50)				
15.00		SPT(S) 50 (6,7/50 for 245mm)		15.00				
15.00 - 15.45	D21				Red SANDSTONE, recovered as angular and subangular, coarse gravel.			
15.50 - 15.60	D22			(1.01)				
16.00		SPT(S) 50 (25 for 5mm/50 for 9mm)		16.01				
					End of Borehole at 16.01m			
16.00 - 16.01	D23							

Chiselling				Borehole Diameter	
From (m)	To (m)	Time (mins)	Remarks	Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
12/06	16:00	16.01	16.00	11.00

Remarks:

SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA CP v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Dando 2000	Project: Gladstone Dock		Location ID: **CP03**
Dates: 13/06/2019 - 17/06/2019	Client: Curtins Consulting		Sheet 1 of 2
Cable Percussion Borehole Log	Location:	Ground level:	Logged by: BL / Vertical scale: 1:50 / Project ID: 42334

Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
				0.02	MADE GROUND: TARMACADAM.			
0.50	ES1				MADE GROUND: Black, gravelly, clayey, fine to coarse SAND, with occasional pockets of soft, sandy clay. Gravel is angular and subangular, fine and medium including ash and brick.			
0.50 - 1.00	B2			(1.08)				
				1.10	MADE GROUND: Black, sandy COBBLES. Cobbles are rounded and subangular including sandstone.			
1.20		SPT(C) N=4 (1,1/1,1,1,1)						
1.20 - 3.50	B3							
2.00		SPT(C) N=2 (1,0/1,0,1,0)						
				(2.40)				
3.00		SPT(C) N=3 (1,0/0,1,1,1)						
				3.50	MADE GROUND: Brown, sandy, slightly silty, GRAVEL. Gravel is angular and subangular, fine to coarse including sandstone and brick.			
4.00		SPT(C) N=6 (1,1/2,1,1,2)		(0.80)				
4.00 - 4.45	D4			4.30	Firm, brown, slightly gravelly, sandy CLAY, with occasional shell fragments and bands of soft, brown, sandy silt. Gravel is angular and subangular, fine and medium including mudstone, sandstone			
5.00		SPT(C) N=9 (1,1/2,2,2,3)						
5.00	ES5							
5.00 - 5.45	D7							
5.00 - 5.50	B6							
6.00		SPT(C) N=11 (2,1/2,2,3,4)						
6.00 - 6.45	D8							
				(4.70)				
7.00	D9							
7.50 - 7.95	B11							
7.50 - 7.95	U10	72 blows. No recovery						
8.00	D12							
9.00		SPT(S) N=23 (2,4/4,3,7,9)		9.00	Stiff, dark brown, slightly sandy, slightly gravelly CLAY. Gravel is angular and subangular, fine and medium including sandstone and mudstone.			
9.00 - 9.45	D13							
9.50 - 10.00	B14							
					Continued next sheet			

Chiselling

From (m)	To (m)	Time (mins)	Remarks
16.40	16.70	45	
17.00	17.50	45	
17.50	17.80	60	

Borehole Diameter

Depth (m)	Dia (mm)
7.50	200
17.92	150

Casing Diameter

Depth (m)	Dia (mm)
7.50	200
17.92	150

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
13/06	16:30	6.45	6.00	5.70
14/06	08:00	6.45	6.00	Dry
14/06	16:30	9.45	9.00	Dry
17/06	08:00	9.45	9.00	Dry

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
1.20	1.00		20	0.50	
12.70	12.70		20	9.10	
17.00	17.00		20	11.40	

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA CP v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Dando 2000	Project: Gladstone Dock		Location ID: **CP03**
Dates: 13/06/2019 - 17/06/2019	Client: Curtins Consulting		Sheet 2 of 2
Cable Percussion Borehole Log	Location:	Ground level: / Logged by: BL / Vertical scale: 1:50	Project ID: 42334

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
10.20	D15				Stiff, dark brown, slightly sandy, slightly gravelly CLAY. Gravel is angular and subangular, fine and medium including sandstone and mudstone.			
10.50 - 10.95	U16	100 blows. 90% recovery						
11.00	D17							
12.00		SPT(S) N=12 (2,1/1,2,4,5)						
12.00 - 12.45	D18							
13.00	D19							
13.50		SPT(S) N=17 (2,1/4,4,4,5)		(8.00)				
13.50 - 13.95	D20							
14.50	D21							
15.00		SPT(S) N=26 (2,4/4,5,8,9)						
15.00 - 15.45	D23							
15.00 - 15.50	B22							
16.50 - 16.95	U24	100 blows. 70% recovery						
				17.00				
17.20		SPT(S) 50 (7,8/50 for 95mm)			Red SANDSTONE, recovered as gravelly, medium sand. Gravel is angular and subangular, medium and coarse.			
				(0.92)				
17.80		SPT(S) 50 (25 for 95mm/50 for 20mm)		17.92				
17.80 - 17.92	D25				End of Borehole at 17.92m			

Chiselling			
From (m)	To (m)	Time (mins)	Remarks

Borehole Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
17/06	16:30	17.92	17.80	12.10

Remarks:

SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA CP v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Dando 2000	Project: Gladstone Dock		Location ID: **CP04**
Dates: 13/06/2019 - 14/06/2019	Client: Curtins Consulting		Sheet 1 of 2
Cable Percussion Borehole Log	Location:	Ground level: / Logged by: TB / Vertical scale: 1:50	Project ID: 42334

Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
0.50 - 0.60	ES1			(1.10)	MADE GROUND: Grey, sandy GRAVEL, with medium cobble content. Gravel is angular and subangular, fine to coarse including sandstone, brick and concrete. Cobbles are angular including concrete and brick. Rare boulder size pieces of concrete.			
1.20		SPT(S) N=9 (1,1/2,2,2,3)		1.10				
1.20 - 1.65	B2				MADE GROUND: Firm, brown, sandy, gravelly CLAY. Gravel is angular to subrounded, fine to coarse including sandstone, siltstone, mudstone, brick and concrete.			
1.20 - 1.65	D3			(1.00)				
2.00		SPT(S) N=3 (1,0/1,0,1,1)		2.10				
2.00 - 2.45	D4				Grey, slightly gravelly, fine and medium SAND. Gravel is subangular and subrounded, fine to coarse including quartzite and sandstone.			
2.50 - 2.60	D5			(1.00)	*At 2.50m: with organic clay bands and amorphous peat.*			
3.00		SPT(S) N=5 (1,1/1,1,1,2)		3.10				
3.00 - 3.45	D6				Firm, brown, slightly sandy, slightly gravelly CLAY, with occasional fine and medium sand lenses. Gravel is subangular and subrounded, fine to coarse including sandstone, siltstone, mudstone.			
4.00		SPT(S) N=7 (1,1/1,2,2,2)						
4.00 - 4.45	D7			(2.50)				
5.00 - 5.45	U8	29 blows. 100% recovery						
5.65 - 5.75	D9			5.60	Soft, bluish grey, silty, organic CLAY, with occasional shell fragments.			
6.00 - 6.50	B10			(1.10)				
6.50		SPT(S) N=12 (1,2/2,3,3,4)		6.70				
6.50 - 6.95	D11				Grey, slightly silty, fine and medium SAND.			
7.50 - 7.70	D12			(1.10)				
8.00 - 8.45	U13	49 blows. 100% recovery		7.80	Firm, brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular and subrounded, fine to coarse including sandstone, siltstone and mudstone with occasional sand lenses.			
9.50		SPT(S) N=24 (4,4/5,6,6,7)			*Below 9.50m: stiff*			
9.50	ES14							
9.50 - 9.95	D15							
10.00	D16				Continued next sheet			

Chiselling

From (m)	To (m)	Time (mins)	Remarks
12.50	12.65	30	
15.95	16.50	50	
18.30	18.50	30	

Borehole Diameter

Depth (m)	Dia (mm)
10.00	200
18.76	150

Casing Diameter

Depth (m)	Dia (mm)
10.00	200
18.76	150

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
13/06	16:30	14.70	14.70	6.10
14/06	08:00	14.70	14.70	Dry

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
6.30	6.30	9.30	20	4.00	
14.00	13.80		20	6.30	
17.50	9.10		20	9.10	

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Checked by:	JT	IFA CP v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Dando 2000	Gladstone Dock	**CP04**
Dates:	**Client:**	Sheet 2 of 2
13/06/2019 - 14/06/2019	Curtins Consulting	

Cable Percussion Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
			TB	1:50	42334

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
					Firm, brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular and subrounded, fine to coarse including sandstone, siltstone and mudstone with occasional sand lenses.				
11.00 - 11.45	U17	53 blows. 100% recovery					11		
11.50 - 11.95	B18								
				(6.20)			12		
12.50		SPT(S) N=42 (6,7/8,10,12,12)			*At 12.50m: very stiff*				
12.50 - 12.95	D19								
12.50 - 12.95	D20						13		
14.00		SPT(S) N=20 (3,3/3,4,5,8)		14.00			14		
14.00 - 14.45	D21			(0.40)	Brown, slightly gravelly, medium to coarse SAND. Gravel is subangular and rounded, fine to coarse including sandstone, quartzite, shell and siltstone.				
				14.40	Very stiff, brown, slightly sandy, slightly gravely CLAY. Gravel is subangular and subrounded, fine to coarse including siltstone and mudstone.				
15.00 - 15.10	D22						15		
15.50		SPT(S) 50 (5,6/50 for 285mm)							
15.50 - 15.94	D23								
16.00 - 16.40	B24			(3.30)			16		
17.00		SPT(S) 50 (8,9/50 for 200mm)					17		
17.00 - 17.35	D25								
17.50 - 17.60	D26			17.70	Red SANDSTONE, recovered as gravelly, medium sand. Gravel is angular and subangular, medium and coarse.				
				(1.06)			18		
18.50		SPT(S) 50 (10,15/50 for 110mm)							
18.50 - 18.76	D27			18.76	End of Borehole at 18.76m				
							19		
							20		

Chiselling				Borehole Diameter		Boring Progress					Remarks:
From (m)	To (m)	Time (mins)	Remarks	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	
											SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA CP v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Dando 2000	Project: Gladstone Dock		Location ID: **CP05**
Dates: 20/06/2019 - 21/06/2019	Client: Curtins Consulting		Sheet 1 of 2
Cable Percussion Borehole Log	Location:	Ground level:	Logged by: JT / Vertical scale: 1:50 / Project ID: 42334

Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Groundwater: Water Strike / Backfill/ Installation
0.50	ES1			(0.80)	MADE GROUND: Soft, dark brown mottled dark grey, slightly sandy, slightly gravelly, slightly silty CLAY. Gravel is angular to subrounded, fine to coarse including brick, flint and mudstone.		
0.50 - 1.00	B2						
				0.80	POSSIBLE MADE GROUND: Firm, brown, slightly sandy, slightly gravelly CLAY. Gravel is angular to subrounded, fine and medium including sandstone, mudstone and quartzite. (Possible reworked material)		
1.20		SPT(C) N=8 (1,1/2,2,1,3)					1
1.20 - 1.65	D3			(1.10)			
1.50	ES4						
				1.90	Firm and stiff, brown, slightly sandy, slightly gravelly CLAY. Gravel is angular to subrounded, fine to coarse including various lithologies.		
2.00		SPT(S) N=10 (1,1/2,2,3,3)					2
2.00 - 2.45	D5						
2.50	D7						
2.50	ES8						
3.00		SPT(S) N=9 (2,1/2,2,2,3)					3
3.00 - 3.45	D9						
4.00 - 4.45	U10	100 blows. 100% recovery		(4.10)			4
5.00		SPT(S) 50 (9,14/50 for 95mm)					5
5.20 - 5.70	B11						
6.00		SPT(S) N=35 (2,4/7,9,9,10)		6.00	Dense, greyish brown mottled dark grey, slightly silty, fine and medium SAND.		6
6.00 - 6.45	D12			(0.60)			
				6.60	Loose, dark grey mottled greyish brown, slightly silty, fine and medium SAND.		
7.20	D13						7
				(1.40)			
7.50		SPT(S) N=8 (1,1/2,2,2,2)					
7.50 - 7.95	D14						
				8.00	Stiff, brown, slightly gravelly, sandy CLAY. Gravel is subangular and subrounded, fine to coarse including various lithologies.		8
9.00		SPT(S) N=32 (2,4/5,7,9,11)					9
9.00 - 9.45	D15						
9.80	D16						
					Continued next sheet		10

Chiselling

From (m)	To (m)	Time (mins)	Remarks
5.00	5.20	30	
13.70	14.00	45	
16.70	16.90	30	
18.10	18.30	60	

Borehole Diameter

Depth (m)	Dia (mm)
6.00	200
18.33	150

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
20/06	16:30	9.00	9.00	6.50
21/06	08:00	9.00	9.00	3.10
21/06	16:30	18.33	18.30	12.10

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter

Depth (m)	Dia (mm)
6.00	200
18.30	150

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
6.60	6.60		20	4.70	
14.50	14.50		20	13.00	
18.10	18.00		20	12.00	

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	11.00	Plain	
11.00	17.00	Slotted	

Checked by:	JT	IFA CP v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Dando 2000	Project: Gladstone Dock		Location ID: **CP05**
Dates: 20/06/2019 - 21/06/2019	Client: Curtins Consulting		Sheet 2 of 2
Cable Percussion Borehole Log	Location:	Ground level: / Logged by: JT / Vertical scale: 1:50	Project ID: 42334

Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
10.00 - 10.50	B17				Stiff, brown, slightly gravelly, sandy CLAY. Gravel is subangular and subrounded, fine to coarse including various lithologies.			
10.50		SPT(S) N=26 (3,3/4,5,8,9)						
10.50 - 10.95	D18							
12.00		SPT(S) N=46 (2,4/9,12,12,13)			*Below 12.00m: very stiff*			
12.00 - 12.45	D19							
12.50	D20							
13.50 - 13.95	U	100 blows. No recovery						
				(10.10)				
14.80	D21							
15.00		SPT(C) 36 (9,11/36 for 160mm)						
15.00 - 15.45	D23							
15.00 - 15.50	B22							
16.50		SPT(S) 50 (10,14/50 for 170mm)						
16.50 - 16.95	D24							
17.20	D25							
				18.10				
18.30		SPT(S) 50 (25 for 20mm/50 for 10mm)		18.33	Red SANDSTONE recovered as slightly silty, fIne and medium sand.			
18.30 - 18.33	D26				End of Borehole at 18.33m			

11 12 13 14 15 16 17 18 19 20

Chiselling

From (m)	To (m)	Time (mins)	Remarks

Borehole Diameter

Depth (m)	Dia (mm)

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)

Remarks:

SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter

Depth (m)	Dia (mm)

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA CP v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Dando 2000	Project: Gladstone Dock		Location ID: **CP06**
Dates: 18/06/2019 - 20/06/2019	Client: Curtins Consulting		Sheet 1 of 3
Cable Percussion Borehole Log	Location:	Ground level: / Logged by: BL / Vertical scale: 1:50	Project ID: 42334

Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Groundwater: Water Strike	Groundwater: Backfill/ Installation
				(0.30)	MADE GROUND: CONCRETE.			
				0.30	MADE GROUND: Grey, sandy GRAVEL. Gravel is angular and subangular, fine to coarse including brick and concrete.			
0.50	ES1							
0.50 - 1.00	B2			(0.80)				
				1.10				
1.20 - 1.65	U	35 blows. No recovery			Soft, brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular and subrounded, fine and medium including mudstone and sandstone.			
1.70	D3							
1.80	ES4							
2.00		SPT(S) N=9 (1,2/2,2,2,3)			*At 2.00m: firm.*			
2.00 - 2.45	D5							
				(2.90)				
3.00 - 3.45	U6	41 blows. 90% recovery						
4.00		SPT(S) N=8 (2,2/2,2,2,2)		4.00	Soft, dark blueish grey, very sandy, silty CLAY.			
4.00 - 4.45	D8							
4.00 - 4.50	B7							
5.00		SPT(S) N=9 (1,1/2,2,2,3)						
5.00 - 5.45	D9							
6.30		SPT(C) N=4 (1,1/1,1,1,1)						
6.30 - 6.75	D10			(5.00)				
7.20	D11							
7.50		SPT(S) N=9 (1,2/2,2,2,3)						
7.50 - 7.95	D12							
9.00		SPT(S) N=16 (1,2/3,4,4,5)		9.00	Stiff, greyish brown, slightly sandy, slightly gravelly CLAY. Gravel is subrounded and rounded, fine and medium including sandstone and mudstone.			
9.00 - 9.45	D13							
9.80	D14							

Continued next sheet

Chiselling

From (m)	To (m)	Time (mins)	Remarks
1.50	1.90	60	
12.40	12.70	45	
13.10	13.50	105	
17.20	17.50	30	
18.50	18.20	30	
19.30	19.50	30	
20.50	20.90	60	

Borehole Diameter

Depth (m)	Dia (mm)
6.00	200
18.00	150

Casing Diameter

Depth (m)	Dia (mm)
6.00	200
18.00	150

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
18/06	16:30	6.00	4.50	4.50
19/06	08:00	6.00	4.50	1.40
19/06	16:30	18.00	17.00	Dry
20/06	08:00	18.00	17.00	12.00

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
1.10	1.10	4.00	20	0.70	

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

Driller noted water seepages throughout borehole.

SPT Hammer: N/R, Energy Ratio: N/R

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	7.00	Plain	
7.00	15.00	Slotted	

Checked by: JT

Log status: DRAFT

IFA CP v01.01

IAN FARMER ASSOCIATES

Plant used: Dando 2000	Project: Gladstone Dock		Location ID: **CP06**
Dates: 18/06/2019 - 20/06/2019	Client: Curtins Consulting		Sheet 2 of 3
Cable Percussion Borehole Log	Location:	Ground level: / Logged by: BL / Vertical scale: 1:50	Project ID: 42334

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
10.00 - 10.50	B15				Stiff, greyish brown, slightly sandy, slightly gravelly CLAY. Gravel is subrounded and rounded, fine and medium including sandstone and mudstone.				
10.50		SPT(S) 51 (2,7/51 for 275mm)							
10.50 - 10.95	D16						11		
11.50	D17								
12.00 - 12.45	B18						12		
12.00 - 12.45	U	100 blows. No recovery							
12.50 - 12.95	U	100 blows. No recovery							
							13		
14.00		SPT(S) N=30 (3,4/6,7,8,9)					14		
14.00 - 14.45	D19								
14.60	D20								
15.00 - 15.45	U21	100 blows. 100% recovery		(11.00)			15		
							16		
17.00		SPT(S) 50 (2,4/50 for 75mm)					17		
17.00 - 17.23	D22								
17.20	D23								
17.50 - 18.00	B24								
18.00		SPT(C) 50 (2,4/50 for 170mm)					18		
18.00 - 18.45	D25								
							19		
19.50		SPT(C) 50 (9,10/50 for 170mm)							
19.50 - 19.95	D26								
19.80	D27			20.00	Continued next sheet		20		

Chiselling

From (m)	To (m)	Time (mins)	Remarks

Borehole Diameter

Depth (m)	Dia (mm)

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
20/06	16:30	21.00	20.90	11.40

Remarks:

SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter

Depth (m)	Dia (mm)

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA CP v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Dando 2000	Gladstone Dock	**CP06**
Dates:	**Client:**	Sheet 3 of 3
18/06/2019 - 20/06/2019	Curtins Consulting	

Cable Percussion Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
			BL	1:50	42334

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
20.40 - 20.90	B28			(1.00)	Red SANDSTONE, recovered as reddish brown, fine and medium sand.				
20.90		SPT(S) 50 (25 for 50mm/50 for 50mm)		21.00	End of Borehole at 21.00m		21		
20.90 - 21.00	D29								
							22		
							23		
							24		
							25		
							26		
							27		
							28		
							29		
							30		

Chiselling				Borehole Diameter		Boring Progress					Remarks:
From (m)	To (m)	Time (mins)	Remarks	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	
											SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA CP v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: Gladstone Dock		Location ID: **RC01**
Dates: 06/06/2019 - 07/06/2019	Client: Curtins Consulting		Sheet 1 of 3
Rotary Borehole Log	Location:	Ground level: / Logged by: / Vertical scale: 1:50	Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
					0.15	MADE GROUND: TARMACADAM. (Driller's description)				
0.15 - 1.30					(1.15)	MADE GROUND: Brownish grey, very strong CONCRETE. 60-70% aggregate of subangular to rounded, elongate, fine to coarse gravel including flint, quartzite and various igneous lithologies. 5% small and medium, rounded voids.		1		
					1.30	MADE GROUND: Brown SAND and GRAVEL. (Driller's description)		2		
					(11.60)			3 4 5 6 7 8 9		
						Continued next sheet		10		

Flush Details				Borehole Diameter	
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)
0.00	22.20	Air mist			

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
06/06	16:30	14.20	14.20	7.70
07/06	08:00	14.20	14.20	6.30
07/06	16:30	22.20	14.20	6.70

Remarks:
Service inspection pit hand excavated from GL to 1.20m.
Rotary openhole between 1.30m and 14.20m.
Rock parameters not applicable for concrete core,

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
1.30			20	1.00	
18.40	14.20		20	6.60	

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: Gladstone Dock		Location ID: **RC01**
Dates: 06/06/2019 - 07/06/2019	Client: Curtins Consulting		Sheet 2 of 3
Rotary Borehole Log	Location:	Ground level: / Logged by: / Vertical scale: 1:50	Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						MADE GROUND: Brown SAND and GRAVEL. (Driller's description)		11		
								12		
					12.90 (0.30) 13.20	MADE GROUND: Brown SAND and GRAVEL, with wood pieces. (Driller's description)		13		
					(1.00) 14.20	MADE GROUND: CONCRETE. (Driller's description)		14		
14.20 - 15.70		AZCL			(1.00) 15.20	Assumed Zone of Core Loss		15		
					15.30 15.40	MADE GROUND: TIMBER. MADE GROUND: Weak, red sandstone COBBLE.				
15.70 - 16.70		AZCL			(2.10)	MADE GROUND: Medium strong and strong, grey CONCRETE. 70-80% aggregate of subangular to rounded, irregular and elongate, fine to coarse gravel and cobbles, including mudstone, quartzite, flint, sandstone and various igneous lithologies. Cobbles are rounded including mudstone. 5% small to large, rounded and honeycombed voids. Some localisation of voids around aggregate. *Between 15.80m and 15.90m: 25-30% voids.* *Between 16.10m and 16.20m: 25-30% voids.*		16		
16.70 - 18.20		AZCL			17.50 (1.55)	MADE GROUND: Medium strong and strong, grey CONCRETE. 60-70% aggregate of subrounded and rounded, irregular, fine to coarse gravel with occasional cobbles including quartzite, flint, sandstone, mudstone and various igneous lithologies. <5% small, rounded voids. *Between 18.80m and 18.95m: recovered as rounded coarse gravel and rounded cobbles.*		17		
18.20 - 19.70		AZCL	19.10m - C1		19.05 (0.45) 19.50	MADE GROUND: Strong, grey CONCRETE. 20-30% aggregate of subrounded and rounded, irregular. fine to coarse gravel of various igneous lithologies. <5% small rounded voids. *Between 19.10m and 19.22m: black fiberous material (possible ACM).* MADE GROUND: Medium strong and strong, grey CONCRETE. 60-70% aggregate of subrounded and rounded, irregular, fine to		18 19		
		AZCL				Continued next sheet		20		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	therefore excluded

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: Gladstone Dock		Location ID: **RC01**
Dates: 06/06/2019 - 07/06/2019	Client: Curtins Consulting		Sheet 3 of 3
Rotary Borehole Log	Location:	Ground level: / Logged by: / Vertical scale: 1:50	Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.70 - 20.70					(1.55)	MADE GROUND: Medium strong and strong, grey CONCRETE. 60-70% aggregate of subrounded and rounded, irregular, fine to coarse gravel with occasional cobbles including quartzite, flint, sandstone, mudstone and various igneous lithologies. <5% small, rounded voids. *Between 20.25m and 20.70m: recovered as subangular and subrounded gravel and cobbles including various igneous lithologies and concrete.*				
20.70 - 22.20	77 57 10	AZCL 10			21.05 (1.15) 22.20	Weak, red mottled greenish grey SANDSTONE. Fractures are 0-10°, planar and undulating, rough and smooth, partially infilled with fine and medium silty sand. *Between 21.67m and 21.73m: recovered as very sandy, angular and subangular, fine to coarse gavel.* *Between 22.03m and 22.15m: recovered as very sandy, angular to subrounded, fine to coarse gravel.* End of Borehole at 22.20m				

21 22 23 24 25 26 27 28 29 30

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: Gladstone Dock		Location ID: **RC02**
Dates: 12/06/2019 - 14/06/2019	Client: Curtins Consulting		Sheet 1 of 3
Rotary Borehole Log	Location:	Ground level:	Logged by: JT/HD	Vertical scale: 1:50	Project ID: 42334

Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
0.00 - 1.50					(0.35) 0.35 (0.50) 0.85	MADE GROUND: Strong brownish grey mottled reddish orange CONCRETE. 25-30% aggregate of subangular, irregular, fine to coarse gravel including granite. <5% small and medium, rounded voids. *At 0.27m: 5mm diameter metal rebar.* MADE GROUND: Very strong, very dark grey mottled yellowish brown, CONCRETE. 70-80% aggregate of angular and subangular, elongate, fine to coarse gravel including limestone. <5% small to large, rounded voids. *At 0.41m: 10mm diameter metal rebar.*			
1.50 - 3.00		AZCL			(1.55) 2.40	MADE GROUND: Very strong, brownish grey CONCRETE. 60% aggregate of subangular and subrounded, irregular fine to coarse gravel including granite, limestone and various igneous lithologies. 5% small to large voids, with occasional honeycombing. *Between 1.10m and 1.20m: recovered as angular, fine to coarse gravel.* *Between 1.74m and 1.78m: <5% aggregate.* *Between 2.00m and 2.40m: 5-10% voids.*			
3.00 - 4.50		AZCL			(1.60) 4.00	MADE GROUND: Strong and very strong, brownish grey CONCRTE. 20-30% aggregate of subrounded and rounded, fine to coarse gravel including granite, limestone, siltstone and various igneous lithologies. <5% small and medium voids. *Between 2.57m and 2.61m: 80% aggregate.* *Between 2.88m and 2.93m: 90% aggregate.* *Between 3.20m and 3.30m: recovered as angular, fine to coarse gravel.* *Between 3.70m and 3.80m: 70% aggregate.*			
4.50 - 6.00					(3.10) 7.10	MADE GROUND: Strong, brownish grey CONCRETE. 60-70% aggregate of subrounded and rounded, fine to coarse gravel including granite, mudstone and various igneous lithologies. Low cobble content including subrounded and rounded brick, granite and basalt. 10-15% small to large voids, some honeycombing around clasts. *Between 4.14m and 4.20m: recovered as angular, medium and coarse gravel.* *Between 4.64m and 4.68m: recovered as angular, fine to coarse gravel.* *Between 6.00m and 7.10m: 5% voids.* *Between 6.40m and 6.50m: recovered as angular and subangular, medium and coarse gravel.* *Between 6.55m and 6.65m: 10% aggregate.*			
6.00 - 7.50		AZCL			(0.90) 8.00	MADE GROUND: Very strong, grey CONCRETE. 20-30% aggregate of subrounded and rounded, fine to coarse gravel including various igneous lithologies. <5% small voids. *Between 7.10m and 7.30m: granite cobble.*			
7.50 - 9.00					(1.95) 9.95	MADE GROUND: Strong and very strong, grey CONCRETE. 60-80% aggregate of subangular to rounded, elongate, fine to coarse including granite and various igneous lithologies. Low cobble content including subrounded granite. <5% small voids. *Between 8.85m and 8.90m: <10% aggregate.* *Between 9.75m and 9.90m: recovered as angular and subangular, fine to coarse gravel.*			
9.00 - 10.50						Continued next sheet			

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
24.00	0.00	Air mist	

Borehole Diameter

Depth (m)	Dia (mm)

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
12/06	16:30	1.50		
13/06	08:00	1.50		0.70
13/06	16:30	21.00		16.90
14/06	08:00	21.00		16.40

Remarks:
Service inspection pit hand excavated from GL to 1.20m.
Rock parameters not applicable for concrete core, therefore excluded

Casing Diameter

Depth (m)	Dia (mm)

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
21.20			20	9.90	

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by: JT
Log status: DRAFT

IFA RC v01.01

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: Gladstone Dock		Location ID: **RC02**
Dates: 12/06/2019 - 14/06/2019	Client: Curtins Consulting		Sheet 2 of 3
Rotary Borehole Log	Location:	Ground level: / Logged by: JT/HD / Vertical scale: 1:50	Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
					10.15	MADE GROUND: Very strong, grey CONCRETE. 10-20% aggregate of rounded, fine to coarse including various igneous lithologies. <5% small and medium voids.				
		AZCL				MADE GROUND: Very strong, grey CONCRETE. 80-90% aggregate of rounded, fine to coarse gravel including various igneous lithologies. Low cobble content including rounded, mixed igneous lithologies, <5% small to large voids, with occasional honeycombing around clasts.		11		
10.50 - 12.00					(1.85)	*Between 11.10m and 11.30m: recovered as subangular and subrounded, fine to coarse gravel and cobbles.*				
					12.00	MADE GROUND: Strong, grey CONCRETE. 50-60% aggregate of subrounded and rounded, fine to coarse gravel including granite, quartzite and various igneous lithologies. Low cobble content including subrounded granite. <5% small and medium voids, some honeycombing around clasts.		12		
12.00 - 13.50					(2.20)	*Between 12.13m and 12.30m: recovered as subrounded, fine to coarse gravel.* *Between 12.70m and 12.83m: <5% aggregate.* *Between 13.40m and 13.70m: sandstone boulder.* *Between 13.70m and 14.00m: recovered as subangular, fine to coarse gravel and cobbles.*		13		
13.50 - 15.00					14.20	MADE GORUND: Strong and very strong, grey CONCRETE. 70-80% aggregate of subrounded and rounded, fine to coarse gravel including granite, sandstone and mixed igneous lithologies. Low cobble content including subrounded granite and mixed igneous lithologies. <5% small voids.		14		
15.00 - 16.50					(2.10)	*Between 15.00m and 15.20m: recovered as subangular, fine to coarse gravel.* *Between 15.70m and 15.77m: <10% aggregate.* *Between 16.10m and 16.25m: recovered as subanguilar, coarse gravel.*		15		
		AZCL			16.30	MADE GROUND: Very strong, grey CONCRETE. <5% aggregate of subangular and subrounded, fine and medium gravel including mixed igneous lithologies. <5% small voids.		16		
					(0.60)					
16.50 - 18.00					16.90	MADE GROUND: Very strong, grey CONCRETE. 50-60% aggregate of subangular to rounded, fine to coarse gravel including granite, basalt and mixed igneous lithologies. <5% small and medium voids.		17		
					(1.60)	*Between 17.57m and 17.85m: sandstone boulder.* *Between 17.58m and 18.05m: chalk pumice.* *Between 18.05m to 18.17m: subangular brick cobble.* *Between 18.17m and 18.40m: aggregate composed of sandstone cobbles.*		18		
18.00 - 19.50					18.50	MADE GROUND: Strong, grey CONCTRETE. 70% aggregate of subrounded and rounded, fine to coarse gravel including siltstone, granite and various igneous lithologies. <5% small and medium voids.		19		
					(0.35)					
		AZCI			18.85	MADE GROUND: Very strong, grey CONCRETE. 50-60% aggregate of sounded and subrounded, fine to coarse gravel including siltstone, sandstone, granite and various igneous lithologies. Low subangular sandstone cobble content. <5% small voids. *Between 19.30m and 19.45m: 10-15% large honeycombed voids.*		20		
						Continued next sheet				

Flush Details				Borehole Diameter		Boring Progress				Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)
						14/06	16:30	24.00		6.40

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: Gladstone Dock		Location ID: **RC02**
Dates: 12/06/2019 - 14/06/2019	Client: Curtins Consulting		Sheet 3 of 3
Rotary Borehole Log	Location:	Ground level:	Logged by: JT/HD	Vertical scale: 1:50	Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.50 - 21.00					(2.40)	MADE GROUND: Very strong, grey CONCRETE. 50-60% aggregate of sounded and subrounded, fine to coarse gravel including siltstone, sandstone, granite and various igneous lithologies. Low subangular sandstone cobble content. <5% small voids. *Between 20.45m and 20.55m: recovered as subangular, coarse gravel.* *Between 20.75m and 21.00m: granite cobble.*		21		
21.00 - 22.50	53 15 0	AZCL			21.25 (0.35) 21.60 21.80	Very weak, orangish red mottled black, fine and medium SANDSTONE, recovered as fine and medium, very gravelly sand. *Between 21.25m and 21.80m: core interior is black.* Weak, grey, fine and medium SANDSTONE. Weak, brownish orange, fine and medium SANDSTONE.		22		
22.50 - 24.00	33 24 0	AZCL			(2.20)			23		
					24.00	End of Borehole at 24.00m		24		
								25		
								26		
								27		
								28		
								29		
								30		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project: Gladstone Dock		Location ID: **RC03**
Dates: 10/06/2019 - 12/06/2019	Client: Curtins Consulting		Sheet 1 of 3
Rotary Borehole Log	Location:	Ground level: / Logged by: SB / Vertical scale: 1:50	Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
0.00 - 1.50					(0.33) 0.33	MADE GROUND: Extremely strong, light grey CONCRETE. 50-60% aggregate of angular and irregular, fine to coarse gravel including granite, diorite and black possible slate or basalt. 5-10% crystalline, small and medium voids.		1		
					(1.17)	MADE GROUND: Strong, dark blueish grey MACADAM. 80-90% aggregate of angular, fine to coarse white quartzite gravel, 10-15% rough and crystalline, smell-medium voids. *At 1.20m: metal rebar.*				
1.50 - 3.00		AZCL			1.50 (1.98)	MADE GROUND: Strong, light grey CONCRETE. 45-55% aggregate, flaky, rounded, fine to coarse gravel with low cobble content. Gravel and cobbles includes granite, sandstone and mudstone. 20-25% rough, crystalline, small honeycomb voids.		2 3		
3.00 - 4.50		AZCL			3.48 (1.62)	MADE GROUND: Extremely strong, light grey CONCRETE. 65-75% aggregate of rounded, fine to coarse gravel with low cobble content. Gravel and cobbles includes granite and other igneous lithologies. 5-10% small rough voids. *Between 4.05m and 4.15m: concrete is absent of aggregate.*		4		
4.50 - 5.70					5.10 (1.40)	MADE GROUND: Extremely strong, light grey CONCRETE. 30-40% aggregate of irregular and rounded, fine to coarse gravel and low cobble content. Cobbles are flaky and rounded. Gravel and cobbles include granite, mudstone, sandstone and other igneous lithologies. 5-10% small and medium, rough voids.		5 6		
5.70 - 7.20					6.50 (5.90)	MADE GROUND: Strong, light grey CONCRETE. 45-55% aggregate of flaky and rounded, fine to coarse gravel with low cobble content. Gravel and cobbles includes granite, sandstone and other igneous lithologies. 5-10% small and medium, rough voids.		7 8		
7.20 - 8.70										
8.70 - 10.20		AZCL						9 10		

Continued next sheet

Flush Details				Borehole Diameter	
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)
0.00	22.20	Air mist			

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
10/06	16:30	10.20		Dry
11/06	08:00	10.20		6.70
11/06	16:30	22.20		14.90

Remarks:
Service inspection pit hand excavated from GL to 1.20m.
Rock parameters not applicable for concrete core, therefore excluded.

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
20.20			20	15.30	

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used:	Project: Gladstone Dock	Location ID: **RC03**
	Dates: 10/06/2019 - 12/06/2019	Client: Curtins Consulting	Sheet 2 of 3
Rotary Borehole Log	Location:	Ground level: / Logged by: SB / Vertical scale: 1:50	Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
10.20 - 11.70		AZCL			12.40 (0.30) 12.70	MADE GROUND: Strong, light grey CONCRETE. 45-55% aggregate of flaky and rounded, fine to coarse gravel with low cobble content. Gravel and cobbles includes granite, sandstone and other igneous lithologies. 5-10% small and medium, rough voids.		11		
11.70 - 13.20		AZCL				MADE GROUND: Extremely strong, light grey CONCRETE. 55-65% aggregate of rounded, fine to coarse gravel and low cobble content. Gravel and cobbles includes granite, sandstone and other igneous lithologies. 20-25% small and medium, rough voids.		12		
13.20 - 14.70					(3.00)	MADE GROUND: Extremely strong, light grey CONCRETE. 10-20% aggregate of rounded, fine to coarse gravel and low cobble content. Gravel includes granite and other igneous lithologies. Cobbles are irregular and rounded including sandstone, brick, dolerite and other igneous lithologies. 15-20% small to large, rough voids.		13		
14.70 - 16.20					15.70			14		
16.20 - 17.70		AZCL			(1.00) 16.70	MADE GROUND: Extremely strong, light grey CONCRETE. 20-30% aggregate of irregular and rounded, fine to coarse gravel. Gravel includes granite, mudstone, sandstone and other igneous lithologies. 10-15% small, rough voids.		15		
17.70 - 19.20					(2.50)	MADE GROUND: Extremely strong, light grey CONCRETE. 50-60% aggregate of flaky and rounded, fine to coarse gravel with low cobble content. Gravel and cobbles include granite, dolerite and other igneous lithologies.		16		
19.20 - 20.70		AZCL			19.20 (0.50) 19.70 (0.42)	Assumed zone of core loss.		17		
						MADE GROUND: Extremely strong, light grey CONCRETE. 10-20% aggregate of irregular and rounded, fine to coarse gravel.		18		
						Continued next sheet		19		
								20		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project: Gladstone Dock		Location ID: **RC03**
Dates: 10/06/2019 - 12/06/2019	Client: Curtins Consulting		Sheet 3 of 3
Rotary Borehole Log	Location:	Ground level:	Logged by: SB / Vertical scale: 1:50 / Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
					20.12 (0.58)	MADE GROUND: Extremely strong, light grey CONCRETE. 10-20% aggregate of irregular and rounded, fine to coarse gravel. Gravel includes granite, dolerite and other igneous lithologies. 15-20% small and rough, honeycombed voids.				
20.70 - 22.20	100 56 0	8 AZCL			20.70 (1.50) 22.20	MADE GROUND: Extremely strong, light grey CONCRETE. 60-70% aggregate of irregular and rounded, fine to coarse gravel with low cobble content. Gravel and cobbles include dolerite and other igneous lithologies. 15-20% small, honeycombed rough voids. Very weak, very thinly bedded, reddish brown mottled blueish grey, medium grained, fine and medium SANDSTONE. Fractures are close and medium spaced, stepped, smooth, very weak infill of reddish brown, slightly gravelly, silty, fine to coarse sand. Gravel is subangular to subrounded, fine and medium including sandstone. End of Borehole at 22.20m				

21 22 23 24 25 26 27 28 29 30

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

RC01 Core Photographs

RC01 Core Photographs

RC01 Core Photographs

RC02 Core Photographs

RC02 Core Photographs

RC02 Core Photographs

RC02 Core Photographs

RC02 Core Photographs

RC02 Core Photographs

RC02 Core Photographs

RC03 Core Photographs

RC03 Core Photographs

RC03 Core Photographs

RC03 Core Photographs

RC03 Core Photographs

RC03 Core Photographs

RC03 Core Photographs

RC03 Core Photographs

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: Gladstone Dock		Location ID: **RO01**
Dates: 14/06/2019	Client: Curtins Consulting		Sheet 1 of 1
Rotary Borehole Log	Location:	Ground level:	Logged by: NA / Vertical scale: 1:50 / Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
					0.20 (0.20)	MADE GROUND: TARMACADAM. (Driller's description)				
					0.40 (0.20)	MADE GROUND: CONCRETE. (Driller's description)				
						End of Borehole at 0.40m				

Flush Details				Borehole Diameter		Boring Progress				
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)

Remarks:
Exploratory hole location cleared of buried services.
Exploratory hole terminated at 0.40m due to metal rebar.

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: Gladstone Dock		Location ID: **RO01A**
Dates: 14/06/2019	Client: Curtins Consulting		Sheet 1 of 1
Rotary Borehole Log	Location:	Ground level:	Logged by: N/A / Vertical scale: 1:50 / Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
					0.20	MADE GROUND: TARMACADAM. (driller's description).				
					(1.20)	MADE GROUND: CONCRETE. (driller's description).		1		
					1.40	End of Borehole at 1.40m		2		
								3		
								4		
								5		
								6		
								7		
								8		
								9		
								10		

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
0.00	1.40	Air mist	

Borehole Diameter

Depth (m)	Dia (mm)

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
14/06	16:30	1.40		Dry

Remarks:
Exploratory hole location cleared of buried services.
Exploratory hole terminated at 1.40m due to rebar.

Casing Diameter

Depth (m)	Dia (mm)

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Commachio 205	Project: Gladstone Dock		Location ID: **RO01B**
Dates: 17/06/2019	Client: Curtins Consulting		Sheet 1 of 1
Rotary Borehole Log	Location:	Ground level:	Logged by: N/A / Vertical scale: 1:50 / Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
					0.20	MADE GROUND: TARMACADAM. (driller's description).				
					0.40 (0.30)	MADE GROUND: CONCRETE. (driller's description).				
					0.70	MADE GROUND: Brown SAND and GRAVEL. (driller's description).				
						MADE GROUND: Brown, sandy, clayey GRAVEL, with wood. (driller's description).		1		
					(3.70)			2		
								3		
								4		
					4.40	MADE GROUND: Dark brown, sandy, clayey GRAVEL. (driller's description).				
					(0.90)			5		
					5.30	MADE GROUND: CONCRETE. (driller's description)				
						End of Borehole at 5.30m		6		
								7		
								8		
								9		
								10		

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
0.00	5.30	Air mist	

Borehole Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
17/06	16:30	5.30		Dry

Remarks:
Exploratory hole location cleared of buried services.
Exploratory hole terminated at 5.30m due to concrete being encountered.

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
4.90			20	4.40	

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: Gladstone Dock		Location ID: **RO02**
Dates: 17/06/2019	Client: Curtins Consulting		Sheet 1 of 1
Rotary Borehole Log	Location:	Ground level:	Logged by: N/A / Vertical scale: 1:50 / Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
					0.20	MADE GROUND: TARMACADAM. (driller's description).				
					(0.40)	MADE GROUND: CONCRETE. (driller's description).				
					0.60	MADE GROUND: Brown, sandy, clayey GRAVEL with wood. (driller's description).				
					(7.70)					
					8.30	MADE GROUND: CONCRETE. (driller's description).				
						End of Borehole at 8.30m				

1 2 3 4 5 6 7 8 9 10

Flush Details				Borehole Diameter		Boring Progress				
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)
0.00	8.30	Air mist				17/06	16:30	8.30		4.90

Remarks:
Exploratory hole location cleared of buried services.
Exploratory hole terminated at 8.30m due to concrete being encountered.

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)
		8.30			20	7.10					

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: Gladstone Dock		Location ID: **RO03**
Dates: 17/06/2019	Client: Curtins Consulting		Sheet 1 of 1
Rotary Borehole Log	Location:	Ground level:	Logged by: N/A / Vertical scale: 1:50 / Project ID: 42334

Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend
					0.20	MADE GROUND: TARMACADAM. (driller's description).	
					0.40	MADE GORUND: CONCRETE. (driller's description).	
						MADE GROUND: Brown, sandy, clayey GRAVEL with wood. (driller's description).	
					(8.70)		
					9.10	MADE GROUND: CONCRETE. (driller's description)	
						End of Borehole at 9.10m	

Groundwater: Water Strike; Backfill/Installation

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
0.00	9.10	Air mist	

Borehole Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
17/06	16:30	9.10		4.80

Remarks:
Exploratory hole location cleared of buried services.
Exploratory hole terminated at 9.10m due to concrete being encountered.

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
9.10			20	8.40	

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: Gladstone Dock		Location ID: **RO04**
Dates: 17/06/2019	Client: Curtins Consulting		Sheet 1 of 2
Rotary Borehole Log	Location:	Ground level:	Logged by: N/A / Vertical scale: 1:50 / Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
					0.20	MADE GROUND: TARMACADAM. (driller's description).				
					0.40	MADE GROUND: CONCRETE. (driller's description).				
						MADE GROUND: Brown, sandy, clayey GRAVEL with wood. (driller's description).				
					(10.70)					
						Continued next sheet				

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	Exploratory hole location cleared of buried services. Exploratory hole terminated at 11.10m due to concrete being encountered.
11.10	0.00	Air mist				17/06	16:30	11.10		4.70	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)
		10.90			20	7.80					

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: Gladstone Dock		Location ID: **RO04**
Dates: 17/06/2019	Client: Curtins Consulting		Sheet 2 of 2
Rotary Borehole Log	Location:	Ground level:	Logged by: N/A / Vertical scale: 1:50 / Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						MADE GROUND: Brown, sandy, clayey GRAVEL with wood. (driller's description).		11		
					11.10	MADE GORUND: CONCRETE. (driller's description)				
						End of Borehole at 11.10m		12		
								13		
								14		
								15		
								16		
								17		
								18		
								19		
								20		

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %

Borehole Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)

Remarks:

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: Gladstone Dock		Location ID: **RO05**
Dates: 18/06/2019	Client: Curtins Consulting		Sheet 1 of 2
Rotary Borehole Log	Location:	Ground level:	Logged by: N/A / Vertical scale: 1:50 / Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
					0.20	MADE GROUND: TARMACADAM. (driller's description).				
					(1.40)	MADE GROUND: CONCRETE. (driller's description).		1		
					1.60	MADE GROUND: Brown, sandy, clayey GRAVEL. (driller's description).		2		
								3		
								4		
								5		
					(11.50)			6		
								7		
								8		
								9		
						Continued next sheet		10		

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %

Borehole Diameter

Depth (m)	Dia (mm)

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
17/06	16:30	0.50		Dry
18/06	08:00	0.50		Dry
18/06	16:30	13.10		3.90

Remarks:
Exploratory hole location cleared of buried services.
Exploratory hole terminated at 13.10m due to concrete being encountered.

Casing Diameter

Depth (m)	Dia (mm)

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
12.70			20	4.80	

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: Gladstone Dock		Location ID: **RO05**
Dates: 18/06/2019	Client: Curtins Consulting		Sheet 2 of 2
Rotary Borehole Log	Location:	Ground level:	Logged by: N/A / Vertical scale: 1:50 / Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						MADE GROUND: Brown, sandy, clayey GRAVEL. (driller's description).		11		
								12		
					13.10	MADE GROUND: CONCRETE. (driller's description)		13		
						End of Borehole at 13.10m		14		
								15		
								16		
								17		
								18		
								19		
								20		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: Gladstone Dock		Location ID: **RO06**
Dates: 18/06/2019	Client: Curtins Consulting		Sheet 1 of 2
Rotary Borehole Log	Location:	Ground level:	Logged by: N/A / Vertical scale: 1:50 / Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
					0.20	MADE GROUND: TARMACADAM. (driller's description).				
					(0.50)	MADE GROUND: CONCRETE. (driller's description).				
					0.70	MADE GROUND: Brown, sandy, clayey GRAVEL with wood. (driller's description).				
					(12.40)					
						Continued next sheet				

Flush Details				Borehole Diameter	
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)
0.00	13.10	Air mist			

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
18/06	16:30	13.10		4.10

Remarks:
Exploratory hole location cleared of buried services.
Exploratory hole terminated at 13.10m due to concrete being encountered.

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
12.70			20	4.30	

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: Gladstone Dock		Location ID: **RO06**
Dates: 18/06/2019	Client: Curtins Consulting		Sheet 2 of 2
Rotary Borehole Log	Location:	Ground level:	Logged by: N/A / Vertical scale: 1:50 / Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						MADE GROUND: Brown, sandy, clayey GRAVEL with wood. (driller's description).		11		
								12		
					13.10	MADE GROUND: CONCRETE. (driller's description)		13		
						End of Borehole at 13.10m		14		
								15		
								16		
								17		
								18		
								19		
								20		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: Gladstone Dock		Location ID: **RO07**
Dates: 18/06/2019	Client: Curtins Consulting		Sheet 1 of 2
Rotary Borehole Log	Location:	Ground level:	Logged by: N/A / Vertical scale: 1:50 / Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
					0.20	MADE GROUND: TARMACADAM. (driller's description)				
					0.40	MADE GROUND: CONCRETE. (driller's description)				
						MADE GROUND: Brown, sandy, clayey GRAVEL with wood. (driller's description)				
					(13.70)					
						Continued next sheet				

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
0.00	14.10	Air mist	

Borehole Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
18/06	16:30	14.10		4.40

Remarks:
Exploratory hole location cleared of buried services.
Exploratory hole terminated at 14.10m due to concrete being encountered.

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
13.80			20	4.60	Fast

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: Gladstone Dock		Location ID: **RO07**
Dates: 18/06/2019	Client: Curtins Consulting		Sheet 2 of 2
Rotary Borehole Log	Location:	Ground level:	Logged by: N/A / Vertical scale: 1:50 / Project ID: 42334

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						MADE GROUND: Brown, sandy, clayey GRAVEL with wood. (driller's description)		11		
								12		
								13		
								14		
					14.10	MADE GROUND: CONCRETE. (driller's description)				
						End of Borehole at 14.10m		15		
								16		
								17		
								18		
								19		
								20		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: 20T tracked excavator	Project: Gladstone Dock		Location ID: **TP01**
Dates: 13/06/2019	Client: Curtins Consulting		Sheet 1 of 1
Trial Pit Log	Location:	Ground level:	Logged by: BL / Vertical scale: 1:25 / Contract ID: 42334

Samples & In Situ Testing			Strata Details						
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation
				0.10 (0.50)	MADE GROUND: TARMACADAM MADE GROUND: CONCRETE.				
				0.60 (0.60)	MADE GROUND: Brown, gravelly SAND. Gravel is angular and subangular, fine to coarse including sandstone, brick and concrete.		1		
2.00	ES1			1.20 (2.05)	MADE GROUND: Firm, brown, sandy, slightly gravelly CLAY. Gravel is angular and subangular, fine to coarse including brick, sandstone and concrete.		2		
				3.25	End of Trial Pit at 3.25m		3	▼	
							4		
							5		

Termination:

Stability:
Trial pit remains stable during excavation.

Remarks:
Service inspection pit hand excavated from GL to 0.46m.
Groundwater encountered at 3.25m.
Please refer to sketch for further details.

Dimensions (Length m x Width m):
2.00 x 3.00

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks
3.25	0	0.00	

Checked by:	JT	IFA TP v01.01
Status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project: Gladstone Dock		Location ID: **WS01**
Dates: 10/06/2019	Client: Curtins Consulting		Sheet 1 of 1
Dynamic Sample Borehole Log	Location:	Ground level:	Logged by: TB / Vertical scale: 1:50 / Project ID: 42334

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
0.30 0.30 0.65	D2 ES1	SPT(C) 50 (25 for 30mm/50 for 40mm)		0.21 (0.39) 0.60 0.71	MADE GROUND: CONCRETE. MADE GROUND: Brown, very gravelly, fine to coarse SAND. Gravel is angular to subrounded, fine to coarse including concrete, sandstone, quartzite and brick. MADE GROUND: CONCRETE End of Borehole at 0.71m		1 2 3 4 5 6 7 8 9 10		

Dynamic Sample Recovery

Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks

Remarks:
Service inspection pit hand excavated from GL to 0.71m.
Terminated at 0.71m after SPT refusal in concrete.

SPT Hammer: N/R, Energy Ratio: N/R

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA DS v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project: Gladstone Dock		Location ID: **WS02**
Dates: 10/06/2019	Client: Curtins Consulting		Sheet 1 of 1
Dynamic Sample Borehole Log	Location:	Ground level:	Logged by: TB / Vertical scale: 1:50 / Project ID: 42334

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
0.60		SPT(C) 50 (25 for 75mm/50 for 75mm)		(0.75)	MADE GROUND: CONCRETE.				
				0.75	End of Borehole at 0.75m				

1 2 3 4 5 6 7 8 9 10

Dynamic Sample Recovery

Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks

Remarks:
Service inspection pit hand excavated from GL to 0.75m.
Terminated at 0.75m after SPT refusal in concrete.

SPT Hammer: N/R, Energy Ratio: N/R

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA DS v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project: Gladstone Dock		Location ID: **WS03**
Dates: 10/06/2019	Client: Curtins Consulting		Sheet 1 of 1
Dynamic Sample Borehole Log	Location:	Ground level:	Logged by: TB / Vertical scale: 1:50 / Project ID: 42334

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
				0.20	MADE GROUND: CONCRETE.				
				(0.40)	MADE GROUND: Grey, sandy GRAVEL, with low cobble content. Gravel is angular to subrounded, fine to coarse including brick, concrete and limestone. Cobbles are angular including brick.				
0.50		SPT(C) N=27 (12,10/8,7,6,6)		0.60					
0.50	D1				MADE GROUND: Firm, light orangish brown, slightly gravelly, sandy CLAY, with occasional bands of fine to coarse sand. Gravel is subangular and subrounded, fine to coarse including sandstone, siltstone and slate.		1		
0.80	ES2								
1.20		SPT(S) N=6 (1,1/1,2,1,2)		(1.20)					
1.20	D3								
1.50	D4								
				1.80					
2.00		SPT(S) N=9 (2,1/2,2,2,3)			Firm, brown mottled grey, slightly sand, slightly gravelly CLAY. Gravel is subangular and subrounded, fine to coarse including sandstone, siltstone, mudstone and quartzite.		2		
2.00	D5								
2.50	D6								
3.00		SPT(S) N=9 (2,2/2,2,2,3)					3		
3.00	D7								
3.50	D8			(3.65)					
4.00		SPT(S) N=13 (3,3/3,3,3,4)					4		
4.00	D9								
4.50	D10								
5.00		SPT(S) N=17 (4,4/4,4,4,5)					5		
5.00	D11								
				5.45	End of Borehole at 5.45m				
							6		
							7		
							8		
							9		
							10		

Dynamic Sample Recovery

Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks
1.20	2.00		80	
2.00	3.00		90	
3.00	4.00		90	
4.00	5.00		80	

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA DS v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project: Gladstone Dock		Location ID: **WS04**
Dates: 10/06/2019	Client: Curtins Consulting		Sheet 1 of 1
Dynamic Sample Borehole Log	Location:	Ground level:	Logged by: TB / Vertical scale: 1:50 / Project ID: 42334

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
0.25	D1			(0.50)	MADE GROUND: CONCRETE *Between 0.22m and 0.30m: layer of light brown, gravelly, fine to coarse sand. Gravel is subangular and subrounded, fine to coarse including brick.* *At 0.30m: SPT refusal on concrete, continue to break out.*				
0.25	ES2								
0.30		SPT(C) 50 (25 for 75mm/50 for 135mm)		0.50					
				(0.40)					
0.80	D3				MADE GROUND: Red, gravelly, fine to coarse SAND, with low cobble content. Gravel is angular to subrounded, fine to coarse including sandstone. Cobbles are angular including sandstone.				
0.80	ES4			0.90			1		
1.20		SPT(S) N=4 (1,0/1,1,1,1)			Soft, brown with dark brown mottling, slightly sandy, slightly gravelly CLAY. Gravel is subangular and subrounded, fine to coarse including sandstone, siltstone, mudstone and coal.				
1.20	D5			(1.00)					
1.50	D6								
					Between 1.70 - 1.75m: grey blue, sandy CLAY with occasional peat lenses.				
1.90	D7			1.90					
2.00		SPT(S) N=0 (0,0/0,0,0,0)		(0.30)	Dark brown, sandy pseudofibrous PEAT.		2		
2.00	D8			2.20	*Between 2.00m and 2.10m: soft, brown, slightly sandy, slightly gravelly clay. Gravel is subangular and subrounded, fine to coarse including sandstone, siltstone and mudstone.*				
2.15	D9			(0.30)					
2.30	D10			2.50	Brown, slightly silty, fine to coarse SAND.				
2.60	D11			2.70	Dark brown, sandy, slightly silty, amorphous PEAT.				
2.90	D12				Firm, brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular and subrounded, fine to coarse including sandstone, siltstone and mudstone.				
3.00		SPT(S) N=4 (1,1/1,1,1,1)			*Between 2.80 - 2.83m: pseudofibrous peat.*		3		
3.00	D13								
4.00		SPT(S) N=7 (1,1/2,1,2,2)					4		
4.30	D14			(3.20)					
					Between 4.60m and 4.80m: grey, organic, fine to course sand with woody material. *At 4.80m: becomes gravelly.*				
5.00		SPT(S) N=7 (2,1/1,2,2,2)					5		
5.00	D15								
5.00 - 6.00	D16								
				5.90					
6.00		SPT(S) N=26 (2,2/5,7,6,8)		(0.40)	Greyish brown, fine to coarse SAND.		6		
				6.30					
				6.50	Firm, brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse including sandstone, siltstone and mudstone.				
6.80	D17				Light brown and grey, fine to coarse SAND.				
7.00		SPT(S) N=14 (2,3/3,3,4,4)		(0.95)			7		
				7.45	End of Borehole at 7.45m				
							8		
							9		
							10		

Dynamic Sample Recovery

Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks
1.20	2.00		80	
2.00	3.00		90	
3.00	4.00		5	

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
3.50			20	3.50	

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA DS v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project: Gladstone Dock		Location ID: **WS05**
Dates: 10/06/2019	Client: Curtins Consulting		Sheet 1 of 1
Dynamic Sample Borehole Log	Location:	Ground level:	Logged by: TB / Vertical scale: 1:50 / Project ID: 42334

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
0.25 0.40	ES1	SPT(C) 32 (25 for 90mm/32 for 150mm)		0.24 0.33 (0.31) 0.64	MADE GROUND: CONCRETE. MADE GROUND: Light, sandy GRAVEL. Gravel is angular and subangular, fine to coarse including sandstone, flint and limestone. MADE GROUND: CONCRETE. *Between 0.34m and 0.40m: void in concrete.* End of Borehole at 0.54m		1 2 3 4 5 6 7 8 9 10		

Dynamic Sample Recovery

Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks

Remarks:
Service inspection pit hand excavated from GL to 0.40m.
SPT terminated at 0.64m due to deviation of SPT rods in concrete. Borehole terminated.

SPT Hammer: N/R, Energy Ratio: N/R

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	JT	IFA DS v01.01
Log status:	DRAFT	

Appendix C Chemical Laboratory Testing Results

- Envirolab, Environmental Chemistry Analysis Results:
  - Soil – Certificate No. 19/05767-1
  - Soil – Certificate No. 19/05907-1
  - Soil – Certificate No. 19/06020-1
  - Water – Certificate No. 19/08697-1

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 19/05767
Issue Number: 1 **Date:** 21 June, 2019

Client:
Curtins Consulting
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: Amber Hatch-Walling
Project Name: Gladstone Dock, Liverpool
Project Ref: B068331.300
Order No: EBMA1912
Date Samples Received: 11/06/19
Date Instructions Received: 17/06/19
Date Analysis Completed: 21/06/19

Prepared by:

Melanie Marshall
Laboratory Coordinator

Approved by:

Georgia King
Admin & Client Services Supervisor

Envirolab Job Number: 19/05767

Client Project Name: Gladstone Dock, Liverpool

Client Project Ref: B068331.300

Lab Sample ID	19/05767/1	19/05767/2	19/05767/3	19/05767/5				Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS01	WS03	WS05	WS04						
Depth to Top	0.30	0.80	0.25	0.80						
Depth To Bottom										
Date Sampled	10-Jun-19	10-Jun-19	10-Jun-19	10-Jun-19						
Sample Type	Soil	Soil	Soil	Soil						
Sample Matrix Code	4AB	5A	4AB	4AB						
% Stones >10mm$_A$	22.8	6.8	48.8	7.7				% w/w	0.1	A-T-044
pH$_D$[M#]	11.88	9.12	10.96	8.88				pH	0.01	A-T-031s
Sulphate (water sol 2:1)$_D$[M#]	0.22	0.11	0.06	0.03				g/l	0.01	A-T-026s
Cyanide (total)$_A$[M#]	<1	<1	<1	<1				mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2	<0.2	<0.2				mg/kg	0.2	A-T-050s
Organic matter$_D$[M#]	2.2	0.3	0.2	0.3				% w/w	0.1	A-T-032 OM
Arsenic$_D$[M#]	6	<1	1	<1				mg/kg	1	A-T-024s
Boron (water soluble)$_D$[M#]	1.9	<1.0	<1.0	<1.0				mg/kg	1	A-T-027s
Cadmium$_D$[M#]	1.2	1.6	0.7	1.0				mg/kg	0.5	A-T-024s
Copper$_D$[M#]	25	10	10	7				mg/kg	1	A-T-024s
Chromium$_D$[M#]	21	21	8	10				mg/kg	1	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1	<1				mg/kg	1	A-T-040s
Lead$_D$[M#]	42	6	8	8				mg/kg	1	A-T-024s
Mercury$_D$	0.29	<0.17	0.18	<0.17				mg/kg	0.17	A-T-024s
Nickel$_D$[M#]	16	21	6	10				mg/kg	1	A-T-024s
Selenium$_D$[M#]	<1	<1	<1	<1				mg/kg	1	A-T-024s
Zinc$_D$[M#]	68	30	27	23				mg/kg	5	A-T-024s

Envirolab Job Number: 19/05767

Client Project Name: Gladstone Dock, Liverpool

Client Project Ref: B068331.300

Lab Sample ID	19/05767/1	19/05767/2	19/05767/3	19/05767/5				Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS01	WS03	WS05	WS04						
Depth to Top	0.30	0.80	0.25	0.80						
Depth To Bottom										
Date Sampled	10-Jun-19	10-Jun-19	10-Jun-19	10-Jun-19						
Sample Type	Soil	Soil	Soil	Soil						
Sample Matrix Code	4AB	5A	4AB	4AB						
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_D^{\#}$	NAD	NAD	NAD	NAD						A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A	N/A						

Envirolab Job Number: 19/05767

Client Project Name: Gladstone Dock, Liverpool

Client Project Ref: B068331.300

Lab Sample ID	19/05767/1	19/05767/2	19/05767/3	19/05767/5				Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS01	WS03	WS05	WS04						
Depth to Top	0.30	0.80	0.25	0.80						
Depth To Bottom										
Date Sampled	10-Jun-19	10-Jun-19	10-Jun-19	10-Jun-19						
Sample Type	Soil	Soil	Soil	Soil						
Sample Matrix Code	4AB	5A	4AB	4AB						
PAH-16MS										
Acenaphthene$_{A}^{M\#}$	0.67	<0.01	0.04	0.18				mg/kg	0.01	A-T-019s
Acenaphthylene$_{A}^{M\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-019s
Anthracene$_{A}^{M\#}$	1.07	<0.02	0.10	0.29				mg/kg	0.02	A-T-019s
Benzo(a)anthracene$_{A}^{M\#}$	1.68	<0.04	0.25	0.56				mg/kg	0.04	A-T-019s
Benzo(a)pyrene$_{A}^{M\#}$	1.46	<0.04	0.23	0.51				mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene$_{A}^{M\#}$	1.72	<0.05	0.26	0.56				mg/kg	0.05	A-T-019s
Benzo(ghi)perylene$_{A}^{M\#}$	0.70	<0.05	0.13	0.23				mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene$_{A}^{M\#}$	0.58	<0.07	0.09	0.20				mg/kg	0.07	A-T-019s
Chrysene$_{A}^{M\#}$	1.81	<0.06	0.27	0.59				mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene$_{A}^{M\#}$	0.21	<0.04	<0.04	0.06				mg/kg	0.04	A-T-019s
Fluoranthene$_{A}^{M\#}$	4.31	<0.08	0.44	1.13				mg/kg	0.08	A-T-019s
Fluorene$_{A}^{M\#}$	0.59	<0.01	0.03	0.13				mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene$_{A}^{M\#}$	0.74	<0.03	0.14	0.24				mg/kg	0.03	A-T-019s
Naphthalene $_{A}^{M\#}$	0.63	<0.03	<0.03	0.07				mg/kg	0.03	A-T-019s
Phenanthrene$_{A}^{M\#}$	5.05	<0.03	0.42	1.11				mg/kg	0.03	A-T-019s
Pyrene$_{A}^{M\#}$	3.97	<0.07	0.48	1.16				mg/kg	0.07	A-T-019s
Total PAH-16MS$_{A}^{M\#}$	25.2	<0.08	2.88	7.02				mg/kg	0.01	A-T-019s

Envirolab Job Number: 19/05767

Client Project Name: Gladstone Dock, Liverpool

Client Project Ref: B068331.300

Lab Sample ID	19/05767/1	19/05767/2	19/05767/3	19/05767/5				Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS01	WS03	WS05	WS04						
Depth to Top	0.30	0.80	0.25	0.80						
Depth To Bottom										
Date Sampled	10-Jun-19	10-Jun-19	10-Jun-19	10-Jun-19						
Sample Type	Soil	Soil	Soil	Soil						
Sample Matrix Code	4AB	5A	4AB	4AB						
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
Ali >C8-C10$_A$	<1	<1	<1	<1				mg/kg	1	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	<1	<1	<1				mg/kg	1	A-T-055s
Ali >C12-C16$_A^{M\#}$	5	<1	<1	<1				mg/kg	1	A-T-055s
Ali >C16-C21$_A^{M\#}$	10	<1	2	1				mg/kg	1	A-T-055s
Ali >C21-C35$_A$	79	1	28	3				mg/kg	1	A-T-055s
Total Aliphatics$_A$	95	1	31	4				mg/kg	1	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
Aro >C8-C10$_A$	34	<1	11	<1				mg/kg	1	A-T-055s
Aro >C10-C12$_A^{M\#}$	3	<1	<1	3				mg/kg	1	A-T-055s
Aro >C12-C16$_A$	12	<1	1	20				mg/kg	1	A-T-055s
Aro >C16-C21$_A^{M\#}$	41	<1	3	75				mg/kg	1	A-T-055s
Aro >C21-C35$_A^{M\#}$	84	1	12	148				mg/kg	1	A-T-055s
Total Aromatics$_A$	176	1	27	247				mg/kg	1	A-T-055s
TPH (Ali & Aro >C5-C35)$_A$	270	2	58	251				mg/kg	1	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s

REPORT NOTES

General
This report shall not be reproduced, except in full, without written approval from Envirolab.
The results reported herein relate only to the material supplied to the laboratory.
The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.
If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Soil chemical analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

Key:
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Curtins Consulting, Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG

Project: Gladstone Dock, Liverpool

Clients Project No: B068331.300

Project No: 19/05767

Date Received: 17/06/2019 (am)

Cool Box Temperatures (°C): 13.4

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

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Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 19/05907
Issue Number: 1 **Date:** 27 June, 2019

Client:
Curtins Consulting
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: Amber Hatch-Walling
Project Name: Gladstone Docks
Project Ref: B068331.300
Order No: EBMA1921
Date Samples Received: 19/06/19
Date Instructions Received: 21/06/19
Date Analysis Completed: 27/06/19

Prepared by:

Holly Neary-King
Client Manager

Approved by:

Georgia King
Admin & Client Services Supervisor

Envirolab Job Number: 19/05907

Client Project Name: Gladstone Docks

Client Project Ref: B068331.300

Lab Sample ID	19/05907/1	19/05907/2	19/05907/3					Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH03	BH03	BH01							
Depth to Top	1.00	5.00	6.60							
Depth To Bottom										
Date Sampled	15-Jun-19	15-Jun-19	12-Jun-19							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	4AE	5A	5A							
% Stones >10mm$_A$	11.8	<0.1	<0.1					% w/w	0.1	A-T-044
pH$_D$[M#]	9.40	9.57	9.32					pH	0.01	A-T-031s
Sulphate (water sol 2:1)$_D$[M#]	0.09	0.07	0.06					g/l	0.01	A-T-026s
Cyanide (total)$_A$[M#]	<1	<1	<1					mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2	<0.2					mg/kg	0.2	A-T-050s
Organic matter$_D$[M#]	5.1	0.6	0.5					% w/w	0.1	A-T-032 OM
Arsenic$_D$[M#]	7	3	2					mg/kg	1	A-T-024s
Boron (water soluble)$_D$[M#]	1.1	3.0	2.4					mg/kg	1	A-T-027s
Cadmium$_D$[M#]	0.6	0.8	0.9					mg/kg	0.5	A-T-024s
Copper$_D$[M#]	64	15	15					mg/kg	1	A-T-024s
Chromium$_D$[M#]	18	34	33					mg/kg	1	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1					mg/kg	1	A-T-040s
Lead$_D$[M#]	79	7	9					mg/kg	1	A-T-024s
Mercury$_D$	<0.17	<0.17	<0.17					mg/kg	0.17	A-T-024s
Nickel$_D$[M#]	16	29	32					mg/kg	1	A-T-024s
Selenium$_D$[M#]	<1	<1	<1					mg/kg	1	A-T-024s
Zinc$_D$[M#]	98	39	41					mg/kg	5	A-T-024s

Envirolab Job Number: 19/05907

Client Project Name: Gladstone Docks

Client Project Ref: B068331.300

Lab Sample ID	19/05907/1	19/05907/2	19/05907/3					Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH03	BH03	BH01							
Depth to Top	1.00	5.00	6.60							
Depth To Bottom										
Date Sampled	15-Jun-19	15-Jun-19	12-Jun-19							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	4AE	5A	5A							
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_D^{\#}$	NAD	NAD	NAD							A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A							

Envirolab Job Number: 19/05907

Client Project Name: Gladstone Docks

Client Project Ref: B068331.300

Lab Sample ID	19/05907/1	19/05907/2	19/05907/3					Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH03	BH03	BH01							
Depth to Top	1.00	5.00	6.60							
Depth To Bottom										
Date Sampled	15-Jun-19	15-Jun-19	12-Jun-19							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	4AE	5A	5A							
PAH-16MS										
Acenaphthene$_A^{M\#}$	0.25	<0.01	<0.01					mg/kg	0.01	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.01	<0.01	<0.01					mg/kg	0.01	A-T-019s
Anthracene$_A^{M\#}$	0.42	<0.02	<0.02					mg/kg	0.02	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	1.05	<0.04	<0.04					mg/kg	0.04	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	0.85	<0.04	<0.04					mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	1.08	<0.05	<0.05					mg/kg	0.05	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	0.50	<0.05	<0.05					mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	0.38	<0.07	<0.07					mg/kg	0.07	A-T-019s
Chrysene$_A^{M\#}$	1.14	<0.06	<0.06					mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	0.12	<0.04	<0.04					mg/kg	0.04	A-T-019s
Fluoranthene$_A^{M\#}$	2.16	<0.08	<0.08					mg/kg	0.08	A-T-019s
Fluorene$_A^{M\#}$	0.20	<0.01	<0.01					mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	0.49	<0.03	<0.03					mg/kg	0.03	A-T-019s
Naphthalene $_A^{M\#}$	0.25	<0.03	<0.03					mg/kg	0.03	A-T-019s
Phenanthrene$_A^{M\#}$	1.92	<0.03	<0.03					mg/kg	0.03	A-T-019s
Pyrene$_A^{M\#}$	2.17	<0.07	<0.07					mg/kg	0.07	A-T-019s
Total PAH-16MS$_A^{M\#}$	13	<0.08	<0.08					mg/kg	0.01	A-T-019s

Envirolab Job Number: 19/05907

Client Project Name: Gladstone Docks

Client Project Ref: B068331.300

Lab Sample ID	19/05907/1	19/05907/2	19/05907/3					Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	BH03	BH03	BH01							
Depth to Top	1.00	5.00	6.60							
Depth To Bottom										
Date Sampled	15-Jun-19	15-Jun-19	12-Jun-19							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	4AE	5A	5A							
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01					mg/kg	0.01	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	<0.01					mg/kg	0.01	A-T-022s
Ali >C8-C10$_A$	<1	<1	<1					mg/kg	1	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	<1	<1					mg/kg	1	A-T-055s
Ali >C12-C16$_A^{M\#}$	2	<1	<1					mg/kg	1	A-T-055s
Ali >C16-C21$_A^{M\#}$	5	<1	<1					mg/kg	1	A-T-055s
Ali >C21-C35$_A$	47	1	<1					mg/kg	1	A-T-055s
Total Aliphatics$_A$	54	1	<1					mg/kg	1	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01					mg/kg	0.01	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	<0.01					mg/kg	0.01	A-T-022s
Aro >C8-C10$_A$	2	<1	<1					mg/kg	1	A-T-055s
Aro >C10-C12$_A^{M\#}$	3	<1	<1					mg/kg	1	A-T-055s
Aro >C12-C16$_A$	14	<1	<1					mg/kg	1	A-T-055s
Aro >C16-C21$_A^{M\#}$	55	<1	<1					mg/kg	1	A-T-055s
Aro >C21-C35$_A^{M\#}$	136	3	2					mg/kg	1	A-T-055s
Total Aromatics$_A$	210	3	2					mg/kg	1	A-T-055s
TPH (Ali & Aro >C5-C35)$_A$	264	5	2					mg/kg	1	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01					mg/kg	0.01	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	<0.01					mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	<0.01					mg/kg	0.01	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01	<0.01					mg/kg	0.01	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	<0.01					mg/kg	0.01	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01					mg/kg	0.01	A-T-022s

REPORT NOTES

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The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.
Analytical results reflect the quality of the sample at the time of analysis only.
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If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Soil chemical analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed.
Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

Key:
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Curtins Consulting, Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG

Project: Gladstone Docks

Clients Project No: B068331.300

Project No: 19/05907

Date Received: 21/06/2019 (am)

Cool Box Temperatures (°C): 14.6

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 19/06020
Issue Number: 1 **Date:** 04 July, 2019

Client:
Curtins Consulting
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: Amber Hatch-Walling
Project Name: Gladstone Dock
Project Ref: B068331.300
Order No: EBMA1937
Date Samples Received: 18/06/19
Date Instructions Received: 25/06/19
Date Analysis Completed: 03/07/19

Prepared by:

Holly Neary-King
Client Manager

Approved by:

Richard Wong
Client Manager

Envirolab Job Number: 19/06020

Client Project Name: Gladstone Dock

Client Project Ref: B068331.300

Lab Sample ID	19/06020/1	19/06020/2	19/06020/4	19/06020/5	19/06020/6	19/06020/7	19/06020/8	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	CP01 (BH1)	CP02 (BH2)	CP04 (BH4)	CP04 (BH4)	BH6	BH6	BH6			
Depth to Top	1.20	0.50	0.50	9.50	0.50	1.80	4.30			
Depth To Bottom		0.60	0.60	9.60						
Date Sampled	11-Jun-19	10-Jun-19	13-Jun-19	13-Jun-19	19-Jun-19	19-Jun-19	19-Jun-19			
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	6A	4AB	4AE	5A	4A	5A	6A			
% Stones >10mm$_A$	2.8	13.5	23.2	10.3	<0.1	5.8	5.8	% w/w	0.1	A-T-044
pH$_D$[M#]	8.99	9.47	12.06	9.28	12.83	8.90	8.68	pH	0.01	A-T-031s
Sulphate (water sol 2:1)$_D$[M#]	0.02	0.13	0.16	0.18	0.01	1.14	0.11	g/l	0.01	A-T-026s
Cyanide (total)$_A$[M#]	<1	<1	<1	<1	<1	<1	<1	mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	mg/kg	0.2	A-T-050s
Organic matter$_D$[M#]	3.1	4.5	1.6	0.8	4.9	1.2	2.2	% w/w	0.1	A-T-032 OM
Arsenic$_D$[M#]	8	10	8	4	13	5	19	mg/kg	1	A-T-024s
Boron (water soluble)$_D$[M#]	<1.0	<1.0	1.5	1.9	<1.0	1.3	5.6	mg/kg	1	A-T-027s
Cadmium$_D$[M#]	<0.5	0.7	<0.5	0.6	0.9	0.7	0.8	mg/kg	0.5	A-T-024s
Copper$_D$[M#]	23	41	20	17	30	14	30	mg/kg	1	A-T-024s
Chromium$_D$[M#]	11	14	13	30	30	29	35	mg/kg	1	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1	<1	<1	<1	<1	mg/kg	1	A-T-040s
Lead$_D$[M#]	56	92	28	11	51	8	99	mg/kg	1	A-T-024s
Mercury$_D$	<0.17	<0.17	0.25	<0.17	0.66	<0.17	0.38	mg/kg	0.17	A-T-024s
Nickel$_D$[M#]	12	16	13	30	21	30	24	mg/kg	1	A-T-024s
Selenium$_D$[M#]	<1	<1	<1	2	1	2	2	mg/kg	1	A-T-024s
Zinc$_D$[M#]	31	158	65	66	266	43	88	mg/kg	5	A-T-024s

Envirolab Job Number: 19/06020

Client Project Name: Gladstone Dock

Client Project Ref: B068331.300

Lab Sample ID	19/06020/1	19/06020/2	19/06020/4	19/06020/5	19/06020/6	19/06020/7	19/06020/8	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	CP01 (BH1)	CP02 (BH2)	CP04 (BH4)	CP04 (BH4)	BH6	BH6	BH6			
Depth to Top	1.20	0.50	0.50	9.50	0.50	1.80	4.30			
Depth To Bottom		0.60	0.60	9.60						
Date Sampled	11-Jun-19	10-Jun-19	13-Jun-19	13-Jun-19	19-Jun-19	19-Jun-19	19-Jun-19			
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	6A	4AB	4AE	5A	4A	5A	6A			
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_{D}^{\#}$	NAD	NAD	NAD	NAD	Chrysotile	NAD	NAD			A-T-045
Asbestos Matrix (microscope)$_{D}$	-	-	-	-	Loose Fibres	-	-			A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A	N/A	N/A	N/A	N/A			
Asbestos in Soil Quantification % (Hand Picking & Weighing)										
Asbestos in soil % composition (hand picking and weighing)$_{D}$	-	-	-	-	0.002	-	-	% w/w	0.001	A-T-054

Envirolab Job Number: 19/06020

Client Project Name: Gladstone Dock

Client Project Ref: B068331.300

Lab Sample ID	19/06020/1	19/06020/2	19/06020/4	19/06020/5	19/06020/6	19/06020/7	19/06020/8	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	CP01 (BH1)	CP02 (BH2)	CP04 (BH4)	CP04 (BH4)	BH6	BH6	BH6			
Depth to Top	1.20	0.50	0.50	9.50	0.50	1.80	4.30			
Depth To Bottom		0.60	0.60	9.60						
Date Sampled	11-Jun-19	10-Jun-19	13-Jun-19	13-Jun-19	19-Jun-19	19-Jun-19	19-Jun-19			
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	6A	4AB	4AE	5A	4A	5A	6A			
PAH-16MS										
Acenaphthene$_A^{M\#}$	0.03	0.69	0.48	<0.01	0.12	<0.01	0.16	mg/kg	0.01	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-019s
Anthracene$_A^{M\#}$	0.08	1.26	0.82	<0.02	0.21	<0.02	0.08	mg/kg	0.02	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	0.23	3.00	1.23	<0.04	0.52	<0.04	0.06	mg/kg	0.04	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	0.19	2.42	0.92	<0.04	0.41	<0.04	<0.04	mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	0.23	2.84	1.03	<0.05	0.50	<0.05	0.06	mg/kg	0.05	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	0.10	1.21	0.47	<0.05	0.24	<0.05	<0.05	mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	<0.07	0.98	0.36	<0.07	0.19	<0.07	<0.07	mg/kg	0.07	A-T-019s
Chrysene$_A^{M\#}$	0.25	3.21	1.23	<0.06	0.58	<0.06	<0.06	mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	<0.04	0.31	0.13	<0.04	0.06	<0.04	<0.04	mg/kg	0.04	A-T-019s
Fluoranthene$_A^{M\#}$	0.42	6.34	2.60	<0.08	1.08	<0.08	0.36	mg/kg	0.08	A-T-019s
Fluorene$_A^{M\#}$	0.03	0.55	0.49	<0.01	0.10	<0.01	0.16	mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	0.10	1.30	0.50	<0.03	0.24	<0.03	<0.03	mg/kg	0.03	A-T-019s
Naphthalene $_A^{M\#}$	<0.03	0.64	0.56	<0.03	0.17	<0.03	<0.03	mg/kg	0.03	A-T-019s
Phenanthrene$_A^{M\#}$	0.32	5.37	3.00	<0.03	0.94	<0.03	0.41	mg/kg	0.03	A-T-019s
Pyrene$_A^{M\#}$	0.45	6.29	2.32	<0.07	1.05	<0.07	0.27	mg/kg	0.07	A-T-019s
Total PAH-16MS$_A^{M\#}$	2.43	36.4	16.1	<0.08	6.41	<0.08	1.56	mg/kg	0.01	A-T-019s

Envirolab Job Number: 19/06020

Client Project Name: Gladstone Dock

Client Project Ref: B068331.300

Lab Sample ID	19/06020/1	19/06020/2	19/06020/4	19/06020/5	19/06020/6	19/06020/7	19/06020/8	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	CP01 (BH1)	CP02 (BH2)	CP04 (BH4)	CP04 (BH4)	BH6	BH6	BH6			
Depth to Top	1.20	0.50	0.50	9.50	0.50	1.80	4.30			
Depth To Bottom		0.60	0.60	9.60						
Date Sampled	11-Jun-19	10-Jun-19	13-Jun-19	13-Jun-19	19-Jun-19	19-Jun-19	19-Jun-19			
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES			
Sample Matrix Code	6A	4AB	4AE	5A	4A	5A	6A			
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
Ali >C8-C10$_A$	1	3	3	<1	3	<1	<1	mg/kg	1	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	<1	<1	<1	1	<1	<1	mg/kg	1	A-T-055s
Ali >C12-C16$_A^{M\#}$	<1	2	5	<1	3	<1	<1	mg/kg	1	A-T-055s
Ali >C16-C21$_A^{M\#}$	<1	6	19	<1	17	<1	1	mg/kg	1	A-T-055s
Ali >C21-C35$_A$	11	46	155	8	132	1	6	mg/kg	1	A-T-055s
Total Aliphatics$_A$	14	56	183	8	159	1	7	mg/kg	1	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
Aro >C8-C10$_A$	5	8	12	3	21	3	1	mg/kg	1	A-T-055s
Aro >C10-C12$_A^{M\#}$	<1	8	3	<1	2	<1	<1	mg/kg	1	A-T-055s
Aro >C12-C16$_A$	1	32	11	<1	5	<1	7	mg/kg	1	A-T-055s
Aro >C16-C21$_A^{M\#}$	6	128	37	<1	12	<1	20	mg/kg	1	A-T-055s
Aro >C21-C35$_A^{M\#}$	13	399	209	4	58	1	34	mg/kg	1	A-T-055s
Total Aromatics$_A$	24	576	273	7	98	4	63	mg/kg	1	A-T-055s
TPH (Ali & Aro >C5-C35)$_A$	37	632	456	16	256	5	70	mg/kg	1	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	0.01	A-T-022s

Envirolab Job Number: 19/06020

Client Project Name: Gladstone Dock

Client Project Ref: B068331.300

Lab Sample ID	19/06020/9	19/06020/10	19/06020/11	19/06020/12				Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	CP05 (BH5)	CP05 (BH5)	CP05 (BH5)	WS02						
Depth to Top	0.50	1.50	2.50	0.40						
Depth To Bottom										
Date Sampled	21-Jun-19	21-Jun-19	21-Jun-19	14-Jun-19						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	6AE	6A	6A	4A						
% Stones >10mm$_A$	17.9	11.7	11.0	34.1				% w/w	0.1	A-T-044
pH$_D$[M#]	12.09	11.24	9.27	11.95				pH	0.01	A-T-031s
Sulphate (water sol 2:1)$_D$[M#]	0.24	0.19	0.09	0.12				g/l	0.01	A-T-026s
Cyanide (total)$_A$[M#]	<1	<1	<1	<1				mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2	<0.2	<0.2				mg/kg	0.2	A-T-050s
Organic matter$_D$[M#]	1.8	1.1	0.4	1.1				% w/w	0.1	A-T-032 OM
Arsenic$_D$[M#]	9	8	3	7				mg/kg	1	A-T-024s
Boron (water soluble)$_D$[M#]	1.4	1.5	1.3	<1.0				mg/kg	1	A-T-027s
Cadmium$_D$[M#]	0.7	0.6	0.5	<0.5				mg/kg	0.5	A-T-024s
Copper$_D$[M#]	22	20	12	14				mg/kg	1	A-T-024s
Chromium$_D$[M#]	24	28	24	17				mg/kg	1	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1	<1				mg/kg	1	A-T-040s
Lead$_D$[M#]	67	39	9	36				mg/kg	1	A-T-024s
Mercury$_D$	0.39	0.35	<0.17	0.43				mg/kg	0.17	A-T-024s
Nickel$_D$[M#]	20	26	24	13				mg/kg	1	A-T-024s
Selenium$_D$[M#]	2	2	2	<1				mg/kg	1	A-T-024s
Zinc$_D$[M#]	116	97	52	45				mg/kg	5	A-T-024s

Envirolab Job Number: 19/06020

Client Project Name: Gladstone Dock

Client Project Ref: B068331.300

Lab Sample ID	19/06020/9	19/06020/10	19/06020/11	19/06020/12				Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	CP05 (BH5)	CP05 (BH5)	CP05 (BH5)	WS02						
Depth to Top	0.50	1.50	2.50	0.40						
Depth To Bottom										
Date Sampled	21-Jun-19	21-Jun-19	21-Jun-19	14-Jun-19						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	6AE	6A	6A	4A						
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_D^{\#}$	NAD	NAD	NAD	NAD						A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A	N/A						

Envirolab Job Number: 19/06020

Client Project Name: Gladstone Dock

Client Project Ref: B068331.300

Lab Sample ID	19/06020/9	19/06020/10	19/06020/11	19/06020/12				Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	CP05 (BH5)	CP05 (BH5)	CP05 (BH5)	WS02						
Depth to Top	0.50	1.50	2.50	0.40						
Depth To Bottom										
Date Sampled	21-Jun-19	21-Jun-19	21-Jun-19	14-Jun-19						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	6AE	6A	6A	4A						
PAH-16MS										
Acenaphthene$_{A}^{M\#}$	0.16	0.02	<0.01	0.05				mg/kg	0.01	A-T-019s
Acenaphthylene$_{A}^{M\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-019s
Anthracene$_{A}^{M\#}$	0.18	0.03	<0.02	0.10				mg/kg	0.02	A-T-019s
Benzo(a)anthracene$_{A}^{M\#}$	0.27	0.07	<0.04	0.21				mg/kg	0.04	A-T-019s
Benzo(a)pyrene$_{A}^{M\#}$	0.18	0.05	<0.04	0.16				mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene$_{A}^{M\#}$	0.22	0.06	<0.05	0.22				mg/kg	0.05	A-T-019s
Benzo(ghi)perylene$_{A}^{M\#}$	0.09	<0.05	<0.05	0.09				mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene$_{A}^{M\#}$	0.07	<0.07	<0.07	0.08				mg/kg	0.07	A-T-019s
Chrysene$_{A}^{M\#}$	0.31	0.08	<0.06	0.24				mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene$_{A}^{M\#}$	<0.04	<0.04	<0.04	<0.04				mg/kg	0.04	A-T-019s
Fluoranthene$_{A}^{M\#}$	0.65	0.15	<0.08	0.49				mg/kg	0.08	A-T-019s
Fluorene$_{A}^{M\#}$	0.14	0.02	<0.01	0.04				mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene$_{A}^{M\#}$	0.09	<0.03	<0.03	0.09				mg/kg	0.03	A-T-019s
Naphthalene $_{A}^{M\#}$	0.31	<0.03	<0.03	0.04				mg/kg	0.03	A-T-019s
Phenanthrene$_{A}^{M\#}$	0.78	0.16	<0.03	0.48				mg/kg	0.03	A-T-019s
Pyrene$_{A}^{M\#}$	0.63	0.15	<0.07	0.46				mg/kg	0.07	A-T-019s
Total PAH-16MS$_{A}^{M\#}$	4.08	0.79	<0.08	2.75				mg/kg	0.01	A-T-019s

Envirolab Job Number: 19/06020

Client Project Name: Gladstone Dock

Client Project Ref: B068331.300

Lab Sample ID	19/06020/9	19/06020/10	19/06020/11	19/06020/12				Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	CP05 (BH5)	CP05 (BH5)	CP05 (BH5)	WS02						
Depth to Top	0.50	1.50	2.50	0.40						
Depth To Bottom										
Date Sampled	21-Jun-19	21-Jun-19	21-Jun-19	14-Jun-19						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	6AE	6A	6A	4A						
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
Ali >C8-C10$_A$	2	<1	<1	1				mg/kg	1	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	<1	<1	2				mg/kg	1	A-T-055s
Ali >C12-C16$_A^{M\#}$	5	<1	<1	3				mg/kg	1	A-T-055s
Ali >C16-C21$_A^{M\#}$	11	2	<1	10				mg/kg	1	A-T-055s
Ali >C21-C35$_A$	83	13	4	111				mg/kg	1	A-T-055s
Total Aliphatics$_A$	101	16	4	128				mg/kg	1	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
Aro >C8-C10$_A$	239	16	<1	12				mg/kg	1	A-T-055s
Aro >C10-C12$_A^{M\#}$	3	<1	<1	2				mg/kg	1	A-T-055s
Aro >C12-C16$_A$	8	2	<1	4				mg/kg	1	A-T-055s
Aro >C16-C21$_A^{M\#}$	21	4	<1	10				mg/kg	1	A-T-055s
Aro >C21-C35$_A^{M\#}$	46	9	5	30				mg/kg	1	A-T-055s
Total Aromatics$_A$	316	30	5	58				mg/kg	1	A-T-055s
TPH (Ali & Aro >C5-C35)$_A$	417	46	10	186				mg/kg	1	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s

REPORT NOTES

General
This report shall not be reproduced, except in full, without written approval from Envirolab.
The results reported herein relate only to the material supplied to the laboratory.
The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.
If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Soil chemical analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed.
Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

Key:
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Curtins Consulting, Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG

Project: Gladstone Dock

Clients Project No: B068331.300

Project No: 19/06020

Date Received: 25/06/2019 (am)

Cool Box Temperatures (°C): 16.3 - 17.6

Lab Sample ID	19/06020/1	19/06020/2	19/06020/12
Client Sample No			
Client Sample ID/Depth	CP01 (BH1) 1.20m	CP02 (BH2) 0.50-0.60m	WS02 0.40m
Date Sampled	11/06/19	10/06/19	14/06/19
Deviation Code			
F	✓	✓	✓

Key
F *Maximum holding time exceeded between sampling date and analysis for analytes listed below*

HOLDING TIME EXCEEDANCES

Lab Sample ID	19/06020/1	19/06020/2	19/06020/12
Client Sample No			
Client Sample ID/Depth	CP01 (BH1) 1.20m	CP02 (BH2) 0.50-0.60m	WS02 0.40m
Date Sampled	11/06/19	10/06/19	14/06/19
Cyanide (total)	✓	✓	
PAH-16MS	✓	✓	✓
VPHCWG	✓	✓	

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

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Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 19/08697
Issue Number: 1 **Date:** 24 September, 2019

Client:
Curtins Consulting
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: Amber Hatch-Walling
Project Name: EMR Gladstone Dock, Liverpool
Project Ref: B068331.300
Order No: EMA1942
Date Samples Received: 17/09/19
Date Instructions Received: 18/09/19
Date Analysis Completed: 24/09/19

Prepared by:

Melanie Marshall
Laboratory Coordinator

Approved by:

Richard Wong
Client Manager

UKAS TESTING
1247

Envirolab Job Number: 19/08697

Client Project Name: EMR Gladstone Dock, Liverpool

Client Project Ref: B068331.300

Lab Sample ID	19/08697/1	19/08697/2	19/08697/3					Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	CP01	CP05	CP06							
Depth to Top	4.40	4.70	5.17							
Depth To Bottom	5.30	5.90	5.30							
Date Sampled	17-Sep-19	17-Sep-19	17-Sep-19							
Sample Type	Water - EW	Water - EW	Water - EW							
Sample Matrix Code	N/A	N/A	N/A							
pH (w)$_{A}^{\#}$	8.51	8.68	8.64					pH	0.01	A-T-031w
Hardness Total$_{A}^{\#}$	130	162	133					mg/l Ca CO3	2	A-T-049w
Sulphate (w)$_{A}^{\#}$	176	132	263					mg/l	1	A-T-026w
Cyanide (total) (w)$_{A}^{\#}$	<0.005	0.013	0.006					mg/l	0.005	A-T-042wTCN
Phenols - Total by HPLC (w)$_{A}$	<0.01	0.01	<0.01					mg/l	0.01	A-T-050w
Sulphide (w)$_{A}$	0.2	0.3	0.5					mg/l	0.1	A-T-S2-w
DOC (w)$_{A}^{\#}$	11.5	10.5	28.3					mg/l	0.2	A-T-032w
Arsenic (dissolved)$_{A}^{\#}$	6	43	15					µg/l	1	A-T-025w
Boron (dissolved)$_{A}^{\#}$	690	1150	1000					µg/l	10	A-T-025w
Cadmium (dissolved)$_{A}^{\#}$	<0.2	<0.2	<0.2					µg/l	0.2	A-T-025w
Calcium (dissolved)$_{A}^{\#}$	29	32	20					mg/l	1	A-T-049w
Copper (dissolved)$_{A}^{\#}$	<1	<1	<1					µg/l	1	A-T-025w
Chromium (dissolved)$_{A}^{\#}$	<1	2	<1					µg/l	1	A-T-025w
Lead (dissolved)$_{A}^{\#}$	<1	<1	<1					µg/l	1	A-T-025w
Mercury (dissolved)$_{A}^{\#}$	<0.1	<0.1	1.6					µg/l	0.1	A-T-025w
Nickel (dissolved)$_{A}^{\#}$	1	7	8					µg/l	1	A-T-025w
Selenium (dissolved)$_{A}^{\#}$	<1	<1	<1					µg/l	1	A-T-025w
Zinc (dissolved)$_{A}^{\#}$	4	<1	<1					µg/l	1	A-T-025w

Envirolab Job Number: 19/08697

Client Project Name: EMR Gladstone Dock, Liverpool

Client Project Ref: B068331.300

Lab Sample ID	19/08697/1	19/08697/2	19/08697/3					Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	CP01	CP05	CP06							
Depth to Top	4.40	4.70	5.17							
Depth To Bottom	5.30	5.90	5.30							
Date Sampled	17-Sep-19	17-Sep-19	17-Sep-19							
Sample Type	Water - EW	Water - EW	Water - EW							
Sample Matrix Code	N/A	N/A	N/A							
PAH 16MS (w)										
Acenaphthene (w)$_A^{\#}$	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Acenaphthylene (w)$_A^{\#}$	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Anthracene (w)$_A^{\#}$	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Benzo(a)anthracene (w)$_A^{\#}$	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Benzo(a)pyrene (w)$_A^{\#}$	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Benzo(b)fluoranthene (w)$_A^{\#}$	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Benzo(ghi)perylene (w)$_A^{\#}$	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Benzo(k)fluoranthene (w)$_A^{\#}$	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Chrysene (w)$_A^{\#}$	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Dibenzo(ah)anthracene (w)$_A^{\#}$	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Fluoranthene (w)$_A^{\#}$	<0.01	<0.01	0.02					µg/l	0.01	A-T-019w
Fluorene (w)$_A^{\#}$	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Indeno(123-cd)pyrene (w)$_A^{\#}$	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Naphthalene (w)$_A^{\#}$	<0.01	<0.01	0.04					µg/l	0.01	A-T-019w
Phenanthrene (w)$_A^{\#}$	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Pyrene (w)$_A^{\#}$	0.01	<0.01	0.02					µg/l	0.01	A-T-019w
Total PAH 16MS (w)$_A^{\#}$	0.01	<0.01	0.08					µg/l	0.01	A-T-019w

Envirolab Job Number: 19/08697

Client Project Name: EMR Gladstone Dock, Liverpool

Client Project Ref: B068331.300

Lab Sample ID	19/08697/1	19/08697/2	19/08697/3					Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	CP01	CP05	CP06							
Depth to Top	4.40	4.70	5.17							
Depth To Bottom	5.30	5.90	5.30							
Date Sampled	17-Sep-19	17-Sep-19	17-Sep-19							
Sample Type	Water - EW	Water - EW	Water - EW							
Sample Matrix Code	N/A	N/A	N/A							
TPH CWG (w)										
Ali >C5-C6 (w)$_A^{\#}$	<1	<1	<1					µg/l	1	A-T-022w
Ali >C6-C8 (w)$_A^{\#}$	<1	<1	<1					µg/l	1	A-T-022w
Ali >C8-C10 (w)$_A^{\#}$	<5	<5	<5					µg/l	5	A-T-055w
Ali >C10-C12 (w)$_A^{\#}$	<5	<5	<5					µg/l	5	A-T-055w
Ali >C12-C16 (w)$_A^{\#}$	<5	<5	<5					µg/l	5	A-T-055w
Ali >C16-C21 (w)$_A^{\#}$	<5	<5	<5					µg/l	5	A-T-055w
Ali >C21-C35 (w)$_A^{\#}$	14	<5	<5					µg/l	5	A-T-055w
Total Aliphatics (w)$_A^{\#}$	14	<5	<5					µg/l	5	A-T-055w
Aro >C5-C7 (w)$_A^{\#}$	<1	<1	<1					µg/l	1	A-T-022w
Aro >C7-C8 (w)$_A^{\#}$	<1	<1	<1					µg/l	1	A-T-022w
Aro >C8-C10 (w)$_A$	10	6	7					µg/l	5	A-T-055w
Aro >C10-C12 (w)$_A^{\#}$	<5	<5	10					µg/l	5	A-T-055w
Aro >C12-C16 (w)$_A^{\#}$	20	9	9					µg/l	5	A-T-055w
Aro >C16-C21 (w)$_A^{\#}$	17	10	9					µg/l	5	A-T-055w
Aro >C21-C35 (w)$_A^{\#}$	20	12	12					µg/l	10	A-T-055w
Total Aromatics (w)$_A$	67	36	48					µg/l	10	A-T-055w
TPH (Ali & Aro >C5-C35) (w)$_A$	81	36	48					µg/l	10	A-T-055w
BTEX - Benzene (w)$_A^{\#}$	<1	<1	<1					µg/l	1	A-T-022w
BTEX - Toluene (w)$_A^{\#}$	<1	<1	<1					µg/l	1	A-T-022w
BTEX - Ethyl Benzene (w)$_A^{\#}$	<1	<1	<1					µg/l	1	A-T-022w
BTEX - m & p Xylene (w)$_A^{\#}$	<1	<1	<1					µg/l	1	A-T-022w
BTEX - o Xylene (w)$_A^{\#}$	<1	<1	<1					µg/l	1	A-T-022w
MTBE (w)$_A^{\#}$	<1	<1	<1					µg/l	1	A-T-022w

REPORT NOTES

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The results reported herein relate only to the material supplied to the laboratory.
The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.
If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.
The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

Soil chemical analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
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Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

Key:
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US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Curtins Consulting, Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG

Project: EMR Gladstone Dock, Liverpool

Clients Project No: B068331.300

Project No: 19/08697

Date Received: 18/09/2019 (am)

Cool Box Temperatures (°C): 19.9, 19.7

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Appendix D Geotechnical Laboratory Testing Results

- Ian Farmers Associates, Geotechnical Results, Test Report 42334/1
- Envirolab, Geotechnical Analysis Results, Test Report 19/06606
- Envirolab, Geotechnical Analysis Results, Test Report 19/07111

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Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 19/06606
Issue Number: 1 **Date:** 19 July, 2019

Client:
Ian Farmer Associates (Warrington)
14/15 Rufford Court
Hardwick Grange
Warrington
WA1 4RF

Project Manager: Hannah Hadwin/Joe Tant/Michelle Hirst-Watson/Olivi
Project Name: Gladstone Dock
Project Ref: 42334
Order No: 46668
Date Samples Received: 10/07/19
Date Instructions Received: 11/07/19
Date Analysis Completed: 19/07/19

Prepared by:

Melanie Marshall
Laboratory Coordinator

Approved by:

Danielle Brierley
Client Manager

Envirolab Job Number: 19/06606

Client Project Name: Gladstone Dock

Client Project Ref: 42334

Lab Sample ID	19/06606/1	19/06606/2	19/06606/3	19/06606/4	19/06606/5	19/06606/6	19/06606/7	Units	Limit of Detection	Method ref
Client Sample No	4	21	19	3	19	14	8			
Client Sample ID	CP01	CP01	CP02	CP04	CP04	CP05	CP06			
Depth to Top	2.50	11.00	13.50	1.20	12.50	7.50	4.00			
Depth To Bottom		11.45	13.95	1.65	12.95	7.95	4.45			
Date Sampled			12-Jun-19	13-Jun-19	13-Jun-19					
Sample Type	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D			
Sample Matrix Code	6AE	5A	5A	5A	5A	4A	5A			
% Stones >10mm$_A$	<0.1	1.3	<0.1	1.3	<0.1	<0.1	<0.1	% w/w	0.1	A-T-044
pH BRE$_D^{M\#}$	8.06	8.69	8.51	8.66	8.63	8.64	8.32	pH	0.01	A-T-031s
Sulphate BRE (water sol 2:1)$_D^{M\#}$	507	68	163	86	164	101	537	mg/l	10	A-T-026s

REPORT NOTES

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For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

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Stones etc. are not removed from the sample prior to analysis.
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Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

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1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
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A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

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Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Ian Farmer Associates (Warrington), 14/15 Rufford Court, Hardwick Grange, Warrington, WA1 4RF

Project: Gladstone Dock

Clients Project No: 42334

Project No: 19/06606

Date Received: 11/07/2019 (am)

Cool Box Temperatures (°C): 16.4

Lab Sample ID	19/06606/1	19/06606/2	19/06606/3	19/06606/4	19/06606/5	19/06606/6	19/06606/7
Client Sample No	4	21	19	3	19	14	8
Client Sample ID/Depth	CP01 2.50m	CP01 11.00-11.45m	CP02 13.50-13.95m	CP04 1.20-1.65m	CP04 12.50-12.95m	CP05 7.50-7.95m	CP06 4.00-4.45m
Date Sampled			12/06/19	13/06/19	13/06/19		
Deviation Code							
E (no date)	✓	✓				✓	✓
F			✓	✓	✓		

Key
E (no date) *No sampling date provided (all results affected if not provided)*
F *Maximum holding time exceeded between sampling date and analysis for analytes listed below*

HOLDING TIME EXCEEDANCES

Lab Sample ID	19/06606/3	19/06606/4	19/06606/5
Client Sample No	19	3	19
Client Sample ID/Depth	CP02 13.50-13.95m	CP04 1.20-1.65m	CP04 12.50-12.95m
Date Sampled	12/06/19	13/06/19	13/06/19
Sulphate BRE (water sol 2:1)	✓	✓	✓

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

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Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 19/07111
Issue Number: 1 **Date:** 05 August, 2019

Client:
Ian Farmer Associates (Newcastle)
Unit 4, Faraday Close
Pattinson North Industrial Estate
Washington
Tyne and Wear
NE38 8QJ

Project Manager: Paul Cathcart; washington@ianfarmer.co.uk
Project Name: Gladstone Dock
Project Ref: 42334
Order No: 46673
Date Samples Received: 26/07/19
Date Instructions Received: 26/07/19
Date Analysis Completed: 02/08/19

Prepared by:

Melanie Marshall
Laboratory Coordinator

Approved by:

Richard Wong
Client Manager

Envirolab Job Number: 19/07111

Client Project Name: Gladstone Dock

Client Project Ref: 42334

Lab Sample ID	19/07111/1	19/07111/2						Units	Limit of Detection	Method ref
Client Sample No	8	5								
Client Sample ID	CP01	CP04								
Depth to Top	4.00	2.50								
Depth To Bottom										
Date Sampled	11-Jun-19	11-Jun-19								
Sample Type	Soil - U	Soil - D								
Sample Matrix Code	5	5A								
% Stones >10mm$_A$	<0.1	3.4						% w/w	0.1	A-T-044
Organic matter$_D^{M\#}$	0.5	1.2						% w/w	0.1	A-T-032 OM

REPORT NOTES

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This report shall not be reproduced, except in full, without written approval from Envirolab.
The results reported herein relate only to the material supplied to the laboratory.
The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.
If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Soil chemical analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

Key:
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Ian Farmer Associates (Newcastle), Unit 4, Faraday Close, Pattinson North Industrial Estate, Washington, Tyne and Wear, NE38 8QJ

Project: Gladstone Dock

Clients Project No: 42334

Project No: 19/07111

Date Received: 26/07/2019 (am)

Cool Box Temperatures (°C): 23.6

Lab Sample ID	19/07111/1	19/07111/2
Client Sample No	8	5
Client Sample ID/Depth	CP01 4.00m	CP04 2.50m
Date Sampled	11/06/19	11/06/19
Deviation Code		
F	✓	✓

Key

F *Maximum holding time exceeded between sampling date and analysis for analytes listed below*

HOLDING TIME EXCEEDANCES

Lab Sample ID	19/07111/1	19/07111/2
Client Sample No	8	5
Client Sample ID/Depth	CP01 4.00m	CP04 2.50m
Date Sampled	11/06/19	11/06/19
Organic matter	✓	✓

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

IAN FARMER ASSOCIATES

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washington@ianfarmer.co.uk www.ianfarmer.co.uk

Merchant Exchange,
17-19Whitworth Street West,
Manchester,
M1 5WG

F.A.O.

Final Test Report - 42334 / 1

Site:	Gladstone Dock
Job Number:	42334
Originating Client:	Curtins Consulting
Originating Reference:	42334
Date Sampled:	Not Given
Date Scheduled:	15/07/2019
Date Testing Started:	30/07/2019
Date Testing Finished:	02/08/2019

Previous Reports		Amendments	Date Issued

Amendments:

Authorised By:

Paul Cathcart
Laboratory Manager

Report Issue Date: 02/08/2019

Constructionline
Part of Capita plc

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Offices in: **Cornwall** (01872) 261775. **Coventry** (024) 7630 3422. **Harpenden** (01582) 460018. **Llanelli** (01554) 566566.
Newcastle upon Tyne (0191) 482 8500. **Motherwell** (01698) 230231. **Warrington** (01925) 855440. **Washington** (0191) 482 8500.

AGS

Site: Gladstone Dock

Job Number: 42334

Client: Curtins Consulting

Determination of Water Content, Liquid Limit and Plastic Limit and Derivation of Plasticity and Liquidity Index

Borehole / Trial Pit	Depth (m)	Sample	Natural / Sieved	Natural Water Content %	Sample Passing 425 µm Sieve		Liquid Limit %	Plastic Limit %	Plasticity Index %	Liquidity Index	Class	Description / Remarks
					Percentage %	Water Content %						
CP01	3.50	D7	Natural	21.2	88	23.0	31	17	14	0.46	CL	Brown CLAY
CP01	4.00	U8	Natural	20	76	25.0	35	14	21	0.51	CL/CI	Brown gravelly CLAY
CP01	9.00	D18	Natural	19.9	77	24.0	30	14	16	0.65	CL	Brown CLAY
CP01	12.50	D23	Natural	19.2	68	26.0	38	17	21	0.42	CI	Brown CLAY
CP02	1.20	D4	Natural	8.9	59	12.0		NP				Brown gravelly, sandy CLAY
CP02	6.50	D12	Natural	16.9	78	20.0	20	14	6	1.04	CL	Brown sandy CLAY
CP02	10.50	D16	Natural	10.3	99	10.0	26	14	12	-0.30	CL	Brown CLAY
CP03	9.00	D13	Natural	17.7	88	19.0	25	14	11	0.49	CL	Brown CLAY
CP03	13.50	D20	Natural	7.5	93	7.7	70	33	37	-0.68	CH/CV	Brown gravelly CLAY
CP03	16.50	U24	Natural	12.3	76	15.0	30	13	17	0.10	CL	Brown gravelly CLAY
CP04	2.50	D5	Natural	21.3	64	30.0	25	15	10	1.53	CL	Brown sandy CLAY
CP04	3.00	D6	Natural	21.4	86	24.0	30	17	13	0.54	CL	Brown gravelly CLAY
CP04	6.50	D11	Natural	46.7	88	52.0	85	45	40	0.19	MV	Brown CLAY
CP04	9.50	D15	Natural	17.2	79	20.0	28	15	13	0.41	CL	Brown gravelly CLAY
CP04	15.50	D23	Natural	13.1	100	13.0	28	15	13	-0.15	CL	Brown gravelly CLAY
CP04	17.00	D25	Natural	18.6	77	23.0	22	14	8	1.08	CL	Brown sandy CLAY
CP05	2.00	D5	Natural	7.9	83	8.5	32	15	17	-0.38	CL	Brown CLAY
CP05	3.00	D9	Natural	4.7	89	4.7	31	17	14	-0.88	CL	Brown CLAY
CP05	10.50	D18	Natural	12.4	67	16.0	26	14	12	0.17	CL	Brown CLAY
CP05	15.00	D23	Natural	13.7	79	16.0	27	13	14	0.22	CL	Brown sandy, gravelly CLAY
CP06	2.00	D5	Natural	20.8	84	24.0	35	19	16	0.30	CL/CI	Brown silty, sandy CLAY
CP06	6.30	D10	Natural	38.1	76	49.0	41	25	16	1.48	CI	Brown sandy, silty CLAY
CP06	9.00	D13	Natural	15.7	100	16.0	32	19	13	-0.25	CL	Brown gravelly CLAY
CP06	18.00	D25	Natural	15.9	93	17.0	23	10	13	0.52	CL	Brown gravelly CLAY

Method of Preparation: BS EN ISO 17892 : Part 1 : 2014 : Clause 5.1 Water content test preparation
BS 1377 : Part 1 : 2016 : Clause 8.4.3 Preparation of samples for plasticity tests
BS 1377 : Part 2 : 1990 : Clause 4.2 Preparation of samples for plastic limit tests

Method of Test: BS EN ISO 17892 : Part 1 : 2014 : Clause 5.2 Water content test execution
BS 1377 : Part 2 : 1990 : Clause 4.3 or 4.4 Determination of the liquid limit
BS 1377 : Part 2 : 1990 : Clause 5.3 Determination of the plastic limit and plasticity index

UKAS TESTING 1464

IAN FARMER ASSOCIATES

Laboratory Test Report	42334 / 1

Site: Gladstone Dock **Job Number:** 42334

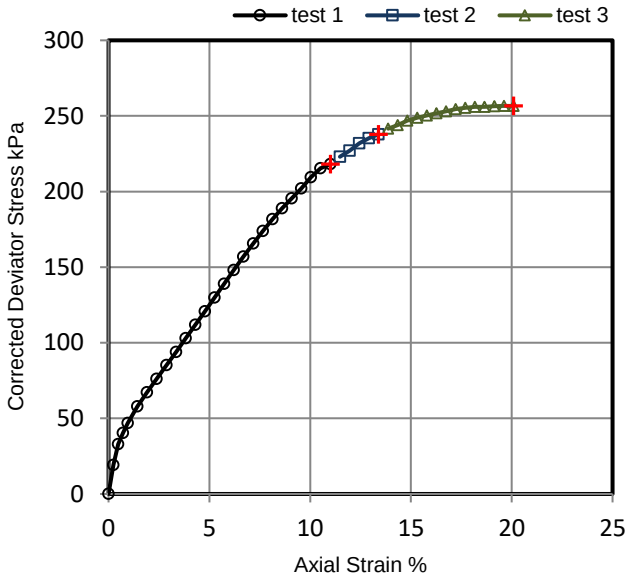
Client: Curtins Consulting **Page:** 3

Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - Multistage test

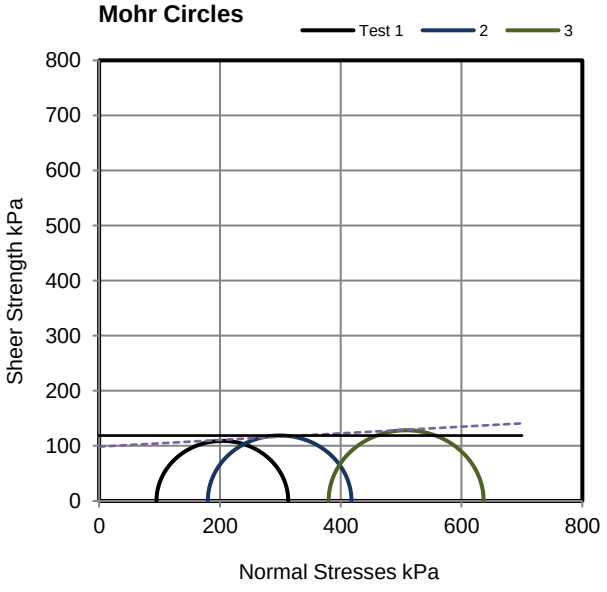
Borehole / Trial Pit	Depth (m)	Sample	Description
CP02	9.50	U14	Brown silty, sandy, gravelly CLAY

Initial Sample	Original Length (mm)	440		
	Depth from Top (mm)	40		
	Condition	Undisturbed		
	Orientation	Vertical		
Length (mm)		209.08		
Diameter (mm)		102.56		
Moisture Content (%)		19.4		
Bulk Density (Mg/m3)		2.13		
Dry Density (Mg/m3)		1.79		
Membrane Thickness (mm)		0.31		
Membrane Type		Latex		
Rate of Strain (%/min)		1.91		
Test Results	Stage Number	1	2	3
	Cell Pressure (kPa)	95	180	380
	Axial Strain (%)	11	13	20
	Membrane Corr. (kPa)	0.7	0.8	1.2
	Deviator Stress (σ1 - σ3)f (kPa)	218	238	257
	Undrained Shear Strength, CU = ½(σ1 - σ3)f (kPa)	109	119	128
	Mode of Failure	Plastic		

Deviator Stress v Axial Strain



Mohr Circles



ϕu = 0

Average cu 119 kPa

Linear Regression

ϕu 3.5 °

cu 99 kPa

Mohr circles and their interpretation is not covered by BS1377. These are provided for information only.

Method of Preparation: BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or
BS 1377:PT1:1990:7.7.5.2 Preparation of disturbed samples for testing

Method of Test: BS 1377:PT2:1990:7.2 Determination of density by linear measurement.
BS 1377:PT7:1990:9.4 Determination of undrained shear strength in triaxial compression with multistage loading and without measurement of pore pressure (Definitive method)

UKAS TESTING 1464

IAN FARMER ASSOCIATES

Laboratory Test Report	42334 / 1

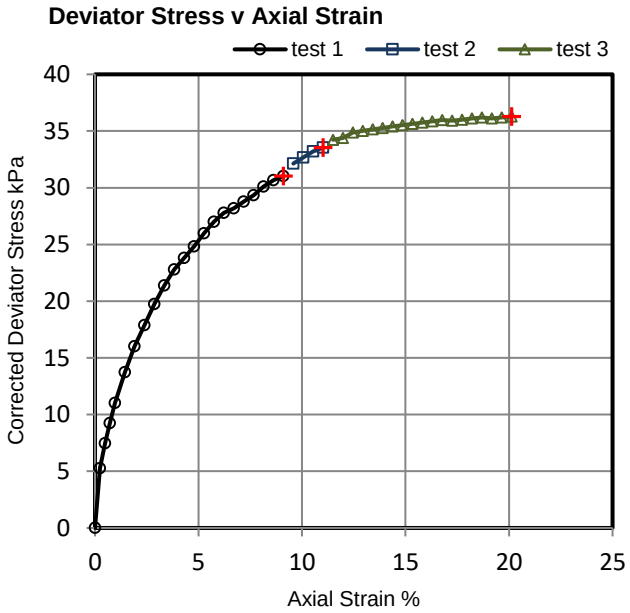
Site: Gladstone Dock **Job Number:** 42334

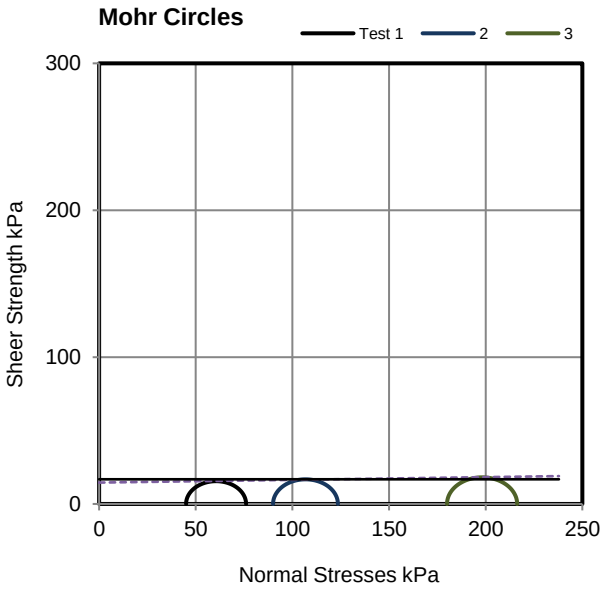
Client: Curtins Consulting **Page:** 4

Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - Multistage test

Borehole / Trial Pit	Depth (m)	Sample	Description
CP04	5.00	U8	Brown silty, sandy, gravelly CLAY

Initial Sample	Original Length (mm)	340		
	Depth from Top (mm)	20		
	Condition	Undisturbed		
	Orientation	Vertical		
Length (mm)		208.75		
Diameter (mm)		103.83		
Moisture Content (%)		17.9		
Bulk Density (Mg/m3)		2.14		
Dry Density (Mg/m3)		1.81		
Membrane Thickness (mm)		0.3		
Membrane Type		Latex		
Rate of Strain (%/min)		1.92		
Test Results	Stage Number	1	2	3
	Cell Pressure (kPa)	45	90	180
	Axial Strain (%)	9	11	20
	Membrane Corr. (kPa)	0.6	0.7	1.1
	Deviator Stress (σ1 - σ3)f (kPa)	31	34	36
	Undrained Shear Strength, CU = ½(σ1 - σ3)f (kPa)	16	17	18
	Mode of Failure	Plastic		





ϕu = 0

Average cu 17 kPa

Linear Regression

ϕu 1.1 °

cu 15 kPa

Mohr circles and their interpretation is not covered by BS1377. These are provided for information only.

Method of Preparation: BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or
BS 1377:PT1:1990:7.7.5.2 Preparation of disturbed samples for testing

Method of Test: BS 1377:PT2:1990:7.2 Determination of density by linear measurement.
BS 1377:PT7:1990:9.4 Determination of undrained shear strength in triaxial compression with multistage loading and without measurement of pore pressure (Definitive method)

UKAS TESTING 1464

IAN FARMER ASSOCIATES

Laboratory Test Report	42334 / 1

Site: Gladstone Dock **Job Number:** 42334

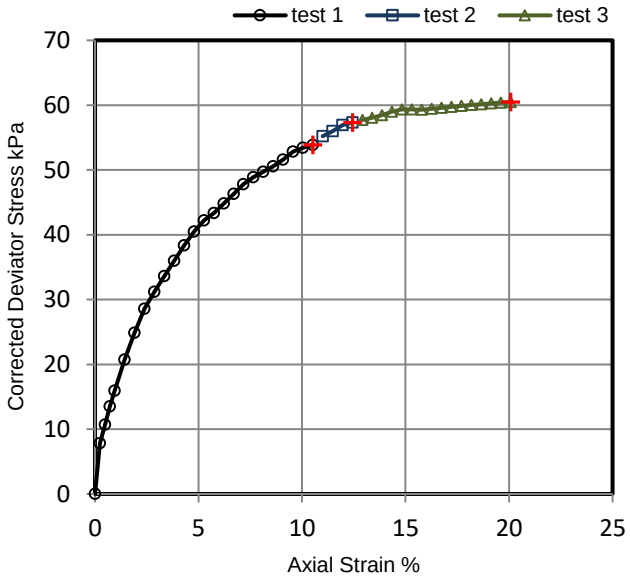
Client: Curtins Consulting **Page:** 5

Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - Multistage test

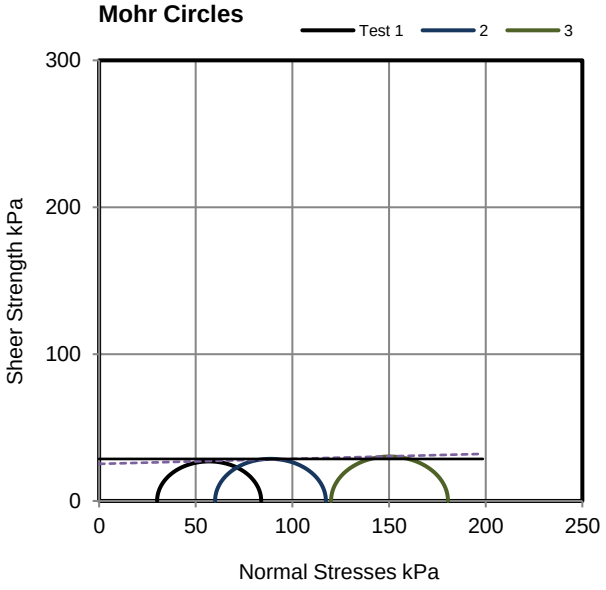
Borehole / Trial Pit	Depth (m)	Sample	Description
CP06	3.00	U6	Brown silty, sandy, gravelly CLAY

Initial Sample	Original Length (mm)	320		
	Depth from Top (mm)	10		
	Condition	Undisturbed		
	Orientation	Vertical		
Length (mm)		209.10		
Diameter (mm)		102.86		
Moisture Content (%)		19.7		
Bulk Density (Mg/m3)		2.11		
Dry Density (Mg/m3)		1.76		
Membrane Thickness (mm)		0.31		
Membrane Type		Latex		
Rate of Strain (%/min)		1.91		
Test Results	Stage Number	1	2	3
	Cell Pressure (kPa)	30	60	120
	Axial Strain (%)	11	12	20
	Membrane Corr. (kPa)	0.7	0.8	1.2
	Deviator Stress (σ1 - σ3)f (kPa)	54	57	60
	Undrained Shear Strength, CU = ½(σ1 - σ3)f (kPa)	27	29	30
	Mode of Failure	Plastic		

Deviator Stress v Axial Strain



Mohr Circles



ϕu = 0

Average cu 29 kPa

Linear Regression

ϕu 2.0 °

cu 25 kPa

Mohr circles and their interpretation is not covered by BS1377. These are provided for information only.

Method of Preparation: BS 1377:PT1:1990:8.3 Preparation of undisturbed samples for testing or
BS 1377:PT1:1990:7.7.5.2 Preparation of disturbed samples for testing

Method of Test: BS 1377:PT2:1990:7.2 Determination of density by linear measurement.
BS 1377:PT7:1990:9.4 Determination of undrained shear strength in triaxial compression with multistage loading and without measurement of pore pressure (Definitive method)

UKAS TESTING 1464

Final Test Report - 42334 / 1

Site:	Gladstone Dock
Job Number:	42334
Originating Client:	Curtins Consulting

All opinions and interpretations contained within this report are outside of our Scope of Accreditation.

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Samples will be retained for 28 days from date of issue of the final test report before being disposed of, unless we receive written instruction to the contrary.

Report Issue Date: 02/08/2019

Appendix E GAC Screening Thresholds

- Curtins GAC Thresholds for 1.0% SOM.
- Curtins Tier 1 Thresholds for Water Contaminants.
- Curtins Groundwater Vapour GAC (SoBRA).

Adopted Soil Generic Assessment Criteria
Sandy loam with 1% SOM

curtins

Contaminants	Residential with home grown produce	Residential without home grown produce	Allotments	Commercial	Public open space near residential housing POS_{resi}	Public park POS_{park}
Metals						
Beryllium	*1.7*	*1.7*	*35*	*12*	*2.2*	*63*
Boron	*290*	*11,000*	*45*	*240,000*	*21,000*	*46,000*
Cadmium	**10**[13] 22	**85**[13] 150	**1.8** 3.9	**230** 410	*120* 220	*560* 880
Chromium III	*910*	*910*	*18,000*	*8,600*	*1,500*	*33,000*
Chromium VI	*6* 21	*6* 21	*1.8* 170	*33* 49	*7.7* 21	*220* 250
Lead	200	310	80	2,300	630	1,300
Mercury *(elemental)*	**1**	**1**	**26**	**26**	*16*	**26**[8] *[30]*
Mercury (inorganic)	**170**	**240**	**80**	**3600**	*120*	*240*
Nickel	*130*[10]	*180*[10]	*53*[11]	*980*[10]	*230*	*800*
Vanadium	*410*	*1200*	*91*	*9000*	*2000*	*5000*
Copper	*2400*	*7100*	*520*	*68000*	*12000*	*44000*
Zinc	*3700*	*40000*	*620*	*730000*	*81000*	*170000*
Semi-Metals and non-metals						
Arsenic	**32**[12] 37	**35**[12] 40	**43**[12] 49	**640**[12] 640	*79* 79	*170* 170
Antimony		***550***		***7500***	***1500***	***3300***
Selenium	**350**	**600**	**120**	**13000**	*1100*	*1800*
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
Aliphatic risk banded hydrocarbons - TPHCWG method						
$EC_{>5}$ - EC_6	*42*	*42*	*730*	*3200*	*570000*	*95000*
$EC_{>6}$ - EC_8	*100*	*100*	*2300*	*7800*	*600000*	*150000*
$EC_{>8}$ - EC_{10}	*27*	*27*	*320*	*2000*	*13000*	*14000*
EC_{10}-EC_{12}	*130*	*130*	*2200*	*9700*	*13000*	*21000*
EC_{12}-EC_{16}	*1100*	*1100*	*11000*	*59000*	*13000*	*25000*
$EC_{>16}$ - EC_{35}	*65000*	*65000*	*260000*	*1600000*	*250000*	*450000*
$EC>_{35}$ - EC_{44}	*65000*	*65000*	*260000*	*1600000*	*250000*	*450000*
Aromatic risk banded hydrocarbons - TPHCWG method						
$EC>_5$ - EC_7	*70*	*370*	*13*	*26000*	*56000*	*76000*
$EC>_7$ - EC_8	*130*	*860*	*22*	*56000*	*56000*	*87000*
$EC_{>8}$ - EC_{10}	*34*	*47*	*8.6*	*3500*	*5000*	*7200*
EC_{10} - EC_{12}	*74*	*250*	*13*	*16000*	*5000*	*9200*
EC_{12} - EC_{16}	*140*	*1800*	*23*	*36000*	*5100*	*10000*
$EC_{>16}$ - EC_{21}	*260*	*1900*	*46*	*28000*	*3800*	*7600*
$EC_{>21}$ - EC_{35}	*1100*	*1900*	*370*	*28000*	*3800*	*7800*
$EC>_{35}$ - EC_{44}	*1100*	*1900*	*370*	*28000*	*3800*	*7800*
Aliph + Arom EC >44-70	*1600*	*1900*	*1200*	*28000*	3800	7800
Aromatic						
Benzene	**0.08**	**0.3**	**0.017**	**28**	*72*	*90*
Ethyl benzene	**65**	**170**	**16**	**520**[8] [17000]	**520**[8] *[24000]*	**520**[8] *[17000]*
Toluene	**120**	**610**	**22**	**860**[8] [59000]	**860**[8] *[56000]*	**860**[8] *[87000]*
Xylene[9]	**41**	**53**	**28**	**480**[8] [69000]	**480**[8] *[41000]*	**480**[8] *[17000]*
Phenol	**180**	**310**	**66**	**760**[14] (31000)	**760**[14] *(10000)*	**760**[14] *(7600)*
Polycyclic Aromatic Hydrocarbons (PAH)						
Naphthalene	*2.3*	*2.3*	*4.1*	*190*	*4900*	*1200*
Acenaphthylene	*170*	*2900*	*28*	*83000*	*15000*	*29000*
Acenaphthene	*210*	*3000*	*34*	*84000*	*15000*	*29000*
Fluorene	*170*	*2800*	*27*	*63000*	*9900*	*20000*
Phenanthrene	*95*	*1300*	*15*	*22000*	*3100*	*6200*
Anthracene	*2400*	*31000*	*380*	*520000*	*74000*	*150000*
Fluoranthene	*280*	*1500*	*52*	*23000*	*3100*	*6300*
Pyrene	*620*	*3700*	*110*	*54000*	*7400*	*15000*
Benz(a)anthracene	*7.2*	*11*	*2.9*	*170*	*29*	*49*
Chrysene	*15*	*30*	*4.1*	*350*	*57*	*93*
Benzo(b)fluoranthene	*2.6*	*3.9*	*0.99*	*44*	*7.1*	*13*
Benzo(k)fluoranthene	*77*	*110*	*37*	*1200*	*190*	*370*
Benzo(a)pyrene	*2.2*	*3.2*	*0.97*	*35*	*5.7*	*11*
Indeno(123cd)pyrene	*27*	*45*	*9.5*	*500*	*82*	*150*
Dibenzo(ah)anthracene	*0.24*	*0.31*	*0.14*	*3.5*	*0.57*	*1.1*
Benzo(ghi)perylene	*320*	*360*	*290*	*3900*	*640*	*1400*
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	*0.00064*	*0.00077*	*0.00055*	*0.059*	*3.5*	*4.8*
Trichloroethene (TCE)	*0.016*	*0.017*	*0.041*	*1.2*	*120*	*70*
1,1,1,2 Tetrachlorethane	*1.2*	*1.5*	*0.79*	*110*	*1400*	*1500*
Tetrachlorethene (PCE)	*0.18*	*0.18*	*0.65*	*19*	*1400*	*810*
1,1,1 Trichlorethane	*8.8*	*9*	*48*	*660*	*140000*	*57000*

Notes

1. All values above are in mg/kg
2. **Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters**, *numbers in italics are S4ULs*, ***numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters*** and underlined numbers are C4SLs
3. Soil organic matter (SOM) is assumed to be 1% - DEFAULT VALUE
4. Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
5. For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
6. For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
7. For classrooms consider increasing the dust loading fator in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m^{-3}
8. Based on vapour saturation limt as suggested by EA / [ ] model value
9. Lowest of o-, m- and p-xylene
10. Based on comparison of inhalation exposure with inhalation TDI
11. Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
12. Based on a comparison of oral and dermal soil exposure with oral Index Dose only
13. Averaged over and based on lifetime exposure
14. Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
15. NA: Not applicable

5 GENERIC ASSESSMENT CRITERIA

5.1 Derived GAC_{gwvap}

The following section provides a summary of the GAC_{gwvap}, presented in the following groups:

- Petroleum Hydrocarbons - Table 6
- Polycyclic Aromatic Hydrocarbons (PAHs) – Table 7
- Pesticides – Table 8
- Halogenated Organics – Table 9
- 'Others' (organic and inorganic) – Table 10

In addition, those substances for which GAC_{gwvap} have not been derived due to having a Kaw lower than $4x10^{-4}$ are listed in Table 11.

Table 6 - GAC_{gwvap} for Petroleum Hydrocarbons

Chemical	CAS	GAC_{gwvap} (µg/l) [1,2]		Aqueous Solubility (µg/l)
		Residential	Commercial	
1,2,4-Trimethylbenzene	95-63-6	24	2,200	559,000
Benzene [3]	71-43-2	210	20,000	1,780,000
Ethylbenzene [3]	100-41-4	10,000	*960,000 (sol)*	180,000
Isopropylbenzene	98-82-8	850	*86,000 (sol)*	56,000
Propylbenzene	103-65-1	2,700	*240,000 (sol)*	54,100
Styrene	100-42-5	8,800	*810,000 (sol)*	290,000
Toluene [3]	108-88-3	230,000	*21,000,000 (sol)*	590,000
TPH Aliphatic EC5-EC6 [3]		1,900	*190,000 (sol)*	35,900
TPH Aliphatic >EC6-EC8 [3]		1,500	*150,000 (sol)*	5,370
TPH Aliphatic >EC8-EC10 [3]		57	*5,700 (sol)*	427
TPH Aliphatic >EC10-EC12 [3]		37	*3,600 (sol)*	34
TPH Aromatic >EC5-EC7 [2,3]		210,000	*20,000,000 (sol)*	1,780,000
TPH Aromatic >EC7-EC8 [3]		220,000	*21,000,000 (sol)*	590,000
TPH Aromatic >EC8-EC10 [3]		1,900	*190,000 (sol)*	64,600
TPH Aromatic >EC10-EC 12 [3]		6,800	*660,000 (sol)*	24,500
TPH Aromatic >EC12-EC16 [3]		39,000	*3,700,000 (sol)*	5,750
meta-Xylene [3,5]	108-38-3	9,500	*940,000 (sol)*	200,000
ortho-Xylene [3,5]	95-47-6	12,000	*1,100,000 (sol)*	173,000
para-Xylene [3,5]	106-42-3	9,900	*980,000 (sol)*	200,000

Notes

1. GAC in *italics* with (sol) exceed aqueous solubility. See Section 5.3.
2. GAC rounded to two significant figures.
3. The GAC for these petroleum hydrocarbon contaminants have been calculated using a sub-surface soil to indoor air correction factor of 10 in line with the physical-chemical data sources
4. The GAC for TPH fractions do not account for genotoxic mutagenic effects. Concentrations of TPH Aromatic >EC5-EC7 should therefore also be compared with the GAC for benzene to ensure that such effects are also assessed.
5. The Health Criteria Value used for each xylene isomer was for total xylene. If site specific additivity assessments are not completed, as a conservative measure the sum of isomer concentrations should be compared to the lowest xylene GAC (as is the case for soil GAC).

Table 7 - GAC_{gwvap} for Polycyclic Aromatic Hydrocarbons (PAH)

Chemical	CAS	GAC_{gwvap} (µg/l) [1,2]		Aqueous Solubility (µg/l)
		Residential	Commercial	
Acenaphthene	83-32-9	*170,000 (sol)*	*15,000,000 (sol)*	4,110
Acenaphthylene	208-96-8	*220,000 (sol)*	*20,000,000 (sol)*	7,950
Fluorene	86-73-7	*210,000 (sol)*	*18,000,000 (sol)*	1,860
Naphthalene	91-20-3	220	*23,000 (sol)*	19,000

Notes

1. GAC in *italics* with (sol) exceed aqueous solubility. See Section 5.3.
2. GAC rounded to two significant figures.

Table 8 - GAC_{gwvap} for Pesticides

Chemical	CAS	GAC_{gwvap} (µg/l) [1,2]		Aqueous Solubility (µg/l)
		Residential	Commercial	
Aldrin	309-00-2	*47 (sol)*	*3,700 (sol)*	20
alpha-Endosulfan	959-98-8	*7,400 (sol)*	*590,000 (sol)*	530
beta-Endosulfan	33213-65-9	*7,500 (sol)*	*600,000 (sol)*	280

Notes

1. GAC in *italics* with (sol) exceed aqueous solubility. See Section 5.3.
2. GAC rounded to two significant figures.

Table 9 - GAC_{gwvap} for Halogenated Organics

Chemical	CAS	GAC_{gwvap} (µg/l) [1,2]		Aqueous Solubility (µg/l)
		Residential	Commercial	
1,1,1,2-Tetrachloroethane	79-34-5	240	22,000	1,110,000
1,1,1-Trichloroethane	71-55-6	3,000	290,000	1,300,000
1,1,2,2-Tetrachloroethane	79-35-4	1,600	150,000	2,930,000
1,1,2-Trichloroethane	79-00-5	520	49,000	4,491,000
1,1-Dichloroethane	75-34-3	2,700	260,000	3,666,000
1,1-Dichloroethene	75-35-4	160	16,000	3,100,000
1,2,3,4-Tetrachlorobenzene	634-66-2	240	*31,000 (sol)*	7,800
1,2,3,5-Tetrachlorobenzene	634-90-2	7.0	600	3,500
1,2,3-Trichlorobenzene	87-61-7	35	3,100	21,000
1,2,4,5-Tetrachlorobenzene	95-94-3	8.1	*700 (sol)*	600
1,2,4-Trichlorobenzene	120-82-1	68	7,200	41,400
1,2-Dichlorobenzene	95-50-1	2,000	*220,000 (sol)*	133,000
1,2-Dichloroethane	107-06-2	8.9	850	8,680,000
1,2-Dichloropropane	78-87-5	22	2,600	2,050,000

Chemical	CAS	GAC_{gwvap} (µg/l) [1,2]		Aqueous Solubility (µg/l)
		Residential	Commercial	
1,3,5-Trichlorobenzene	108-70-3	7.4	660	6,000
1,3-Dichlorobenzene	541-73-1	31	2,800	103,000
1,4-Dichlorobenzene	106-46-7	5,000	*460,000 (sol)*	51,200
Bromobenzene	108-86-1	220	20,000	388,040
Bromodichloromethane	75-27-4	17	1,600	3,000,000
Bromoform (Tribromomethane)	75-25-2	3,100	400,000	3,000,000
Chlorobenzene	108-90-7	98	15,000	387,000
Chloroethane	75-00-3	10,000	1,000,000	5,742,000
Chloroethene (Vinyl Chloride)	75-01-4	0.62	63	2,760,000
Chloromethane	74-87-3	14	1,400	5,350,000
cis-1,2-Dichloroethene	156-59-2	130	13,000	7,550,000
Dichloromethane	75-09-2	3,300	370,000	20,080,000
Hexachlorobenzene	118-74-1	*16 (sol)*	*1,400 (sol)*	10
Hexachlorobutadiene	87-68-3	1.7	230	4,800
Hexachloroethane	67-72-1	8.5	740	49,900
Pentachlorobenzene	608-93-5	140	*12,000 (sol)*	500
Tetrachloroethene	127-18-4	34	4,600	225,000
Tetrachloromethane (Carbon Tetrachloride)	56-23-5	5.3	770	846,000
trans-1,2-Dichloroethene	156-60-5	160	16,000	5,250,000
Trichloroethene	79-01-6	5.7	530	1,370,000
Trichloromethane (Chloroform)	67-66-3	790	85,000	8,950,000

Notes

1. GAC in *italics* with (sol) exceed aqueous solubility. See Section 5.3
2. GAC rounded to two significant figures.

Table 10 - GAC_{gwvap} for Others (organic and inorganic)

Chemical	CAS	GAC_{gwvap} (µg/l) [1,2]		Aqueous Solubility (µg/l)
		Residential	Commercial	
2-Chloronaphthalene	91-58-7	160	*14,000 (sol)*	11,700
Biphenyl (Lemonene)	92-52-4	*15,000 (sol)*	*1,300,000 (sol)*	4,060
Carbon disulphide	75-15-0	56	5,600	2,100,000
Mercury, elemental	7439-97-6	1.1	*95 (sol)*	56
Methyl tertiary butyl ether (MTBE)	1634-04-4	83,000	7,800,000	48,000,000

Notes

1. GAC in *italics* with (sol) exceed aqueous solubility. See Section 5.3.
2. GAC rounded to two significant figures.

Table 11 – Substances for which GAC_{gwvap} have not been derived due to being insufficiently volatile (K_{aw} < $4x10^{-4}$) or aqueous solubility (≤1 µg/L)

Chemical	CAS	Kaw (cm^3/cm^3)	Aqueous Solubility (µg/l)	Reference
Petroleum Hydrocarbons				
Aliphatic C12-C16		171	0.759	1
Aliphatic C16-C35		1070	0.00254	1
Aliphatic C35-C44		1070	0.00254	1
Aromatic C16-C21		6.95E-04	653	1, 3
Aromatic C21-C35		2.48E-05	6.61	1
Aromatic C35-C44		2.48E-05	6.61	1
Aromatic and Aliphatic C44-C70		1.64E-03	0.1	1
PAHs				
Anthracene	120-12-7	1.81E-04	56	1
Benzo[b]fluoranthene	205-99-2	2.05E-06	2	1
Benzo[ghi]perylene	191-24-2	2.86E-06	0.26	1
Benzo[a]anthracene	56-55-3	3.16E-05	3.8	1
Benzo[a]pyrene	50-32-8	1.76E-06	3.8	1
Benzo[k]fluoranthene	207-08-9	1.74E-06	0.8	1
Chrysene	218-01-9	3.18E-06	2	1
Dibenzo[ah]anthracene	53-70-3	5.4E-06	0.6	1
Fluoranthene	206-44-0	6.29E-05	230	1
Indeno[123-cd]pyrene	193-39-5	2.05E-06	0.2	1
Phenanthrene	85-01-8	1.43E-04	1120	1
Pyrene	129-00-0	5.64E-05	130	1
Others				
2,3,4,6-Tetrachlorophenol	58-90-2	2.33E-05	183000	1
2,4,6-Trichlorophenol	88-06-2	3.36E-05	434000	1
2,4,6-Trinitrotoluene	118-96-7	3.32E-07	76400	1
2,4-Dichlorophenol	120-83-2	3.52E-05	4500000	1
2,4-Dimethylphenol	105-67-9	3.57E-04	8106000	2
2,4-Dinitrotoluene	121-14-2	3.67E-07	129000	2
2,6-Dinitrotoluene	606-20-2	1.57E-06	232000	2
2-Chlorophenol	95-57-8	8.08E-05	22700000	1
2-Methylphenol	95-48-7	1.80E-05	12383000	2
3-Methylphenol	108-39-4	1.04E-05	22500000	2
4-Methylphenol	106-44-5	1.63E-05	23392000	2
alpha-Hexachlorocyclohexane	319-84-6	8.11E-05	2000	1

Chemical	CAS	Kaw (cm^3/cm^3)	Aqueous Solubility (µg/l)	Reference
Atrazine	1912-24-9	2.81E-08	70000	1
beta-Hexachlorocyclohexane	319-85-7	4.71E-06	200	1
Bis (2-ethylhexyl) phthalate	117-81-7	3.90E-05	270	2
Butyl benzyl phthalate	85-68-7	5.26E-06	2320	2
Dichlorvos	62-73-7	6.51E-07	16000000	1
Dieldrin	60-57-1	3.51E-04	200	1
Diethyl Phthalate	84-66-2	2.64E-04	1200000	2
Di-n-butyl phthalate	84-74-2	3.00E-04	13300	2
Di-n-octyl phthalate	117-84-0	4.96E-12	75.83076	2
gamma-Hexachlorocyclohexane	58-89-9	3.10E-05	7300	1
HMX	2691-41-0	1.49E-14	1210	1
Pentachlorophenol	87-86-5	5.55E-06	14000	1
Phenol	108-95-2	8.35E-06	84100000	1
RDX	121-82-4	1.31E-10	21900	1
Tributyl tin oxide	56-35-9	4.24E-05	5100	2

References

1. Nathanail et al, 2015

2. CL:AIRE, 2010

3. TPHCWG, 1997 noted that an inhalation reference concentration (health criteria value) could not be determined for this fraction "*because the compounds in this carbon range are not volatile*".

5.2 Use of GAC_{gwvap}

This section provides a brief summary of how the GAC_{gwvap} are intended to be used.

Each GAC_{gwvap} is the theoretical concentration in groundwater / perched water beneath a property that is modelled as resulting in estimated average daily exposure (ADE) to the critical receptor that is equal to the HCV, i.e. ADE=HCV or ADE/HCV =1.

The GAC have been designed to incorporate a number of precautionary assumptions. This means that in most cases the exposure to the critical receptor will actually be significantly lower than the HCV, so that further consideration of the risks to human health from vapour intrusion from groundwater / perched water, is not required. These conservatisms include:

- the assumption that the impacted groundwater / perched water is directly beneath the building, when in fact it may be laterally offset from the receptor;
- the assumption that there is an infinite source term, when in fact the source may be finite;

Tier 1 Thresholds

Water Contaminants: Initial Assessment of Risk

Introduction

The Generic Assessment Criteria (GAC) employed as Tier 1 Controlled Water Screening criteria are given in Tables 1 and 2. The more conservative available Drinking Water Standards (DWS) and Environmental Quality Standards (EQS) (Freshwater and Saltwater), applicable in England and Wales have been included in the tables.

The list of determinands is non-industry specific and it should be recognised that additional site specific determinands may need to be taken into account. The applicability of these criteria, with regard to the developed Conceptual Site Model, is discussed within the relevant section of the preceding report. Further details on individual GAC can be obtained in the referenced source legislation.

Generic Assessment Criteria

Table 1 – Inorganic Contaminant Controlled Waters Generic Assessment Criteria

Contaminant	Units	Hardness Banding (mg/l CaCO3)	EQS (Freshwater)	EQS (Saltwater)	EU DWS	WHO
Arsenic	µg/l	-	50	25	10	10
Boron	µg/l	-	2000	7000	1000	0.3
Cadmium	µg/l	<40	0.08	0.2	5	3
		40- <50	0.08			
		50- <100	0.09			
		100- <200	0.15			
		>200	0.25			
Chromium III	µg/l	-	4.7	-	50	50
Chromium VI	µg/l	-	3.4	0.6		
Copper	µg/l	-	1 bioavailable[i]	3.76 Where DOC[ii] ≤ 1mg	2000	2000
				3.76 + (2.677 x ((DOC/2)-0.5)) Where DOC[ii] >1mg/l		
Cyanide (Free)	µg/l	-	1	1		
Cyanide (Total)	µg/l	-	1	1	50	70
Iron	µg/l	-	1000	1000	200	300
Lead	µg/l		1.2	1.3	10	10
Mercury	µg/l	-	0.07[iii]	0.07 [iii]	1	1
Nickel	µg/l	-	4 bioavailable[i]	8.6	20	70

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Contaminant	Units	Hardness Banding (mg/l CaCO3)	EQS (Freshwater)	EQS (Saltwater)	EU DWS	WHO
Selenium	µg/l	-	-	-	10	10
Sulphate	mg/l	-	400	-	250	-
Sulphide	µg/l	-	0.25	-	-	-
Zinc	µg/l	-	10.9 bioavailable[ii] + ABC[v]	6.8 dissolved[iV] + ABC	5000	3000

i - fraction likely to have toxic effect as determined using the UKTAG Metal Bioavailability Assessment Tool
ii - concentration of dissolved organic carbon in mg/l of the receiving water (as identified in the Conceptual Site Model)
iii - in absence on Annual Average the Maximum Allowable Concentration Used
iv - total dissolved as reported
V - Average Background Concentration (ABC) as listed in Part 2 Table 2 in Ref. 1.

Table 2 – Organic Contaminant Controlled Waters Generic Assessment Criteria

Contaminant	Units	EQS (Freshwater)	EQS (Saltwater)	EU DWS	WHO
Organics					
Phenol (total)	µg/l	7.7	7.7	0.5	-
MTBE	µg/l	-	-	-	15
Total Petroleum Hydrocarbons (TPH)					
Aliphatic C5-C6	µg/l	-	-	-	15000
Aliphatic C6-C8	µg/l	-	-	-	15000
Aliphatic C8-C10	µg/l	-	-	-	300
Aliphatic C10-C12	µg/l	-	-	-	300
Aliphatic C12-C16	µg/l	-	-	-	300
Aliphatic C16-C21	µg/l	-	-	-	300
Aliphatic C21-C35	µg/l	-	-	-	300
Aromatic C6-C7 (benzene)	µg/l	10	8	1	10
Aromatic C7-C8 (toluene)	µg/l	74	74	-	700
Aromatic C8-C10 (ethylbenzene)	µg/l	20	20	-	300
Aromatic C10-C12	µg/l	-	-	-	100
Aromatic C12-C16	µg/l	-	-	-	100
Aromatic C16-C21	µg/l	-	-	-	90
Aromatic C21-C35	µg/l	-	-	-	90
Total Hydrocarbons (Dissolved / Emulsion)	µg/l	-	-	10 (revoked)	300

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Contaminant	Units	EQS (Freshwater)	EQS (Saltwater)	EU DWS	WHO
BTEX Compounds					
Benzene	µg/l	10	8	1	10
Toluene	µg/l	74	74	-	700
Ethyl-benzene	µg/l	20	20	-	300
Xylene (o+p+m)	µg/l	30	30	-	-
Polycyclic Aromatic Hydrocarbons (PAH)					
Anthracene	µg/l	0.1	0.1	-	-
Benzo(a)pyrene	µg/l	0.00017	0.00017	0.01	0.01
Napthalene	µg/l	2	2	-	-
PAHs Sum of four- benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, indeno(1,2,3-c,d)pyrene	µg/l	-	-	0.1	-

References

1 The Water Framework Directive, (Standards and Classification) Directions (England and Wales) [2015]
2 Council Directive 76/464/EEC, Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) [1976]
3 Council Directive 98/83/EC on the quality of water intented for human consumption [1998]
4 World Health Organisation (WHO), Guidelines for Drinking Water Quality. Third edition [2004]

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