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Report No 2859/02-1

**MANCHESTER ENTERPRISE ACADEMY,
SIMONSWAY, WYTHENSHAW,
MANCHESTER, M22 9RH**

PHASE 2 SITE INVESTIGATION REPORT

Carried out for: Willmott Dixon Construction Ltd

Lead Consultant: Kier Business Services Ltd



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DISCLAIMER

This report should be read with the Service Constraints Report Limitations & Planning Requirements set out in Appendix A.



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PHASE 2 INVESTIGATION REPORT

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PHASE 2 SITE INVESTIGATION REPORT

1. INTRODUCTION

1.1 Background Information

1.1.1 TerraConsult Limited was commissioned by Willmott Dixon Construction Ltd to carry out an intrusive site investigation at Manchester Enterprise Academy. The purpose of the report is to provide intrusive site investigation information on conditions at the site for a new block of classrooms to enable the number of pupils to be doubled at the academy. There will also be a new 4G (MUGA) pitch constructed.

1.1.2 This report has been devised to generally comply with the relevant principles and requirements of a range of guidance including:

- Part IIA of the Environment Protection Act, 1990;
- Contaminated Land (England) (Amendment) Regulations 2012 and Contaminated Land Statutory Guidance (DEFRA, April 2012);
- National Planning Policy Framework (HCA, March 2012);
- BS5930:2015: “Code of practice for site investigations”;
- BS10175: 2011 +A1:2013 “Investigation of Potentially Contaminated Sites - Code of Practice”;
- DEFRA/Environment Agency (2004) Report CLR11 “Model Procedures for the Management of Land Contamination”;
- Environment Agency (2011) Report GPLC1 “Guiding Principles for Land Contamination”;
- Environment Agency (2013) Report GP3 “Groundwater protection: Principles and Practice” Version 1.1.

1.1.3 TerraConsult’s service constraints and report limitations are presented in Appendix A and a description of environmental risk assessment methodology and terminology is presented in Appendix B. This report should be read in conjunction with TerraConsult’s Phase 1 report for the development (Report 2859R01-1 of June 2016).

1.2. Development Proposals

1.2.1 The proposed development of the site is indicated on the following drawings from Ryder Landscape Consultants:

- 16008-RYD-00-XX-GA-L-20000 (3) General Arrangement
- 16008-RYD-00-XX-GA-L-20004 Existing & Proposed Overlay

1.2.2 The development is summarised below:

- The proposed location of the new school building is to be on the site of an existing landscaped area. The proposed 3 storey school building will likely comprise of steel frame construction with ground bearing concrete or suspended slab, suspended composite metal deck concrete floors, lightweight external walls and a lightweight metal deck roof. Column loads are likely to be in the order of 1,450kN (unfactored).
- A 4G football pitch, new MUGA for basketball and netball ,
- hard surfaced car parking (two areas, one in west and one in northwest,
- associated hard and soft landscaping; and
- new below ground drainage will be required including removal of an existing attenuation tank from below the southern end of the new building and construction of a new attenuation tank below the 4G football pitch.

1.2.3 There are no proposals regarding possible development on the playing fields at the north of the site. However, investigation was requested of this area to provide information if further developments were required at the site such as more MUGA pitches etc.

1.2.4 The findings and conclusions of the risk assessments have been set out and recommendations given for the proposed end use as a school. If there is a subsequent change in the proposed land the risk assessments and conclusions should be reviewed to determine whether they are still applicable for the revised end use.

1.3. Planning Status & Requirements

1.3.1 This report is designed to comply with the requirements of The National Planning Policy Framework (NPPF, 2012) and is intended to be used by the developer as part of the submission to gain planning for the works.

1.4 Scope of the Investigation

1.4.1 The scope of the investigation were to meet the requirements to provide information for planning purposes and for design of the development. The specific activities carried out are as follows:

- carry out an intrusive investigation comprising a single rotary boreholes, dynamic sampling, trial pitting with associated sampling;
- ground gas and groundwater monitoring;
- laboratory testing for potential contaminants and geotechnical purposes;
- assess the general nature and extent of contamination at the site and carry out a contamination risk assessment to determine if the site poses a risk to potential receptors;

- to monitor the ground gas conditions at the site and confirm that the conditions are Characteristic Situation 1, very low risk;
- should the investigation indicate that remediation of contaminants be required, provide recommendations of feasible remedial measures to facilitate development of the site for an academic / school end use;
- provide geotechnical information on the ground conditions for design of foundations, floor slabs and hard standing.

1. SITE LOCATION AND DESCRIPTION

2.1 Site Location

2.1.1 The site is indicated in Figure 1 below and the site location is summarised in Table 1:

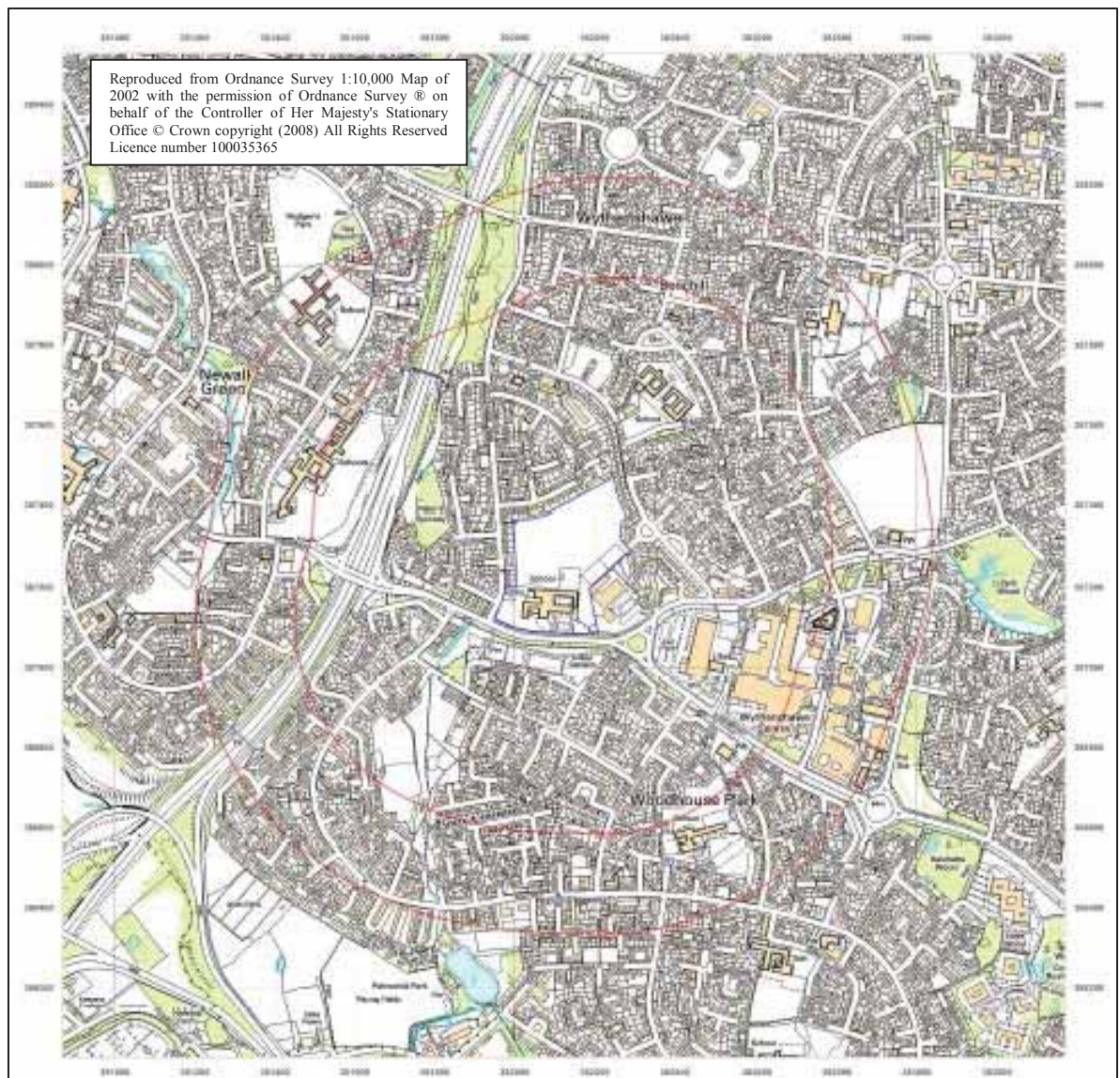


Figure 1: Site Location

Table 1: Summary of Site Location	
Location	Manchester Enterprise Academy is located off Simonsway, Wythenshawe, about 10 km south of the centre of Manchester
Grid Reference	382110 387210
Post Code	M22 9RH
Site Area	7.92 ha
Site Shape	The site has maximum plan dimensions of 325 m by 220 m and is irregular in shape.
Topography	The elevation is at approximately 56 to 58 mOD. The site slopes slightly downwards from the east to the west. There are also some “mounds” on the site. Topographical survey gives further detail and topography is discussed more in Section 2.2 below.

2.2 Site Description

3.1.1 A site visit was undertaken on 31st May 2016 and further details and photographs can be found in TerraConsult report 2859R01, June 2016. The walkover is summarised below:

Table 2: Summary of Description of the Site and its Environs	
Current Use:	Manchester Enterprise Academy
Access	Main access to site is from the west from Greenwood Road. There is also vehicular access from the south from Simonsway but this access is normally just used for buses.
Existing Buildings & Structures	Main academy building in southwest of site. Sports hall relatively centrally on the site with an adjacent changing room block. To the west of the sports hall there is a semi-derelict building which was the site offices from when the academy was constructed. There is also a small wooden garden type shed next to this.
Site Surface	Asphalt parking areas to west and north of academy building, Some asphalt around buildings. Two larger asphalt areas centrally and on eastern edge. MUGA pitches to north of sports hall. Northern and south eastern parts of site are grassed, northern part has sports pitches marked out.
Vegetation	Generally cut grass with some semi-mature trees in the southern half of the site. Mature trees along some of the boundaries. Along the northern boundary there is some scrub/brambles.
Storage Tanks	Below Ground Tanks: Stormwater attenuation tank below southern part of proposed building. Above Ground Tanks: None present.
Services	A number of service covers were noted, see tanks above and Section 2.4 for more details.
Asbestos	No potential Asbestos Containing Materials (ACMs) noted in the buildings or on the ground surface
Waste Disposal/ Materials Storage	Generally waste absent. Minor amount present adjacent to former site office (bulk bags of sand, pallets, etc).
Surrounding Area	Residential to the north, north east and west. To southeast there are offices. Simonsway to the south.
Ecology	There is no evidence of protected burrowing animals (e.g. badgers) or habitats suitable for protected amphibians (e.g. Great Crested Newts). Trees are present on the site and these should not be cut down during the nesting season. No evidence of invasive plant species were noted. <i>These comments on the ecology are for initial preliminary assessment. They are based on the assessment of personnel who are not trained ecologists and does not constitute a Phase I Habitat Survey or similar.</i>

2. PREVIOUS INVESTIGATIONS

3.1 Background

- 3.1.1 A review of various previous investigation was undertaken as part of the TerraConsult Phase 1 desk based study. Further details can be found in TerraConsult report 2859R01, June 2016. Pertinent points relevant to the current intrusive investigation are summarised below.

3.2 Site History

- 3.2.1 The history of the site has been previous researched within the Phase 1 desk study is summarised below:

- The first map studied dated 1877 shows the site to be undeveloped farmland with a small copse and buildings in the south eastern part of the site along with a small pond which is about 15 m off the site which is present until the 1977 map of the area. There are other historic ponds 165 m west of the site and 190 m east.
- The map dated 1935 and 1938 shows the buildings to be named as North Poundswick Farm and that the houses to the north east on Leybrook Road had been built. No change to the site itself is indicated on the 1954 map with an increase in housing to the northeast of the site.
- The 1960 and 1967 maps show the former school (the Poundwick Grammar School) along with playgrounds and tennis courts. There is housing shown to the north, west and south. Little or no further change is shown on the subsequent maps to 1977 when an L-shaped building is shown to have been added to the west of the school. The 1992 map indicates the school to be named Poundswick High School.
- The 1977 map indicates that on the land to the south east of the site there the off-site office block.
- The 2010 1:25,000 map shows the former school buildings all to be present which is thought to be out of date.
- The current academy is thought to have been constructed in 2008/2009 and the previous school buildings demolished during this period. These are shown on the 1:25,000 map of 2014.

3.3 Environmental Setting

Geology

- 3.3.1 The site is shown to be underlain by Glacial Till, with no drift deposits shown to be present in the southeast of the site. Bedrock deposits are shown to be the Bollin Mudstone Member of the Mercia Mudstone Formation.

Mining and Quarrying

- 3.3.2 There is no evidence of mining or quarrying in the vicinity of the site.

Hydrology, Flooding and Drainage

- 3.3.3 The nearest water courses is located 720 m from the site, however there is a culvert which runs along the western side of Greenwood Roads approximately 30 m to the west
- 3.3.4 The site is located in a Flood Zone 1 area, where the risk of flooding is classified as low.

Hydrogeology

- 3.3.5 The Environment Agency have classified different types of aquifer from which groundwater can be extracted (see Appendix B for definitions). The bedrock (Bollin Mudstone Formation) is classified as a Secondary B Aquifer. Drift deposits at the site are classified as a Secondary (undifferentiated) aquifer, where present. There are no abstractions within 2km of the site.

3.4 Potential Sources of Contamination

- 3.4.1 The investigation for the current school buildings indicated generally low concentrations of contaminants with a limited number of localised exceedances of screening criteria. For the purpose of this assessment the potential contaminants of concern have been considered according to whether they are likely to have originated from on-site or off-site sources.

Potential On-site Sources of Contamination

- Made Ground: possible metals, metalloids, asbestos, PAH and petroleum hydrocarbons – note no testing for asbestos in 2007 SI;
- Possible Mounds: possible metals, metalloids, asbestos, PAH and petroleum hydrocarbons relating to potential construction wastes;
- Former electrical sub-station: PCB's and petroleum hydrocarbons;

Potential Off-site Sources of Contamination

- Potentially infilled pond to the southeast – based on the data from the previous investigation this does not present a significant source for the proposed investigation so this is not considered further.

3.5 Conceptual Site Model and Contaminant Linkages

- 3.5.1 The hazard assessment, produced in TerraConsult report 2859R01, June 2016, is summarised in Table 3 below.

Table 3: Preliminary Hazard Assessment							
Hazard Identification				Hazard Assessment			
Link	Contaminant	Pathway	Receptor	Probability	Consequence	Risk	Hazard Assessment
1	Contaminated soil/groundwater	Ingestion (via soil dust) and inhalation (via soil dust and vapours), ingestion through dirty hands, dermal contact with soil/water.	A- Humans using the site during construction.	High Likelihood	Mild	Medium/Low	SIR - Total soil and groundwater concentration of relevant contaminants and ground gas vapours for contractors and designer's risk assessments.
2		Ingestion (via soil dust) and inhalation (via soil dust and vapours), ingestion through dirty hands, dermal contact with soil/water.	B- Humans using the site after development completion.	Medium/Reasonably Foreseeable	Medium	Medium	SIR- Total soil and groundwater concentration of relevant contaminants for contractor's risk assessments.
3		Via service pipes	B- Humans using the site after construction. F- Building structures	Low/Unlikely	Medium	Medium/Low	SIR - Total soil and groundwater concentration of relevant contaminants and ground gas vapours and designer's risk assessments.
4		Downward migration	D- Perched groundwater	Medium/Reasonably Foreseeable	Mild	Medium/Low	SIR- Total soil and groundwater concentration of relevant contaminants for contractor's risk assessments.
5		Downward migration	D - Secondary aquifer/water supply	Low/Unlikely	Mild	Low	NAR – However, analysis will be undertake of other pathways
6	Contaminated soil / groundwater	Ingestion, inhalation, dermal/direct contact	E- Ecology (Flora/Fauna)	Medium/Reasonably Foreseeable	Mild	Low	NAR – However, assessment is prudent in relation to potential re-use of soils in areas of landscaping / playing fields.
7	Contaminated groundwater	Secondary Aquifer/ Surface water	E- Ecology (Flora/Fauna)	Low/Unlikely	Medium	Medium/Low	SIR - Total soil and groundwater concentration of relevant contaminants for designer's risk assessments.
8	Contaminated soil/groundwater	Direct contact.	F- Building structures.	Medium/Reasonably Foreseeable	Medium	Medium	SIR - Total soil and groundwater concentration of relevant contaminants for designer's risk assessments.

4. INVESTIGATION METHODOLOGY

4.1 Investigation Strategy

4.1.1 The purpose of the various exploratory holes are as follows:

Table 4: Purpose of Exploratory Holes		
Exploratory Hole Type	Exploratory Hole No	Target Area
Rotary Cored	RC100	Hole to a depth of 12 m to allow bedrock conditions to be determined below centre of new building.
Dynamic Percussive (Window sampler) Boreholes. (WS)	WS101 to WS105	To assess shallow ground conditions and depth to bedrock including allow SPT's to be undertaken. To allow collection of samples for contamination and geotechnical testing. Two of these holes to be located in mound. Two holes installed with monitoring wells.
	WS106	Hole in northeast corner of building adjacent to proposed retaining wall and to investigate mound materials. Monitoring well installed
	WS107 to WS109	Holes investigated in area of new MUGA pitch to enable sampling of mounded soils. WS 107 in area of proposed attenuation tank. WS107 and WS109 to have monitoring wells.
	WS110 to WS115	Investigation in area of possible future construction works. Three holes to have monitoring wells.
Hand Dug Trial Pits. (TP)	TP116	To allow collection of sample of mound material for contamination testing.
	TP117 & TP118	Holes investigated in area of new MUGA pitch to enable sampling of mounded soils. Pits to include TRL/DCP tests.
	TP119 & TP120	Pits in area of westerly car park extension. Pits to include TRL/DCP tests.
	TP121	To allow collection of sample of mound material for contamination testing.
	TP122 & TP123	Pits in area of northerly car park extension. Pits to include TRL/DCP tests.
	TP124 to TP127	Investigation in area of possible future construction works. Pits to include TRL/DCP probes
Service Pits (SP)	SP1 to SP6	In area of school extension to attempt to delineate potential services identified during third party services search.
Note: Exploratory locations to be checked to ensure they avoid underground services.		

4.1.2 The site investigation locations are shown on Drawing No. 2859/01/001.

4.2 Monitoring Strategy

4.2.1 The previous site investigation for the current school buildings had indicated that there was a very low risk from ground gases with Characteristic Situation 1 conditions. Monitoring was therefore only required to measure the groundwater levels for geotechnical design. However, ground gas monitoring was also carried out during these monitoring visits to confirm that there is a very low risk from ground gas and no mitigation measures are required. The gas monitoring was in accordance with BS 8576 : 2013 and comprised three visits over approximately four weeks.

5 FIELDWORK

5.1 General Observations

5.1.1 The fieldwork was carried out between 20th and 24th June 2016. TerraConsult personnel were present to supervise all work, describe the ground encountered, carry out in situ testing and decide on the depths and response zones of monitoring wells. A services search was carried out prior to the site work and a CAT scan performed at the location of each exploratory hole location. Fieldwork procedures were undertaken in accordance with the relevant sections of:

- British Drilling Association “Guidance for Safe Intrusive Activities on contaminated or Potentially Contaminated Land” (2008);
- BS EN 1997-2:2007 [Eurocode 7 Part 2];
- BS5930:2015 "Code of Practice for Site Investigations;"
- BS10175:2011 + A1:2013 “Investigation of potentially contaminated sites – Code of practice.”

5.1.2 The investigation comprised the following fieldwork scope:

- 6 No window sample boreholes to a depth of 2.5 to 3.5 m or to rockhead if shallower within the footprint of the proposed building.
- 9 No. dynamic (window) sample holes with plastic liners of 1.5 to 2.5 m all to prove the thickness on Made Ground across the rest of the site.
- Each hole to have with SPT tests;
- 1 No. rotary borehole carried out using a truck mounted drilling rig using coring drilling methods with air flush;
- 12 No hand dug inspection pits to a maximum depth of 1.20 m to determine the thickness of the Made Ground and carry out DCP CBR testing;
- 5 No hand dug inspection pits to a maximum depth of 1.00m to identify potential buried services picked up during third party services search;
- Installation of 8 No. Gas and groundwater monitoring wells (all 51 mm internal diameter HDPE with slotted sections having a 250 µm geotextile filter wrap);
- Sampling and testing of soils and groundwaters;
- Description of the ground encountered in accordance with BS5930:2015 "Code of Practice for Site Investigations;" with the weathering scheme for Mercia Mudstone applied as set out in CIRIA Report C579 (2001);
- Three rounds of groundwater monitoring (also with gas monitoring);
- Geoenvironmental assessment of the site with generic qualitative risk assessments.

- Up to 15,000 m³ of excess soil to be sent off site for disposal so a waste assessment to be carried out to assess the Made Ground and classify them in accordance with Landfill Waste Acceptance Criteria; and
- Geotechnical assessment of the ground conditions.

5.2 Trial Pits

- 5.2.1 Hand excavated trial pits (TP116 to TP127) were excavated to depths between 0.85 m (TP119) and 1.20 m (TP125, 126 and 127) using hand tools. After inspection and sampling, the trial pits were back-filled with the as-dug excavated material and fully reinstated. One trial pit (TP120) encountered a concrete obstruction at 0.22m. This exploratory hole was relocated immediately adjacent and progressed as TP120A.
- 5.2.2 Trial pits remained open during excavation and no groundwater was encountered.
- 5.2.3 The trial pit logs and photographs are included as Appendix D.
- 5.2.4 Service pits SP1 to SP6 were excavated to depths between 0.38 m (SP6) and 1.00 m (SP3) to identify any buried services possibly picked up during the third party services search. SP4 could not be completed due to its close proximity to the rotary rig and equipment. At SP1 to SP5, no services were encountered. At SP6, the pit was terminated at 0.38 m on a concrete obstruction. It could not be ascertained whether this was representative of a service covering or simply an obstruction within the Made Ground.
- 5.2.5 The service pit logs and findings are detailed in Table 5 below.

Table 5: Service Pit Logs			
Location	Depth	Basic description	Notes
SP1	0.00 – 0.15	Soft dark brown slightly sandy CLAY.	No services located
	0.15 – 0.85	Firm dark brown sandy gravelly CLAY. Gravel of asphalt, concrete and mudstone.	
SP2	0.00 – 0.10	Asphalt	No services located
	0.10 – 0.30	Dark grey angular fine to coarse GRAVEL of limestone.	
	0.30 – 0.75	Dark brown very gravelly SAND. Gravel of brick, concrete and mudstone.	
SP3	0.00 – 0.09	Asphalt	No services located
	0.09 – 1.00	Firm reddish brown slightly sandy slightly gravelly CLAY. Gravel of mudstone.	
SP5	0.00 – 0.08	Asphalt	No services located
	0.08 – 0.20	Dark grey angular fine to coarse GRAVEL of limestone.	
	0.20 – 0.45	Brown very gravelly SAND. Gravel of concrete, limestone and brick.	
	0.45 – 0.90	Stiff grey slightly sandy CLAY	
SP6	0.00 – 0.07	Asphalt	Obstruction encountered - possible service at 0.38 m
	0.07 – 0.38	Firm reddish brown slightly sandy slightly gravelly CLAY. Gravel of mudstone.	

5.3 Dynamic (Window) Sample Boreholes

- 5.3.1 Six dynamic sampling boreholes (WS101 to WS106) were carried out in the vicinity of the proposed school extension and a further nine dynamic sampling boreholes (WS107 to WS115) were progressed across the remainder of the site using a tracked Dando Competitor rig.
- 5.3.2 Boreholes in the area of the proposed school extension were progressed to depths of between 1.45 mbgl (WS106) to 3.14 mbgl (WS101). It should be noted that WS101 was progressed through an existing mound. Across the remainder of the site boreholes were progressed to depths of between 2.17 mbgl and 2.85 mbgl. All boreholes were terminated due to encountered bedrock deposits.
- 5.3.3 Standard Penetration Tests (SPTs) were carried out at 1 m intervals in the holes in general accordance with BS EN ISO 22476-3:2005. The dynamic sample logs and the SPT Calibration Certificate are presented in Appendix D.
- 5.3.4 Groundwater was encountered at the boundary of Made Ground / Topsoil deposits in WS101 to WS106 in the area of the proposed school extension.

5.4 Rotary Boreholes

- 5.4.1 One rotary cored borehole (RC100) was completed to a depth of 10 m bgl. The hole was commenced by using Duplex drill-and-case system through the drift deposits which produced a 130 mm fully cased hole to 3.00 m bgl. The drilling in the bedrock carried out using a coring using air flush to produce a 125 mm diameter hole. The rotary borehole was backfilled with bentonite pellets on completion.

5.5 CBR Tests

- 5.5.1 Twelve California Bearing Ratio (CBR) tests were carried out using the Transport & Road Research Lab (TRRL) Dynamic Cone Penetration (DCP) method to provide design parameters for road/pavement design. The tests were commenced below the existing topsoil / hardstanding. The results are presented and discussed within Section 10.4 to 10.7.

5.6 Samples and Sample Containers

- 5.6.1 Soil samples for chemical analysis each comprised a pair of samples: a plastic tub for metals and inorganics, and an amber glass jar for organics.
- 5.6.2 Prior to taking any water samples, the wells were developed and three well volumes of water (where possible) was purged from the wells using dedicated disposable bailers (also called a grab sampler). If recharge was relatively slow and not sufficient to allow a full suite of sampling vesicles to be filled for a purged sample, then a sample was taken at a subsequent sampling round to allow analysis for the remaining analytical suite.

5.6.3 Insufficient waster was retrievable to allow for collection of well head parameters. A range of different sample containers were used for sampling groundwater:

- 1 litre plastic bottles metals and inorganics;
- 1 litre glass bottles for SVOC's
- Amber glass vial for VOC's

5.6.4 Water samples and soil samples for organic analysis were stored in a cool box, with plastic tubs stored in a plastic crate directly to the testing laboratory.

5.7 Monitoring

5.7.1 After completion of the fieldwork, three visits were made to the site to carry out monitoring of groundwater levels and ground gas concentrations. Ground gas monitoring was carried out in accordance with BS8576:2013 and comprised measurement of:

- VOCs using an Ion Science Photo Ionisation Detector (PID);
- Landfill gases using a GasData GFM435 infra-red meter to measure gas flow rate, methane, carbon dioxide, oxygen, carbon monoxide and hydrogen sulphide.

5.7.2 The results of this monitoring are presented in Appendix E, together with details of the instrumentation specifications.

5.7.3 It should be noted that no free phase hydrocarbons were encountered in any of the monitoring wells.

6 LABORATORY TESTING

6.1 Chemical Laboratory Testing

6.1.1 Soil samples were submitted to QTS Environmental of Lenham in Kent and groundwater samples were submitted to SAL in Manchester. Both laboratories are UKAS accredited in accordance with ISO17025 and are also MCERTS accredited for soil analysis in accordance with the Environment Agency's scheme. The laboratory carries out Quality Assurance and Quality Control in accordance with BS ISO 17025 and participate in external laboratory comparison and quality control schemes. Details of the accreditation and the methods of analysis are provided on the relevant test reports.

6.1.2 The selection of samples for laboratory testing and analytes to be determined were made based on the Phase 1 assessment, the excavation records and other observations during the investigations. The sample selection rational was as follows:

- to gain a good coverage across the site and of the various material types and strata encountered;

- to characterise samples which had visual or olfactory evidence of contamination;
- to characterise samples from the interface of permeable and less permeable horizons within the ground;
- to characterise soils samples located at groundwater level;
- to characterise the groundwater.

- 6.1.3 The selected soil and groundwater samples were tested for a range of typical contamination indicators including specific tests for contaminants suspected as being present from the desk study and from observations made on site. Tests were also performed for waste classification purposes.
- 6.1.4 Each of the soil samples were analysed for the 'total' concentration of a suite of potential contaminants. A number of leachate samples were also prepared from selected soil samples in accordance with BS EN 12457: Part 4 : 2002 with a 10:1 water:soil extract prepared. The results of the leaching are presented in terms of µg/l and also in mg/kg.
- 6.1.5 The results of the laboratory analysis are presented in Appendix F. The various suites of analysis for the soil, leachate and water were as follows:

Table 6: Analytical Testing Suites				
Determinand	Soil Suite 1	Soil Suite 2	Landfill WAC Suite	Water Suite
Anticipated Number of Samples	14	6	5	2 for full suite (Up to 5 samples including some of suite)
Index Tests				
Asbestos Screen	10 screens in total No Asbestos Quantification tests required		-	-
pH	✓	✓	✓ (L)	✓
Electrical Conductivity	-	-	✓ (L)	✓
Dissolved Solids	-	-	✓ (L)	-
Alkalinity	-	-	-	✓
Hardness	-	-	-	✓
Metals				
As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Zn	✓	✓	✓ (L)	✓
Ba, Mo, Sb	-	-	✓ (L)	-
Inorganics				
Ammonium	-	✓	-	**
Cyanide - Total	✓	✓	-	✓
Chloride (2:1 extract on soil samples)	✓	✓	✓ (L)	**
Fluoride (2:1 extract on soil samples)	-	✓	✓ (L)	-
Nitrate (2:1 extract on soil samples)	-	✓	✓ (L)	**
Sulphate (2:1 extract on soil samples)	✓	✓	✓ (L)	**
Organics				
Phenols - Total (monohydric)	✓	✓	✓ (L)	✓
Total Organic Carbon (TOC)	-	✓	DOC & TOC	-
PAH (Speciated USEPA 16)	✓	✓	✓ (S)	✓
TPH (C ₈ to C ₃₆) TPH CWG (RBCA) Speciation	-	✓	-	✓
Mineral Oil (C ₁₀ to C ₄₀)	-	✓	✓ (S)	
Benzene, Toluene, Ethyl Benzene, Xylenes (BTEx);	-	✓	✓ (S)	✓
Poly Chlorinated Biphenyls (PCBs)	-	-	✓ (S)	-
NOTE ✓ = Test required on all samples **= Test required on selected samples only - allowed for 5 No in total 2. All soil samples to be tested and reported in accordance with EA MCERTS for Soils Scheme 3. WAC Leachate preparation and reporting in accordance with ISO/EN/BS12457:Part 3 with results reported in terms of both mg/kg and mg/l for a 10:1 leachate extract. 4. (S) test carried out on soil sample, (L) test on leachate prepared from soil sample in accordance with Landfill WAC Criteria 5. It should be noted that the suites and quantities of chemical laboratory testing proposed have based on our current assessment of the site risks in order to provide an assessment of the risk. If the Phase 1 or 2 investigations encounter different conditions then the type and quantity of testing may require revision. If it is proposed that soils are to be sent off site for disposal at a landfill site then additional testing is likely to be required in order to meet the Environment Agency's requisite testing requirements for waste disposal.				

6.2 Geotechnical Laboratory Testing

6.2.1 Samples were submitted to PSL Limited in Doncaster who are UKAS accredited in accordance with ISO17025. Samples for analysis for the full BRE SD1 suite were submitted to QTS along with the soils for other chemical analysis. The following geotechnical testing was undertaken:

- 13 No. natural moisture contents;
- 10 No. liquid and plastic (Atterberg) limits;

- 1 No. particle size distribution determination;
- 6 No. analyses for sulfate and aggressive chemical environment classification for buried concrete (the full BRE SD1 suite, Building Research Establishment 2005);

6.2.2 The results of the geotechnical testing are included in Appendix G.

7 GROUND CONDITIONS

7.1 General

- 7.1.1 The site investigations have allowed the site specific ground conditions to be described and this information was used to provide an improved conceptual ground model.
- 7.1.2 The geology encountered during the site investigations was generally consistent with that anticipated from the desk study and is summarised below.

7.2 Ground Surface

- 7.2.1 All exploratory holes, with the exception three trial pits, encountered topsoil comprising sandy gravelly clay with gravel comprising brick, ceramics, coal and mudstone.
- 7.2.2 Two of the trial pits that did not encounter Topsoil encountered Made Ground of a similar composition to the topsoil deposits encountered. One trial pit was progress through asphalt. The combined thickness of asphalt and sub-base was 0.60 m.
- 7.2.3 No visual or olfactory indications of contamination were encountered.

7.3 Anthropogenic Materials

- 7.3.1 Made Ground was present across the site to depths of between 0.25 m (TP127) and 2.0 m (WS105). The thickness of Made Ground varied depending on whether or not the holes were located on mounds. In each of the areas investigated the Made Ground varied in thickness as follows:

School Building:	0.50 to 2.0 m (probable backfill to attenuation tank excavation)
MUGA Pitch Area:	0.30 to 1.30 m
Western Car Park:	0.30 to 0.35 m (topsoil with brick and ceramic)
North of Existing Building:	Greater than 1.0 m
Northern Car Park:	0.60 & 0.70 m
Northern Area:	Mainly 0.25 to 0.45 m but 0.95 m thick in TP124

- 7.3.2 The Made Ground typically comprised silty slightly sandy slightly gravelly clay or very gravelly very clayey fine to coarse sand with gravel comprised of brick, concrete, mudstone, limestone and coal. In some areas the Made Ground was just re-worked

Mercia Mudstone clay with occasional brick fragments. Limited areas of black staining were observed, although these are not suspected as being associated with petroleum hydrocarbon contamination. The depth of the Made Ground varied depending

- 7.3.3 The only obstruction was encountered in TP120, which encountered concrete at 0.2 m. In other trial pits, some were terminated before the target depth of 1.2 m bgl, but this was due to general difficult conditions for hand excavation due to gravel or encountering natural clay and not due to obstructions.

7.4 Drift Deposits

Glacial Till

- 7.4.1 No deposits interpreted as Glacial Till were encountered in any of the exploratory holes.

7.5 Solid Geology

- 7.5.1 Weathered bedrock was encountered directly underlying Made Ground deposits in all exploratory holes. The bedrock deposits were initially recovered as stiff light grey mottled yellowish brown slight sandy clay (Grade IVb) to depths of between at least 0.85 m bgl and 3.14 m bgl (WS101) and these deposits are interpreted as weathered Bollin Mudstone Member. Below the weathered mudstone deposits, bedrock was recovered as core comprising very weak light grey mottled reddish brown thinly laminated mudstone. (Grade III – II) to a depth of 7 m bgl. Below these deposits bedrock was recovered as very stiff brown slightly sandy gravelly clay. Gravel is angular fine to coarse of mudstone (Grade III) to a proven depth of at least 10 m bgl.

7.6 Groundwater

- 7.6.1 Groundwater seepages were encountered in WS101 to WS106 at the junction between Made Ground and the underlying weathered bedrock deposits. No groundwater seepages was encountered in bedrock deposits. During the monitoring period groundwater was encountered as follows:

School Building:	Two holes were dry. Groundwater at 1.3 m depth in WS101
MUGA Pitch Area:	Groundwater at 1.9 m depth in the single well
Western Car Park:	Groundwater at 1.6 m depth in the single well
Northern Area:	Groundwater at 0.5 to 1.3 m depth in the three wells

- 7.6.2 It should be noted that during the investigation during the 2006/07 winter the depth to groundwater were shallower than those during the current investigation with groundwater found to rest at depths of between about 0.30 m and 1.00 m in the area of the main school buildings.

7.7 Surface Water

7.7.1 No surface water was encountered.

8 GENERIC QUANTITATIVE RISK ASSESSMENT

8.1 Introduction

8.1.1 The assessment of contamination has been carried out in accordance with the overall guidance presented in CLR11 Model Procedures for the Management of Land Contamination using the procedures as indicated in Appendix B.

8.1.2 Generic risk assessment is a two stage process. Firstly, in the Risk Estimation stage, the measured contaminant concentrations are compared to the relevant GACs or C4SLs/S4ULs where they have been published. Where there is a suitable dataset, this is done after carrying out statistical analysis to determine the upper confidence limit on the true mean. Otherwise, maximum or specific data points are compared directly. The second stage, Risk Evaluation, comprises an authoritative review of the findings with other pertinent information, in cases where the C4SLs or GACs are exceeded, in order to consider if exceedance may be acceptable in the particular circumstances.

8.1.3 The aspects of risk from substances in the ground considered below are as follows:

- human health;
- plant life;
- pollution of Controlled Waters;
- water supply pipes
- below ground concrete; and
- ground gases.

8.2 Assessment for the Protection of Human Health

8.2.1 The Generic Qualitative Risk Assessment (GQRA) is based on a soil with a Soil Organic Matter of 1% was carried in accordance with the methodology for assessing soil samples set out in Appendix B based on a residential end use. This is a very conservative approach based on the proposed use of the site for academic use as a secondary school. A full summary of the chemical test results is presented in Appendix H. Exceedance of applicable Generic Assessment Criteria (GAC) threshold concentrations are indicated in yellow. A discussion on the various exceedances are presented below.

Metals

8.2.2 No metals have concentrations higher than the GAC, or for lead the pC4SL, were encountered.

PAHs

- 8.2.3 Polycyclic aromatic hydrocarbons (PAHs) are a wide range of over 200 different compounds normally associated with combustion or processing of hydrocarbons and coal with sixteen of these (the USEPA 16) analysed for as part of this investigation with a seventeenth (Coronene) included in the assessment of soil for waste disposal at landfill sites. Each of the PAH compounds have different toxicity.
- 8.2.4 Fifteen of the tested samples had total PAH levels less than 1.6 mg/kg with the maximum total PAH concentration of 13.7 mg/kg. One exceedance of the applicable PAH GACs was encountered for benzo(a)pyrene from a sample from WS102, at 0.6 m below ground level. The concentration recorded was 1.0 mg/kg compared to the conservative GAC of 0.83 mg/kg. Comparison to the pC4SL of 5.0 mg/kg and the S4UL of 2.2 mg/kg shows the concentration is not of concern. In addition, the sample is obtained from Made Ground which is likely to be removed during the construction of the proposed school extension. Therefore the PAH concentrations do not represent a significant increased risk to long term human health and give no cause for concern.

Hydrocarbons

- 8.2.5 Three of the six Petroleum Hydrocarbon (PHC) determinations PHC concentrations less than the detection levels. The highest concentration of PHCs was 54 mg/kg.
- 8.2.6 The toxicity of the various compounds which form petroleum hydrocarbons varies decreasing from petrol range C₆ to C₁₀ (often referred to as Gasoline Range Organics, GRO) to the diesel range (C₁₀ to C₂₅), with the lower toxicity again for the longer chain, heavier oils and greases (C₂₅ to C₄₀). Additionally the toxicity of hydrocarbons varies depending on the relative proportion of aliphatic (straight chain hydrocarbons) and aromatic (hydrocarbons formed from carbon rings). Therefore TPH testing involves speciating the hydrocarbons into different ranges for both aliphatic and aromatic fractions. The results of the speciated TPH banding GACs were not exceeded in any sample.
- 8.2.7 No BTEX compounds were detected above the laboratory limit of detection in any of the ten samples analysed, and therefore the applicable GACs were not exceeded.

Asbestos

- 8.2.8 Asbestos can be present in soil as fragments of bulk Asbestos Containing Materials (ACMs) (e.g. asbestos cement sheeting) and also as discrete asbestos fibres within the soil matrix. This investigation has carried out assessments to determine whether both bulk fragments of asbestos and discrete fibres are present in the soil at the site. The asbestos assessment commenced on site with inspection of the Made Ground by our site staff for the presence of bulk ACMs. During the fieldwork no suspected ACMs were identified.
- 8.2.9 Ten samples underwent laboratory assessment to determine whether asbestos fibres or ACMs are present. No ACMs or asbestos fibres were found in any of the samples (note that the laboratory detection limit for these samples is 0.001%). The laboratory analysis confirmed that asbestos was not present in the tested soil samples.

Risks to Human Health (Construction Phase)

8.2.10 During the construction works there will be no significant risk to health from dust due to chemical contaminants. However, prevention of the generation of dust should still be given a priority during groundworks. Appropriate risk assessments should be carried out by the contractor to allow appropriate controls for the mitigation of risk to health of construction workers to be put in place. This risk can be controlled to within acceptable limits by:

- workers wear suitable Personal Protective Equipment (PPE);
- having adequate site hygiene facilities allowing staff to keep a good level of personal hygiene;
- all groundworkers should have been trained in asbestos awareness and should keep a look out for this being encountered during excavations. The earthworks contractor should have a contingency plan in place before any works commence in case the presence of asbestos is suspected in groundworks;
- only permitting smoking or eating on site in appropriate pre-designated areas.
- control of dust generation:
 - access roads and stockpiles should be regularly damped down with water;
 - vehicles used to transport materials and aggregates should be enclosed or tarpaulined;
 - local roads should be regularly cleaned;
 - vehicle movements and speed should be kept to a minimum within the site ;
 - minimising drop heights of all loading and unloading activities that involve the transfer of soils and demolition materials.

8.3 Risk to Plant Life

8.3.1 The concentrations of the phytotoxic metals copper, chromium, nickel and zinc have the potential to be harmful to plants. However, all the measured concentrations of these metals are lower than the guideline values for the protection of plants as presented in the MAFF document “Code of Good agricultural practice for the protection of soil”. Therefore there is no risk to plants at the site due to phytotoxicity should any be planted in the ground as part of the proposed development.

8.4 Assessment for the Protection of Controlled Waters

8.4.1 The risks to controlled waters (groundwater and surface waters) from contaminants on-site have been assessed in accordance with the EA documents Groundwater Protection : Policy and Practice GP3 (2012) and Remedial Targets Methodology (RTM, 2006). Pollutant inputs from contaminated land sites are considered as passive inputs under the European Water Framework Directive (2000/60/EC) (WFD) and its daughter Directives, and as such are regulated under the Agency’s ‘limit’ pollution objective. Acceptable water quality targets (WQT) are defined for protection of human health (based on

Drinking Water Standards (DWS)) and for protection of aquatic ecosystems (Environmental Quality Standards (EQS)).

8.4.2 The results of the remedial targets methodology assessment are presented in Appendix I and are summarised in the following Table.

Table 7: Summary of Exceedances of Generic Assessment Criteria for Controlled Waters						
Chemical of Potential Concern	Water Quality Target (µg/l)	Basis for Water Quality Target	No. Samples Tested	Min. (µg/l)	Max. (µg/l)	No. Samples Exceeding Target
Sulphate	400,000	EQS	5	25,000	1,200,00	2 (both from WS101)
TPH	10	DWS	2	210	470	2
Unionised ammonia	15	EQS	5	0.76	15	1 (WS101)
Fluoranthene	0.1	EQS	2	0.05	0.48	1
Benzo(b)fluoranthene	0.03	EQS	2	<0.01	0.17	1
Benzo(k)fluoranthene	0.03	EQS	2	<0.01	0.05	1
Benzo(a)pyrene	0.1	EQS	2	<0.01	0.12	1
Indeno(123cd)pyrene	0.002	EQS	2	<0.01	0.07	1
Benzo(ghi)perylene	0.002	EQS	2	0.01	0.08	1

8.4.3 The data indicates that relevant water quality targets are exceeded in respect of sulphate, TPH, unionised ammonia and various PAH compounds. Whilst there are elevated concentrations of Chemicals of Potential Concern, and subject to agreement with the Environment Agency, TerraConsult does not believe the site poses a significant risk to Controlled Water because:

- Water samples were collected from perched water contained within Made Ground which occurred mainly as a small seepage;
- the underlying bedrock although classified as a secondary aquifer, has been shown to be of low permeability, with groundwater seepages in Made Ground above likely to be hydraulically isolated with minimal downward or lateral migration occurring;
- the shallow groundwaters at and in the vicinity of the site are not abstracted for human consumption; and
- the nearest surface water is over 700 m from the site, and culvert located 30 m away is unlikely to be in hydraulic continuity with the perched groundwater.

8.4.4 TerraConsult recommends that discussion with the Environment Agency is entered into at the earliest opportunity.

8.5 Water Supply Pipe Material Assessment

- 8.5.1 Plastic pipe materials are potentially vulnerable to attack from elevated levels of hydrocarbons, which can potentially lead to contamination of potable water supplies and water supply companies also require the risk to their workers from other contaminants in the ground to be assessed. The assessment has been completed in accordance with the current UK Guidance for the Specification of Water Supply Pipes to be used in Brownfield Sites (UK Water Industry Research Ltd. UKWIR, 2014) together with guidance from United Utilities. This guidance provides threshold concentrations for different pipe material for various chemical groups.
- 8.5.2 The pipeline materials considered by the guidance are PE, PVC, wrapped steel, wrapped ductile iron or copper pipe and barrier pipe. PE are assessed using threshold concentrations for various chemical groups including volatile organic compounds (VOC) with tentatively identified compounds (TICs), semi-volatile organic compounds (SVOC) with TICs, and mineral oils. Wrapped steel, wrapped ductile iron and copper pipe are assessed using corrosive properties. The default recommendation for water supply pipes is to use PE with other types of pipework only used if the limits for PE pipes are exceeded.
- 8.5.3 The available data indicates no exceedances for the PE water supply pipe are present and as such the use of PE pipe is deemed permissible with the following caveats:
- should areas of unexpected contamination be found during construction and any water supply pipes are routed through those areas, additional sampling and testing will be required.
 - Following confirmation of the water supply pipe route, the water supplier for the area should be contacted and written approval sought. They may require additional chemical data along any proposed potable water supply pipe routes.

8.6 Chemical Attack on Below Ground Concrete

- 8.6.1 The results of laboratory pH and sulphate content indicate that ACEC Class AC-1s conditions prevail in accordance with BRE Special Digest 1, 2005 (the Design Concrete Class). Therefore no special precautions are required at the site for the design of concrete in terms of the durability and structural performance.
- 8.6.2 Gross hydrocarbon contamination can also have an adverse impact on the setting of concrete, which may affect foundation construction and piling. Based on the measured concentrations of hydrocarbons at the site there is no risk of these affecting the setting of concrete.

8.7 Permanent Ground Gases

Measured Gas Concentrations

- 8.7.1 Three rounds of gas monitoring carried out by TerraConsult in the eight gas monitoring wells with atmospheric conditions varying from 996 to 1013 mbar during July

2016. One monitoring visit was carried out with atmospheric pressures less than 1000 mbar (996 mbar) with the other two sets of readings were taken with air pressured greater than 1000 mbar. The highest VOC, flow rates, methane and carbon dioxide concentrations, together with the lowest oxygen levels (i.e. a combination of the worst case temporal conditions recorded) from the monitoring visits are summarised in the table below:

Borehole	Area of Site	Response Zone mbgl	Contamination evidence	No. of monitoring occasions	Steady State Flow (l/hr)	Methane (%v/v)	Carbon Dioxide (%v/v)	Oxygen (% v/v)	Carbon Monoxide (ppm)	Hydrogen sulphide (ppm)	PID Readings (ppm)	Water Level mbgl	Atmospheric pressure readings mb
WS101	Proposed Extension	1-3.0m	No	3	<0.1	<0.1	0.6 - 1.8	13.7 - 16.5	<1	<1	<0.1	1.36 - 2.15	996 - 1010
WS103		1.0-2.0m	No	3	<0.1	<0.1	2.2	17.2 - 18.8	<1	<1	<0.1	DRY	996 - 1010
WS105		0.5-2.5m	No	3	<0.1	<0.1	<0.1 - 0.1	20.7 - 21.4	<1	<1	<0.1	DRY	996 - 1010
WS108	MUGA	1.0-2.0m	No	3	<0.1	<0.1	<0.1 - 0.9	6.7 - 9.4	<1	<1	<0.1	1.89 - 1.95	996 - 1010
WS110	Western Car Park	1.0-2.0m	No	3	<0.1	<0.1	2.0 - 4.2	15.7 - 18.2	<1	<1	<0.1	1.61 - 1.88	996 - 1010
WS111	Northern Area	1.0-2.0m	No	3	<0.1	<0.1	0.1 - 0.6	19.9 - 20.6	<1	<1	<0.1	0.51 - 0.94	996 - 1011
WS114		1.0-2.0m	No	3	<0.1	<0.1	0.4 - 1.5	19.4 - 20.2	<1	<1	<0.1	0.69 - 1.34	996 - 1011
WS115		1.0-2.0m	No	3	<0.1	<0.1	0.2 - 0.8	19.4 - 20.6	<1	<1	<0.1	0.61 - 0.82	996 - 1013

Ground Gas Assessment

8.7.2 Background information relating to the origin and production of landfill and ground gases are presented in Appendix J, together with current guidance on the assessment of ground gases. In accordance with this approach and the above measured ground gas levels, it is considered that the worst case temporal conditions may not have been measured during the monitoring period. However, as gas concentrations were measured at atmospheric pressures of 996 mbar, it is anticipated that the worst case temporal conditions will not be significantly worse than those presented in Table 7 above. The gas flow rates measured across the whole of the site at all of the monitoring visits was less than the instrument detection limit of 0.1 l/hr. From Table 8.5 of CIRIA C665 the worst case Characteristic Situation for the two areas of the site are as follows:

Table 9: Characteristic Gas Situations							
Borehole Number	Steady State Flow	CH ₄			CO ₂		
	l/h	% v/v	GSV (l/hr)	Characteristic Situation	% v/v	GSV (l/hr)	Characteristic Situation
Proposed School Extension							
WS101	0.1	0.1	0.0001	1	1.8	0.0018	1
WS103	0.1	0.1	0.0001	1	2.2	0.0022	1
WS105	0.1	0.1	0.0001	1	0.1	0.0001	1
MUGA							
WS108	0.1	0.1	0.0001	1	0.9	0.0009	1
Western Car Park							
WS110	0.1	0.1	0.0001	1	4.2	0.0042	1
Northern Area							
WS111	0.1	0.1	0.0001	1	0.6	0.0006	1
WS114	0.1	0.1	0.0001	1	1.5	0.0015	1
WS115	0.1	0.1	0.0001	1	0.8	0.0008	1

- 8.7.3 Based on the ground gas monitoring data from 2006/2007 for the site and the current confirmatory ground gas monitoring it can be seen that Characteristic ~Situation 1 conditions apply and no gas protection measures are considered to be required. This assessment is in accordance with the methodology in BS8485:2015.

8.8 Updated Conceptual Site Model

- 8.8.1 The conceptual site model initially developed from the desk study and walk-over survey (Reported in the TerraConsult Phase1 report reference: 2859R01, June 2016) has been updated using the findings of the Phase 2 ground investigation.

- 8.8.2 The site investigation revealed the following general downward succession:

Site surface: mostly topsoil with some areas of asphalt.

Topsoil (0.1 to 0.3 m thick).

Asphalt and sub-base (0.5 m thick)

Made Ground (between 0.25 to 2.0m thick, typically <1.0 m thick)

Glacial Till: Not encountered.

Bedrock: Weathered mudstone encountered beneath Made Ground to depth of between 0.86 to 3.14m. Grade III – II mudstone encountered to 7 m bgl and Grade III mudstone proven to 10 m bgl.

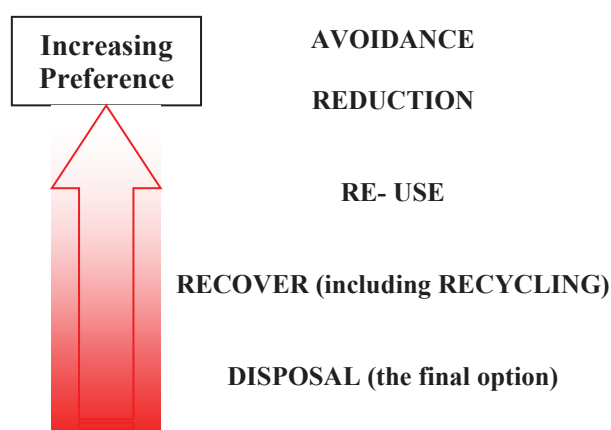
- 8.8.3 The results of the risk assessments indicate that there is no significant source of contaminants present at the site so there is a negligible risk to humans, ecology or archaeological receptors. No asbestos containing materials or discrete asbestos fibres were identified during the investigation. No specific precautions are required with

respect to landfill type ground gases or hydrocarbons for the development or radon. All below ground concrete should be designed to meet the requirements of Design Sulphate 2 and ACEC Class AC-1s. There is no significant risk to controlled waters at the site.

9 WASTE ASSESSMENT

9.1 Waste Hierarchy

- 9.1.1 In accordance with government guidance, it is required that the production and disposal of waste is managed in accordance with the following hierarchy of preference:



- 9.1.2 Site visits have indicated the presence of mounds of what are interpreted as construction waste and trees in the vicinity of the proposed school extension and the proposed MUGA pitch. Although exploratory holes have been progressed to allow inspection of these materials, during excavation, other deleterious materials may be encountered. It is recommended that this material will require quantification, separation into a number of waste types on site so as to enable recovery/recycling of materials to minimise off-site disposal along the following lines:

- Metal – recover and sell as scrap.
- Timber, tree roots and vegetation – chip and use in landscaped areas.
- Plastic & polystyrene – send to landfill.
- Concrete, tarmac, bricks, gravel and tiles – crush and use as hardcore.
- Soils - use in soft landscaping.

- 9.1.3 As with most developments, there will be waste materials produced from excavations for drainage/services. Where possible, these arisings should be incorporated into soft landscaping with the arisings being separated into Made Ground and weathered and unweathered mudstone as they are excavated in order to facilitate the re-use.

- 9.1.4 When soil is excavated it is technically a waste and can only be re-used if it fulfils the following requirements:

- There is a planned use for the material;
- There is planning permission for the proposed re-use;
- The material when re-used will not be a risk to flora, fauna or controlled waters;
- Appropriate procedures are followed to demonstrate the above criteria are met and the re-use of materials is recorded in a systematic way and appropriate permissions/permits are gained and relevant procedures followed.

9.2 Waste Characterisation and Classification

9.2.1 If there is a portion of excess soil this will then have to be sent to a suitable landfill site. A summary of current relatively complex guidance on categorising waste from earthworks is presented in Appendix K. A two phase approach is required comprising comprises:

- Waste Characterisation; and
- Waste Classification (Waste Acceptance Criteria).

Waste Characterisation

9.2.2 The results of the total concentrations from the chemical testing on soil samples have been assessed to determine their waste characterisation. The samples were first assessed to determine whether they are non-hazardous or are hazardous in terms of waste classification. The results of this assessment indicate that none of the materials encountered during the investigation can be classified as hazardous.

Waste Classification

9.2.3 In order to determine whether soils can be sent to a licensed landfill for disposal further testing analysis for Waste Acceptance Criteria (WAC) for both total concentrations for certain chemicals and for leachate analysis has been undertaken on 5 samples.

9.2.4 Four of the samples have shown that the soils are classified as inert. One sample of Made Ground from WS105 (in the footprint of the proposed school extension) had sulphate and total dissolved solids concentrations which exceeded the criteria for inert waste. It is possible that this could just be from a relatively small fragment of plasterboard in the sample. Given the rest of the sulphate test results on soil samples in addition to the WAC testing it is assessed that this is a relatively isolated exceedance of the WAC requirements. It should be noted that two samples were analysed from this area, with the other sample being classified as inert.

9.2.5 Note that the above assessment should only be seen as an initial guide. Defining the class of waste is carried out on the actual waste being disposed of and the destination landfill site will have the final decision on acceptability of the waste. Therefore, it is recommended that if soils are to be removed from the site, the appointed contractor should approach a landfill site with the available chemical data and seek a formal waste characterisation.

Testing Frequency

- 9.2.6 There are also set requirements for the required sampling and testing frequencies for materials being sent for disposal at landfills. The required testing frequencies for each different waste type are summarised in Table below.

Table 10: Laboratory Sampling Testing Frequencies for a Single Waste Type			
Testing Level	Quantity of Waste	Number of Samples	
		Homogeneous	Heterogeneous & New Wastes
Level 1 Characterisation (Description, Total Concentrations & Leaching)	<100T	2	5
	<500T	3	8
	<1000T	5	14
	10,000 T	11	22
	Per additional 10,000T	+5 pro rata	+10 pro rata
Level 2 Compliance For Regularly Generated Wastes (Total Concentrations & Leaching)		1 per defined waste sub-population per year	3 per defined waste sub-population per year
Level 3 Verification Delivery document & visual check Chemical testing as per Level 2 suite		Visual – Each Load	Visual – Each Load
		1 per year per waste stream	3 per year per waste stream

9.3 Materials Management and Reuse of Arisings On-site

- 9.3.1 The reuse of excavated arisings on site should be maximised. Any material excavated on site may be classified as waste and it is the responsibility of the holder of a material to form their own view on whether or not it is waste. This includes determining when waste that has been treated in some way can cease to be classed as waste for a particular purpose.
- 9.3.2 As soil is technically a waste when it has been excavated, it cannot be re-used on site unless one of the following three procedures are implemented:
- the procedures are followed in the recently introduced CL:AIRE Code of Practice ‘The Definition Of Waste: Development Industry Code of Practice Version 2 (2011).’ If these procedures are followed, excavated arisings can be re-used without them being defined as waste “where it is certain that the material will be used for the purposes of construction in its natural state on the site from which it was excavated.” or;
 - the site applies for an Environmental Permit exemption from the Waste Management Regulations so the material can be placed without a permit (note that the rules for permit exemptions have been changed and the maximum quantity covered by a permit exemption for re-using soil is 1,000 T), or;
 - the site applies for a full Environmental Permit (either a standard rules permit or a bespoke permit) from the Environment Agency under the Environmental Permitting Regulations 2007.

9.3.3 The length of time taken for the above three regimes also need to be considered:

- CL:AIRE Code of Practice takes 7 to 14 days to gain approval and fees of £0.01 per m³ of soil move is payable to CL:AIRE (no charge for sites requiring reuse of up to 5,000 m³ of soil);
- An Environmental Permit exemption takes 7 to 14 days to gain approval and there are no fees due;
- Allow a minimum of 12 weeks to develop a Waste Recovery Plan and gain approval or the Environmental Permit from the Environment Agency and there are significant fees payable to the Agency (typically £5,000) for the permit.

9.3.4 Given the size of the development TerraConsult recommends that the CL:AIRE Code of Practice is utilised if more than 1,000 T (i.e. about 550 m³) of soils are to be retained on site.

10 GEOTECHNICAL ASSESSMENT & RECOMMENDATIONS

10.1 Introduction

10.1.1 The site will be split into discrete areas for the purposes of geotechnical design:

- Proposed new building
- Proposed MUGA Pitch
- Western Car Park
- Northern Car Park
- Northerly playing fields

10.1.2 Note that there is no risk from mining or quarrying at this site

10.2 Laboratory Analysis

10.2.1 Laboratory analysis indicates that the weathered Mercia Mudstone is a clay of low to intermediate plasticity and has a low volume change potential.

10.2.2 The particle size analysis on the weathered Mercia Mudstone indicates that it is about 25 % clay 67 % silt and 8 % fine sand.

10.3 Proposed New Building

10.3.1 Six window sample boreholes (WS101 to WS106) were completed in the area of the proposed new building to depths between 1.395 m bgl (WS106) and 3.14 m bgl (WS101). In addition, rotary borehole RC100 was progressed to a depth of 10.00m bgl. All

boreholes encountered Made Ground above Grade IVB Mercia Mudstone. A hand dug trial pit, TP116, was completed to the north of the proposed development footprint and did not encounter Mercia Mudstone after terminating at 1.00m bgl.

- 10.3.2 Due to its variability, the Made Ground is deemed unsuitable for foundation design and much of this is present in the mound of Made Ground which will be removed and will not be considered further.
- 10.3.3 The Mercia Mudstone is a weak mudstone rock which weathers to a clay near the ground surface. It's weathering is described in accordance with a weathering scheme of which the most commonly used is that first produced by Chandler in 1969 and is set out in CIRIA Report C570 (2001) with the weathering scheme presented in Figure 1 below:

Weathering Grade		Description	Notes
Fully weathered	IVb	Matrix only	Can be confused with solifluction or drift deposits, but contains no pebbles. Plastic slightly silty clay. May be fissured.
Partially weathered	IVa	Matrix with occasional claystone pellets less than 30 mm dia, but more usually coarse sand size.	Little or no trace of original (Grade I) structure, through clay may be fissured. Lower permeability than underlying layers.
	III	Matrix with frequent lithorelicts up to 25 mm. As weathering progresses, lithorelicts become less angular.	Water content of matrix greater than that of lithorelicts.
	II	Angular blocks of unweathered marl with virtually no matrix.	Spheroidal weathering. Matrix starting to encroach along joints: first indications of chemical weathering
Unweathered	I	Mudstone (often jointed and fissured).	Water content varies due to depositional variations.

Figure 2: Weathering Scheme for Mercia Mudstone (from CIRIA C579:2001)

- 10.3.4 Mercia Mudstone was encountered at depths ranging from 0.60 m bgl (WS102) to 2.00 m bgl (WS105). The material was recorded as an orangish brown or light grey slightly sandy slightly gravelly clay with mudstone gravel, representative of Grade IVa Mercia Mudstone. Based on an assessment of the SPT N-values all of these window sample holes are terminated in Grade III Mercia Mudstone. In the rotary cored hole RC100

Grade II Mercia Mudstone was recorded from a depth of 5.50 m to 7.00 m but below this depth the mudstone was of poorer quality being Grade III or VIa.

- 10.3.5 With the current varying ground level across the area of the proposed building with the grassed mounds rising between 2.00 and 2.50 m above the flat sections of hardstanding the reduced level rather than just depth to Mercia Mudstone needs to be considered. The top of the Mercia Mudstone was first encountered in this area between 57.77 mOD (WS101) and 54.91 mOD (WS105) as indicated in Table 10:

Table 11: Reduced Level & Depths to Mercia Mudstone in Area of Proposed Building				
Location	Ground Level (m OD)	Depth to Mercia Mudstone (m bgl)	Reduced Level of Top of Mercia Mudstone (m OD)	Depth below FFL of 57.5 mOD (m)
WS101*	59.37	1.60	57.77	0.27
WS102	58.50	1.00	57.50	0.00
WS103	57.97	0.60	57.37	-0.17
WS104**	57.55	1.60	55.85	1.65
WS105**	56.91	2.00	54.91	2.59
WS106	57.00	0.50	56.50	1.00
RC100	57.26	0.70	56.56	0.94
Note * = Depth to top of Mercia Mudstone influenced by drilling through mound ** = Depth to top of Mercia Mudstone influenced by excavation for stormwater attenuation tank FFL = Approximate Finished Floor Level				

- 10.3.6 In Table 1 above the column “Depth below FFL of 57.5 mOD” is provided to give an indication of depth below this arbitrary but approximate finished floor level (FFL) to give a better idea of the depth to the top of the Mercia Mudstone. In WS101, WS102 and WS103 along the eastern side the Mercia Mudstone will be encountered at approximately this FFL and in WS106 and RC100 in the central west the depth will be about 1.0 m below this FFL. The depth to the top of the mudstone will be deeper in WS104 and WS105 due to these holes being located close to the stormwater attenuation tank and these holes probably penetrating through the tank excavation backfill.
- 10.3.7 SPT N-values were recorded throughout each borehole and are summarised below for the three main strata encountered. The listed N-values have been corrected to the standard Energy Ratio of 60% and are therefore reported below as N_{60} values:

Table 12: Summary of SPT N_{60} Values

Hole No	Depth Below Current Ground Level (m)	Reduced Level of Test (mOD)	Depth below FFL of 57.5 mOD (m)	N_{60} for Strata:		
				Made Ground	Mercia Mudstone Grade VIa	Mercia Mudstone Grade III
WS101*	1.20 – 1.65	57.89	-0.39	18.4	-	-
	2.00 – 2.45	57.07	0.43	-	32.2	-
	2.80 – 3.14	56.35	1.15	-	-	>50 Ext 88
WS102	1.20 – 1.65	57.00	0.50	-	21.9	-
	1.70 – 2.03	56.50	1.00	-	-	>50 Ext 83
WS103	1.00 – 1.45	56.67	0.83	-	18.4	-
	2.00 – 2.39	55.67	1.83	-	-	>50 Ext 64
WS104**	1.00 – 1.45	56.25	1.25	-	17.3	-
	2.00 – 2.33	55.25	2.25	-	-	>50 Ext 83
WS105**	1.20 – 1.65	55.41	2.09	11.5	-	-
	2.00 – 2.45	54.61	2.89	-	43.6	-
	2.50 – 2.76	54.10	3.40	-	-	>50 Ext 143
WS106	1.00 – 1.40	55.70	1.08	-	-	>50 Ext 61
No of Tests				2	5	6
Range of Values				11.5 – 18.4	17.3 - 143	61 - 143
Mean				14.9	33.4	85.5
Notes: * = Depth to top of Mercia Mudstone influenced by drilling through mound ** = Depth to top of Mercia Mudstone influenced by excavation for stormwater attenuation tank >50 Ext then value = Extrapolated N_{60} values for tests which met refusal with extrapolation to full test penetration length.						

10.3.8 The allowable bearing pressure depends upon the grade of the Mercia Mudstone with presumed bearing pressures can be taken for the different grades as follows:

Table 13: Presumed Bearing Values and Weathering Grades

Weathering Grade	Presumed Bearing Pressure (kPa)	Remarks
IVa	125 – 250	Encountered below reduced levels varying from 54.9 mOD adjacent to attenuation tank to 57.7 m OD.
III	250 – 500	Encountered below reduced levels varying from 54.1 mOD adjacent to attenuation tank to 56.50 m OD.
II	500 – 750	Encountered only in RC100 below a depth of 5.50 m.
I	750 – 1000	Not Encountered in this investigation

10.3.9 However, the above presumed bearing grades just based on descriptions are set to be conservative, particularly if the lower bound bearing pressures are adopted. If analytical tests are carried out to determine properties of the Mercia Mudstone and then bearing capacity and settlement calculations are carried out then less conservative bearing pressures are normally assessed. Based on the SPT N_{60} values as set out in Table 11 and

published correlation factors in CIRIA C570 (2001), our assessment for the net allowable bearing pressures for the Mercia Mudstone at this site are:

Grade IVa	275 kPa	Assuming that foundation level of the footing is more than 300 mm into this stratum
Grade III	475 kPa	

- 10.3.10 It is understood that the maximum column load will be 1,450 kN and this can be safely and economically be founded on spread footings less than 1.75 m square in the Grade III Mercia Mudstone. This will be at relatively shallow depth for most of the building but in the southern part of the site Grade III bedrock will be at a depth greater than would normally likely to be economic for spread footings but this is due to the presence of the attenuation tank which will be removed. If the tank excavation is backfilled with appropriately compacted structural fill (HA Class 6N or 6P) then the footings can be cast on this at a higher level than the Grade III Mercia Mudstone.
- 10.3.11 Therefore piles will not be required for this development.
- 10.3.12 It should be noted that during construction of the building any excess pore pressures will dissipate and there should be no settlement of the structure after the building is complete.
- 10.3.13 If the Made Ground is removed below the floor slabs and replaced with compacted sub-base then ground bearing floor slabs can be used.

10.4 Proposed MUGA Pitch

- 10.4.1 Made Ground was encountered to depths of 0.30 to 1.30m below ground level overlying natural clay comprising Grade VIa Mercia Mudstone. The dynamic sample holes terminated in what is probably Grade III Mercia Mudstone at depths of 2.17 m (WS107) to 2.85m (WS109).
- 10.4.2 It is understood that most of the Made Ground will be removed from the area in order to form required level for the MUGA pitch. This will result in Grade VIa Mercia Mudstone being the principal material at formation level but there could still be some Made Ground locally present.
- 10.4.3 The CBR test results in this area strata are summarised below:

Table 14: Summary of CBR Results					
Location	Depth Range (m)		CBR Value (%)	Stratum	Remarks
	From	To			
DCP116	0.25	0.67	6.7	MADE GROUND	Test commenced at 0.25 m below ground level.
	0.67	0.72	29.2	REWORKED MERCIA MUDSTONE	
	0.72	0.96	8.9	REWORKED MERCIA MUDSTONE	
DCP117	0.25	0.45	13.1	MADE GROUND	Test commenced at 0.25 m below ground level.
	0.45	0.97	5.2	MERCIA MUDSTONE	
DCP118	0.25	0.53	9.5	MADE GROUND	Test commenced at 0.25 m below ground level.
	0.53	0.76	20.3		
	0.76	0.85	42.9		
	0.85	0.97	21.6		
	0.97	1.02	66.2		

10.4.4 The measured CBR values are relatively variable across the site with different strata. In the Mercia Mudstone clays the CBR value will be dependent on whether the clay was desiccated with higher CBR values anticipated adjacent to the existing trees. The overall performance of any hard standing will be determined by the weaker areas. Therefore based upon the nature of the ground conditions encountered during the site investigations undertaken, it is recommended that a lower bound CBR value of 5% is adopted for design purposes. If improvement measures such as lime or cement stabilisation were adopted then considerably higher CBR values would be appropriate and this sub-grade improvement may prove to be more economic than using thicker sub-base materials as there will be less excavated material and a thinner sub-base. All exposed formations should be proof rolled and any soft spots revealed should be excavated and replaced with suitable compacted granular fill.

10.5 Western Car Park

10.5.1 Topsoil was encountered to depths of 0.30 to 0.35m and this contained some anthropogenic materials such as brick and ceramics.. this was underlain by stiff natural clay comprising Grade VIa Mercia Mudstone. The dynamic sample hole WS110 terminated in what is probably Grade III Mercia Mudstone at a depth of 2.40 m.

10.5.2 The CBR test results in this area strata are summarised below:

Table 15: Summary of CBR Results					
Location	Depth Range (m)		CBR Value (%)	Stratum	Remarks
	From	To			
DCP119	0.33	0.70	3.7	MERCIA MUDSTONE	Test commenced at 0.25 m below ground level.
	0.70	0.80	10.0		
	0.80	0.90	5.0		
DCP120A	0.25	0.72	5.8	MERCIA MUDSTONE	Test commenced at 0.25 m below ground level.
	0.72	0.88	10.2		

10.5.3 It is recommended that a lower bound CBR value of 5% is adopted for design purposes.

10.6 Northern Car Park

10.6.1 Topsoil/Made Ground was encountered to depths of 0.60 to 0.75m and this contained anthropogenic materials such as concrete, brick and ceramics. This was underlain by stiff natural clay comprising Grade VIb Mercia Mudstone. The dynamic sample hole WS110 terminated in what is probably Grade III Mercia Mudstone at a depth of 2.40 m.

10.6.2 The CBR test results in this area strata are summarised below:

Table 16: Summary of CBR Results					
Location	Depth Range (m)		CBR Value (%)	Stratum	Remarks
	From	To			
DCP122	0.25	0.68	6.5	MADE GROUND	Test commenced at 0.25 m below ground level.
	0.68	0.97	14.4	MERCIA MUDSTONE	
DCP123	0.25	0.36	13.8	MADE GROUND	Test commenced at 0.25 m below ground level.
	0.36	0.64	7.2	MADE GROUND	
	0.64	0.92	14.1	MERCIA MUDSTONE	

10.6.3 It is recommended that a lower bound CBR value of 6% is adopted for design purposes.

10.7 Northerly Playing Fields

- 10.7.1 Topsoil/Made Ground was encountered to depths of 0.25 to 0.45m and this contained anthropogenic materials such as concrete, brick and ceramics. The exception to this is TP124 which was located on a mound to the north of the north car park where there was 0.95 m of Made Ground. The mound is about 0.70 m higher than the playing fields to the north of this area.
- 10.7.2 This was underlain by stiff natural clay comprising Grade VIb and VIa Mercia Mudstone. The dynamic sample holes terminated in what is probably Grade III Mercia Mudstone at depths of 2.27 to 2.45 m.
- 10.7.3 The CBR test results in this area strata are summarised below:

Table 17: Summary of CBR Results					
Location	Depth Range (m)		CBR Value (%)	Stratum	Remarks
	From	To			
DCP124	0.25	0.89	5.0	MADE GROUND	Test commenced at 0.25 m below ground level.
	0.89	1.04	14.7	MERCIA MUDSTONE	
DCP125	0.25	0.48	4.5	MADE GROUND	Test commenced at 0.25 m below ground level.
	0.48	0.55	35.6	MADE GROUND	
	0.55	0.91	7.8	MADE GROUND/ MERCIA MUDSTONE	
DCP126	0.25	0.97	3.0	MADE GROUND/ MERCIA MUDSTONE	Test commenced at 0.25 m below ground level.
DCP127	0.30	0.81	3.5	MERCIA MUDSTONE	Test commenced at 0.30 m below ground level.
	0.81	1.01	6.3		

10.8 Groundwater & Excavations

- 10.8.1 All excavations should be carried out in accordance with CIRIA Report 97 “Trenching Practice” and BS6031: 2009: Code of Practice for Earthworks. Further guidance on this aspect of site works is given in the British Standards for “Workmanship on Building Sites”, BS 8000, Parts 1 and 14, and in the Construction Industry Training Board’s Site Safety Note 10.
- 10.8.2 Excavation depths should generally be readily achieved using conventional hydraulic plant (e.g. wheeled JCB or similar) although larger plant (tracked 360° or similar) are recommended for deeper excavations into the mudstone for foundations and attenuation tanks.

10.9 Buried Concrete and Pipework

- 10.9.1 The results of laboratory pH and sulphate content indicate that ACEC Class AC-1s conditions prevail in accordance with BRE Special Digest 1, 2005 (the Design Concrete Class). Therefore no special precautions are required at the site for the design of concrete in terms of the durability and structural performance.

11 DEVELOPMENT CONSIDERATIONS

11.1 Environmental Assessment

- 11.1.1 A risk assessment has been made based on the contaminant-pathway-receptor model as defined in Part IIA of the Environment Protection Act, 1990, and in accordance with BS 10175: 2011+A1:2013 “Investigation of Potentially Contaminated Sites – Code of Practice”. In order to make a detailed assessment of the potential hazards, a more comprehensive conceptual ground model of the site was developed by carrying out a Phase 2 intrusive investigation. This detailed the characteristic ground conditions and elements of the surrounding environment and assisted with identifying the potential sources of contamination, the potential receptors of the contamination and the potential pathways between them.
- 11.1.2 The results of the risk assessments indicate that there is no significant source of contaminants present at the site. There is a negligible risk to receptors including humans (following development), controlled waters and ecological receptors and no mitigation measures are required due to ground gases (e.g. methane, carbon dioxide and radon).
- 11.1.3 The pH and sulphate content of the soils and groundwater indicate that with respect to potential attack of concrete Design Sulphate 2 and ACEC AC-1s specifications should be assumed.

11.2 Unforeseen Ground Contamination

- 11.2.1 There is the potential for areas of previously unexpected contamination to be present, as is the case with any “brownfield” site. Any significant quantities of asbestos, significant ashy soils, unusual, brightly coloured or significantly oily or odorous material should be considered in this category. If unexpected contamination is found the following procedures should be adhered to:
1. All site works at the position of the suspected contamination will cease.
 2. A suitably trained geo-environmental specialist should assess the visual and olfactory observations of the condition of the ground and the extent of contamination and the Client and the Local Authority should be informed of the discovery. Should the contamination be likely to affect controlled waters the Environment Agency shall also be informed.
 3. The suspected contaminated material will be investigated and tested appropriately in accordance assessed risks. The investigation works will be carried out in the presence of a suitably qualified geo-environmental engineer.

The investigation works shall commence to recover samples for testing and, using visual and olfactory observations of the condition of the ground, delineate the area over which contaminated materials are present.

4. The unexpected contaminated material will either be left in situ or be stockpiled whilst testing is carried out and suitable assessments completed to determine whether the material can be re-used on site or requires to be disposed as appropriate.
5. Where the material is left in situ awaiting results it will be reburied or covered with plastic sheeting.
6. Where the potentially contaminated material is to be temporarily stockpiled it will be placed either on a prepared surface of Glacial Till, or on 2000 gauge Visqueen sheeting (or other impermeable surface) and covered to prevent dust and odour emissions.
7. Any areas where unexpected visual or olfactory ground contamination is will be surveyed, a photographic record kept and testing results incorporated into the Verification Report.
5. A photographic recorded will be made of relevant observations.
6. The testing suite will be determined by the independent geo-environmental specialist on the basis of visual and olfactory observations.
7. Test results will be compared against current assessment criteria suitable for the future use of the area of the site affected.
8. The results of the investigation and testing of any suspect unexpected contamination will be used to determine the relevant actions. After consultation with the Local Authority and if necessary the Environment Agency, materials should either be:
 - re-used in areas where test results indicate that it meets compliance targets so it can be reused without treatment; or
 - treatment of material on site to meet compliance targets so it can be reused; or
 - removal from site to a treatment centre or to a suitably licensed landfill or permitted treatment facility.
9. Verification Report will be produced for the work.

Asbestos

- 11.2.2 Asbestos cement products and asbestos fibres have not been encountered in the soils at the site, but based on the age of the Made Ground material containing asbestos could be expected to be encountered. If non-notifiable asbestos (e.g. chrysotile asbestos cement board) is encountered in excavations then it will be dealt with in accordance with the Control of Asbestos Regulations 2012 (CAR 2012) and the HSE's ACoP for asbestos (2013). Finding non-notifiable asbestos is a very common occurrence on brownfield sites and is a relatively low risk activity and can be dealt with as a matter of routine. Therefore it is not proposed that the Council will be notified but an appropriate record will be kept of confirmatory testing and disposal. This will be included in remediation verification reports.

11.2.3 If suspect notifiable asbestos is encountered then the Council and the HSE will be notified. An appropriate action plan will be agreed with the Council and the HSE in accordance with CAR 2012. The action plan will include the preparation of the Risk Assessment and Plan of Work in accordance with CAR and other statutory requirements including:

- Site mobilisation;
- Excavation methodology;
- Handling, movement and storage on site of excavation arisings;
- Any processing of excavation arisings containing ACMs;
- Movement and placement of arisings to final destination;
- Placing of cover system over soils with and ACMs remaining on site;
- Off-site disposal of ACMs;
- Licences;
- PPE & RPE;
- Dust and fibre monitoring.

11.2.4 Potential mitigation measures that would be required include:

- Site investigation and risk assessment;
- Removal or treatment of asbestos hotspots;
- Use of PPE and RPE by construction workers; and
- Compliance monitoring.

Unexpected Tanks

11.2.5 No buried underground fuel storage tanks have been encountered during the site investigation works; however, there remains a low risk that tanks are present on site. Should an underground tank be encountered, operations should cease in the area. Additionally there may be pipework associated with these tanks which could have oily residues. The following procedures are to be adhered to if tanks and pipework are identified:

1. All site works at the position of the tanks/pipework should stop.
2. A description of the tank should be made by the geo-environmental engineer including; condition and surround, along with visual and olfactory observations should any contents in the tank be apparent. A photographic record will also be made of relevant observations.
3. The tank's position and depth should be determined and marked on a plan of the site.
4. The independent geo-environmental engineer will inform Client and the Local Authority.

5. During the presence of the independent geo-environmental engineer, investigation works should be undertaken to obtain samples of any liquid or sludge contents and to establish dimensions of the tank.
 6. Testing will be determined on the basis of visual and olfactory observations by independent geo-environmental engineer.
 7. Test results will be compared against current assessment criteria and proposals for disposal of any contents determined in agreement with the appropriate Regulatory Parties.
 8. Emptying the tank and disposal of contents to a suitable licenced disposal facility.
 9. Degassing and removal of the tank by a suitably qualified contractor will be required, and a Naked Flame Certificate should be provided.
 10. Once the tank has been emptied in accordance with the above proposals, it is to be removed for disposal to a licensed waste management facility. Copies of the relevant waste consignment notes are to be kept and included in the Verification Report.
 11. Excavation and remediation of any contaminated soils around the tank will be carried out.
 12. Samples of the base and sides of the resultant hole will be sampled and supervised by the independent geo-environmental engineer to confirm whether risks to human health or controlled waters.
- 11.2.6 All of the above information will be incorporated into the Verification Report and submitted to the regulatory parties, the Local Authority and the Environment Agency where groundwater may potentially have been impacted.

12 CONCLUSION

12.1 Environmental Risk Assessment

- 12.1.1 A risk assessment has been carried out based on the contaminant-pathway-receptor model as defined in Statutory Guidance to Part IIA of the Environment Protection Act, 1990, and in accordance with BS 10175: 2011 +A1:2013 “Investigation of Potentially Contaminated Sites – Code of Practice”. In order to make a detailed assessment of the potential hazards, a Phase 2 intrusive investigation was carried out to develop a more comprehensive conceptual ground model of the site. This detailed the characteristic ground conditions and elements of the surrounding environment and has assisted with identifying the potential contaminants of contamination, the potential receptors of the contamination and the potential pathways between them.
- 12.1.2 The results of the risk assessments indicate that there is no significant source of contaminants present at the site so there is a negligible risk to all receptors including humans, controlled waters and ecological receptors. No specific precautions are required with respect to landfill type ground gases, radon and hydrocarbons for the development.

12.2 Geotechnical Design

- 12.2.1 Based on the description of the weathered Mercia Mudstone, the SPT N_{60} values and published correlation factors in CIRIA C570 (2001), our assessment for the net allowable bearing pressures for the Mercia Mudstone at this site are:

Grade IVa	275 kPa	Assuming that foundation level of the footing is more than 300 mm into this stratum
Grade III	475 kPa	

- 12.2.2 It is understood that the maximum column load will be 1,450 kN and this can be safely and economically be founded on spread footings less than 1.75 m square in the Grade III Mercia Mudstone. This will be at relatively shallow depth for most of the building but in the southern part of the site Grade III bedrock will be at a depth greater than would normally likely to be economic for spread footings but this is due to the presence of the attenuation tank which will be removed. If the excavation for the existing attenuation tank is backfilled with appropriately compacted structural fill (HA Class 6N or 6P) then the footings can be cast on this at a higher level than the Grade III Mercia Mudstone.
- 12.2.3 Therefore piles will not be required for this development.
- 12.2.4 It should be noted that during construction of the building any excess pore pressures will dissipate and there should be no settlement of the structure after the building is complete.
- 12.2.5 If the Made Ground is removed below the floor slabs and replaced with compacted sub-base then ground bearing floor slabs can be used.
- 12.2.6 The pH and sulphate content of the soils requires checking with respect to its potential attack of concrete and take appropriate action in terms of specifying a suitable mix in line with Building Research Establishment Special Digest 1 Concrete in Aggressive Ground (2005).

12.3 Health and Safety

- 12.3.1 As outlined within the HSE publication “Successful Health and Safety Management – HSG65” this report should inform your development of safe systems of work and information as an input into the safety management system. The contents of this report may be used to supplement the contents of the Health and Safety File as required under the Construction Design and Management (CDM) Regulations 2015.
- 12.3.2 In accordance with the Construction Design and Management (CDM) Regulations 2015, TerraConsult has acted in the role of Principal Contractor and as Principal Designer for the works as described in this report. With issue of this report TerraConsult has discharged and completed all contractual and legal requirements for these positions and we have no further involvement with the project.

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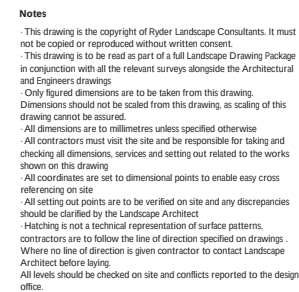
DRAWINGS

List of Drawings

16008-RYD-00-XX-GA-L-20000 (3) General Arrangement

16008-RYD-00-XX-GA-L-20004 Existing & Proposed Overlay

2859/1/001 Ground Investigations



KEY

- 2 Existing Mechanical, Electrical, Plumbing and Fire Protection
- 3 Proposed Extension: Please refer to attached drawings
- 4 Existing sports building
- 5 Existing changing facilities for sports building
- 6 Existing 7-a-side artificial pitches
- 7 Existing Area A: Proposed new stand and 2nd pitch. Total 2nd pitch seating capacity of 3,000 seats (Total 122 parking spaces, 6 CGOA spaces and 2 mobile spaces)
- 8 Proposed new drop off area
- 9 Reallocated bus stop to allow access from main car park entrance. Existing bus stop removed and relocated to building, existing parking lot built up with drained and new tarmac. New bus stop and safety barriers proposed
- 10 Proposed extension of existing 7-a-side
- 11 Proposed extension of existing 7-a-side
- 12 Existing Area B: 3 Mobile spaces (Total 122 parking spaces, 6 CGOA spaces and 2 mobile spaces)
- 13 Existing cycle store, existing 4 CGOA spaces. Total proposed of provision for 22 Mobile access Areas including existing and proposed
- 14 Proposed new 7-a-side pitches. Indicated provision for either climbing frame and basket swing, free bench and safety barriers proposed
- 15 Proposed new 7-a-side pitches. Outline shown for 2nd 7-a-side pitch. Total of 122 Mobile access Areas including existing and proposed
- 16 Proposed new 7-a-side pitches. parking 51 open spaces 3 CGOA spaces (Total 122 parking spaces, 6 CGOA spaces and 2 mobile spaces)
- 17 Existing Area C: 2nd extension to accommodate new pitch and stand (Total 122 parking spaces, 6 CGOA spaces and 2 mobile spaces)
- 18 Additional seating, double, third pitch details on the available new parking area
- 19 Cultural artwork to complement building colours and M&A colours. Feature to be affixed to all of the between two buildings and provide visual interest
- 20 Creation of new hard landscape areas with new existing grass
- 21 Existing surface areas for pitch and stand and maintenance pitch around new extension
- 22 Accommodation for ramp. Ramp 30m x 12m 2-bay 2-lane building at all four corners.
- 23 Existing 7-a-side pitches. Existing 7-a-side pitch. Third pitch to be added after two bays proposed
- 24 Existing 7-a-side pitches for artificial areas in 4G pitches
- 25 Existing 7-a-side pitches 22 high access areas 8m x 10m seating area
- 26 2nd pitch 200m (200m to be added to 7A) proposed. To be proposed to be part of hard surfaced M&A area due to landscaped facilities near Sainsbury boundary
- 27 Existing 7-a-side pitches 22 high access areas 8m x 10m seating area
- 28 Vehicle space - 2.4m high single hard surfaced
- 29 Proposed new area consisting of mobile and grass playing with existing area
- 30 Proposed new area consisting of mobile and grass playing with existing area
- 31 New M&A M&A (M&A) New Games Area. New line markings. Hard surfaced (10m x 20m) 2-bay 2-lane building at all four corners. Third pitch to be added after two bays proposed
- 32 Existing 7-a-side pitches 22 high access areas 8m x 10m seating area
- 33 Existing 7-a-side pitches 22 high access areas 8m x 10m seating area
- 34 Existing 7-a-side pitches 22 high access areas 8m x 10m seating area
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- 100 Existing 7-a-side pitches 22 high access areas 8m x 10m seating area

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LANDSCAPE CONSULTANTS

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Meyer House
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Title
General Arrangement

Scale @ A1	Drawn By	Checked By	Date
1 : 500	SO	GO	05/09/16
Drawing Number			Rev.
16008-RYD-00-XX-GA-L-20000			P0,2



Notes

- This drawing is the copyright of Ryder Landscape Consultants. It must not be copied or reproduced without written consent.
- This drawing is to be read as part of a full Landscape Drawing Package in conjunction with all the relevant surveys alongside the Architectural and Engineers drawings.
- Only figured dimensions are to be taken from this drawing.
- Dimensions should not be scaled from this drawing, as scaling of this drawing cannot be assured.
- All dimensions are to millimetres unless specified otherwise
- All contractors must visit the site and be responsible for taking and checking all dimensions, services and setting out related to the works shown on this drawing
- All coordinates are set to dimensional points to enable easy cross referencing on site
- All setting out points are to be verified on site and any discrepancies should be clarified by the Landscape Architect
- Hatching is not a technical representation of surface patterns, contractors are to follow the line of direction specified on drawings .
- Where no line of direction is given contractor to contact Landscape Architect before laying.
- All levels should be checked on site and conflicts reported to the design office.

...if in doubt ask

Proposed Surfacing Areas

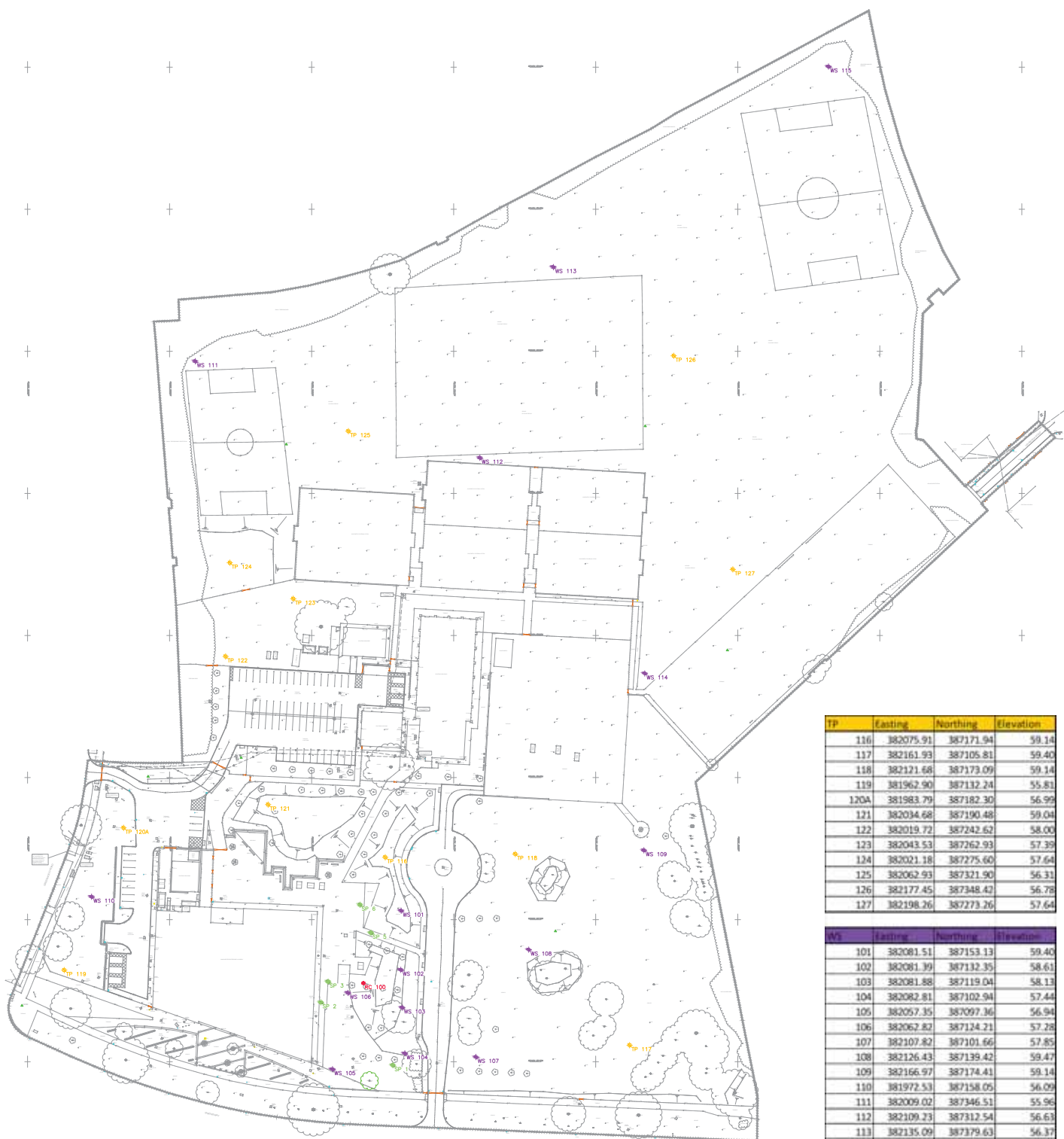
Hard Landscape = 205,687 m² (includes proposed extension area of 1,472,500 m²)
Soft Landscape = 17,250 m²
Existing buildings on site including existing academy = 14,592.22 m²

Existing Surfacing Areas

Hard Landscape = 18,880 m²
Soft Landscape = 61,244.51 m²
Existing buildings on site including existing academy = 15,082.22 m²

Variance between existing and proposed = 4008.88 m²

Rev	Revision description	Drawn	Checked	Date
RYDER LANDSCAPE CONSULTANTS Ryder Landscape Consultants Meyer House 42 City Road Tel +44 (0) 1244 400054 web: www.ryderlandscape.co.uk				
Client Willmott Dixon				
Project Manchester Enterprise Academy				
Title Existing & Proposed Overlay				
Scale @ A1 1 : 500				
Drawn By SO				
Checked By GO				
Date 05/19/16				
Drawing Number 16008-RYD-00-XX-GA-L-20004				
Rev. P0.1				



SP	Easting	Northing	Elevation
1	382078.61	387098.76	57.11
2	382053.24	387120.90	56.81
3	382055.80	387128.18	56.96
5	382070.89	387145.37	57.40
6	382067.02	387155.23	57.21

APPENDICES

List of Appendices

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Appendix B	Environmental Risk Assessment Methodology and Terminology
Appendix C	Photographs
Appendix D	Exploratory Hole Records
Appendix E	Gas and Groundwater Monitoring
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Appendix G	Laboratory Geotechnical Test Results
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Appendix J	Current Guidance for Ground Gas Risk Assessment
Appendix K	Summary of Guidance for Classification of Soil as a Waste Material

APPENDIX A

Service Constraints, Report Limitations & Planning

Service Constraints, Report Limitations & Planning Requirements

This consultancy contract, report and the site investigation (together comprise the "Services") were compiled and carried out by TerraConsult Limited (TCL) for Willmott Dixon Ltd (the "client") and the lead consultant Kier Business Services Ltd on the basis of a defined programme and scope of works and the terms of a contract between TCL and the "client." The Services were performed by TCL with all reasonable skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by TCL taking into account the limits of the scope of works required by the client, the prevailing site conditions, the time scale involved and the resources, including financial and manpower resources, agreed between TCL and the client. TerraConsult Ltd cannot accept responsibility to any parties whatsoever, following the issue of this report, for any matters arising which may be considered outwith the agreed scope of works.

Other than that expressly contained in the above paragraph, TCL provides no other representation or warranty whether express or implied, is made in relation to the Services. Unless otherwise agreed this report has been prepared exclusively for the use and reliance of the client in accordance with generally accepted consulting practices and for the intended purposes as stated in the agreement under which this work was completed. This report may not be relied upon, or transferred to, by any other party without the written agreement of a Director of TCL. If a third party relies on this report, it does so wholly at its own and sole risk and TCL disclaims any liability to such parties.

It is TCL's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of, or reliance upon the report in those circumstances by the client without TCL 's review and advice shall be at the client's sole and own risk.

The information contained in this report is protected by disclosure under Part 3 of the Environmental Information Regulations 2004 pursuant to the provisions of Regulation 12(5) without the consent in writing of a Director of TerraConsult Limited.

The report was written in July 2015 and should be read in light of any subsequent changes in legislation, statutory requirements and industry practices. Ground conditions can also change over time and further investigations or assessment should be made if there is any significant delay in acting on the findings of this report. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of TCL. In the absence of such written advice of TCL, reliance on the report in the future shall be at the client's own and sole risk. Should TCL be requested to review the report in the future, TCL shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between TCL and the client.

The observations and conclusions described in this report are based solely upon the Services that were provided pursuant to the agreement between the client and TCL. TCL has not performed any observations, investigations, studies or testing not specifically set out or mentioned within this report. TCL is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, TCL did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, radon gas or other radioactive or hazardous materials.

The Services are based upon TCL's observations of existing physical conditions at the site gained from a walkover survey of the site together with TCL's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The findings and recommendations contained in this report are based in part upon information provided by third parties, and whilst TerraConsult Ltd have no reason to doubt the accuracy and that it has been provided in full from those it was requested from, the items relied on have not been verified. No responsibility can be accepted for errors within third party items presented in this report. Further TCL was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. TCL is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to TCL and including the doing of any independent investigation of the information provided to TCL save as otherwise provided in the terms of the contract between the client and TCL.

Where field investigations have been carried out these have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions can also be variable and as investigation excavations only allow examination of the ground at discrete locations. The potential exists for ground conditions to be encountered which are different to those considered in this report. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and TCL] based on an understanding of the available operational and historical information, and it should not be inferred that other chemical species are not present.

The groundwater conditions entered on the exploratory hole records are those observed at the time of investigation. The normal speed of investigation usually does not permit the recording of an equilibrium water level for any one water strike. Moreover, groundwater levels are subject to seasonal variation or changes in local drainage conditions and higher groundwater levels may occur at other times of the year than were recorded during this investigation.

Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.

Throughout the report the term 'geotechnical' is used to describe aspects relating to the physical nature of the site (such as foundation requirements) and the term 'geoenvironmental' is used to describe aspects relating to ground-related environmental issues (such as potential contamination). However, it should be appreciated that this is an integrated investigation and these two main aspects are inter-related. The geoenvironmental sections are written in broad agreement with BS 10175:2011+A1 2013. For the geotechnical aspects of the report, the general requirements of Eurocode 7 (BS EN 1997-2:2007) are to produce a Ground Investigation Report (GIR) which shall form part of the Geotechnical Design Report (GDR). The geotechnical section of this report is intended to fulfil the general requirements of the GIR as outlined in BS EN 1997-2, Section 6. The GIR contains the factual information including geological features and relevant data, and a geotechnical evaluation of the information stating the assumptions made in the interpretation of the test results. This report shall not be considered as being a GDR.

Planning Requirements

The National Planning Policy Framework (NPPF, 2012) has twelve core land-use planning principles, two of which directly relate to the potential for pollution and contaminated land:

- Requirement to “*contribute to conserving and enhancing the natural environment and reducing pollution*” and setting out of a preference for developments to be on land of “*lesser environmental value*”; and
- “*encourage the effective use of land by re-using land that has been previously developed (brownfield land), providing that it is not of high environmental value.*”.

In accordance with the core principles of NPPF, Paragraph 109 clarifies that enhancing the natural environment includes:

- “*preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability; and*
- *remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.*”.

Paragraph 121 of NPPF states that planning policies and decisions for developments should also ensure that:

- “*the site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;*
- *after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and*
- *adequate site investigation information, prepared by a competent person, is presented.*”.

This report has been prepared and authorised by staff that are competent as defined in the NPPF.

APPENDIX B

Environmental Risk Assessment Methodology & Terminology

ENVIRONMENTAL RISK ASSESSMENT METHODOLOGY & TERMINOLOGY

LEGISLATION OVERVIEW

This report includes hazard identification and environmental risk assessment in line with the risk-based methods referred to in relevant UK legislation and guidance. Government environmental policy is based upon a “suitable for use approach,” which is relevant to both the current use of land and also to any proposed future use. The contaminated land regime is the statutory regime for remediation of contaminated land that causes an unacceptable level of risk and is set out in Part 2A of the Environmental Protection Act 1990 (“EPA 1990”). The main objective of introducing the Part IIA regime is to provide an improved system for the identification and remediation of land where contamination is causing unacceptable risks to human health or the wider environment given the current use and circumstances of the land. Part IIA provides a statutory definition of contaminated land under Section 78A(2) as:

“any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on, or under the land, that:

- (a) Significant harm is being caused or there is a significant possibility of such harm being caused;*
- or*
- (b) Pollution of controlled waters is being, or is likely to be, caused.”*

In order to assist in establishing if there is a “significant possibility of significant harm” there must be a “contaminant linkage” for potential harm to exist. That means there must be a source(s) of contamination, sensitive receptors present and a connection or pathway between the two. This combination of contaminant-pathway-receptor is termed a “contaminant linkage or CPR linkage.”

Part IIA of The Environmental Protection Act 1990 is supported by a substantial quantity of guidance and other Regulations. Key implementing legislation of the Part 2A regime includes the Contaminated Land (England) Regulations 2006 (SI 2006/1380) as amended by the overarching legislation for the contaminated land regime, which implements the provisions of Part IIA of the Environmental Protection Act 1990 (as inserted by section 57 of the Environment Act 1995), came into force on 14th July 2000 together with recent amended regulations: Contaminated Land (England) (Amendment) Regulations 2012 (SI 2012/263). Revised Contaminated Land Statutory Guidance was published by DEFRA in April 2012. Part IIA defines the duties of Local Authorities in dealing with it. Part IIA places contaminated land responsibility as a part of planning and redevelopment process rather than Local Authority direct action except in situations of very high pollution risk.

In the planning process guidance is provided by National Planning Policy Framework (NPPF) of March 2012 which requires that a site which has been developed shall not be capable of being determined “contaminated land” under Part IIA. In practice, Planning Authorities require sites being developed to have a lower level of risk post development than the higher level of risk that is required in order to determine a site as being contaminated in accordance with Part IIA. This is to ensure that there is a suitable zone of safety below the level for Part IIA determination and prevent recently developed sites becoming reclassified as contaminated land if there are future legislative or technical changes (e.g. a substance is subsequently found to be more toxic than previously assessed this increases its hazard).

The criteria for assessing concentrations of contaminants and hence determining whether a site represents a hazard are based on a range of techniques, models and guidance. Within this context it is relevant to note that Government objectives are:

- (a) to identify and remove unacceptable risks to human health and the environment;*
- (b) to seek to bring damaged land back into beneficial use;*
- (c) to seek to ensure that the cost burdens faced by individuals, companies and society as a whole are proportionate, manageable and economically sustainable.*

These three objectives underlie the “suitable for use” approach to risk management and remediation of contaminated land. The “suitable for use” approach focuses on the risks caused by land contamination. The approach recognises that

the risks presented by any given level of contamination will vary greatly according to the use of the land and a wide range of other factors, such as the underlying geology of the site. Risks therefore should be assessed on a site-by-site basis.

The "suitable for use" approach then consists of three elements:

- (a) *ensuring that land is suitable for its current use* - in other words, identifying any land where contamination is causing unacceptable risks to human health and the environment, assessed on the basis of the current use and circumstances of the land, and returning such land to a condition where such risks no longer arise ("remediating" the land); the contaminated land regime provides the regulatory mechanisms to achieve this;
- (b) *ensuring that land is made suitable for any new use, as planning permission is given for that new use* - in other words, assessing the potential risks from contamination, on the basis of the proposed future use and circumstances, before official permission is given for the development and, where necessary to avoid unacceptable risks to human health and the environment, remediating the land before the new use commences; this is the role of the town and country planning and building control regimes; and
- (c) *limiting requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to the current use or future use of the land for which planning permission is being sought* - in other words, recognising that the risks from contaminated land can be satisfactory assessed only in the context of specific uses of the land (whether current or proposed), and that any attempt to guess what might be needed at some time in the future for other uses is likely to result either in premature work (thereby running the risk of distorting social, economic and environmental priorities) or in unnecessary work (thereby wasting resources).

The mere presence of contaminants does not therefore necessarily warrant action, and consideration must be given to the scale of risk involved for the use that the site has, and will have in the future.

OVERALL METHODOLOGY

The work presented in this report has been carried out in general accordance with recognised best practice as detailed in guidance documents such as in the CLR 11 Model Procedures for the Management of Land Contamination (Environment Agency, 2004), and BS10175:2011+A1 2013. Important aspects of the risk assessment process are transparency and justification. The particular rationale behind the risk assessments presented is given in this appendix.

The first stage of a two-staged investigation and assessment of a site is the Preliminary Investigation (BS 10175:2011), often referred to as the Phase 1 Study, comprising desk study and walk-over survey, which culminates in the Preliminary Risk Assessment. A preliminary conceptual site model (CSM) is developed which identifies potential geotechnical and geo-environmental hazards and the qualitative degree of risk associated with them. From the geo-environmental perspective, the Hazard Identification process uses professional judgement to evaluate all the hazards in terms of potential contaminant linkages (of contaminant source-pathway-receptor). Potential contaminant linkages are potentially unacceptable risks in terms of the current contaminated land regime legal framework and require either remediation or further assessment. These are normally addressed via intrusive ground investigation and generic risk assessment.

The second stage is the Ground Investigation, Generic Risk Assessment and Geotechnical Interpretation. This represents the further assessment mentioned above. The scope of the Ground Investigation is based on the findings of the Preliminary Risk Assessment and is designed to reduce uncertainty in the geotechnical and geo-environmental hazard identification. The Ground Investigation comprises fieldwork, laboratory testing and usually also on-site monitoring. The Ground Investigation may include the Exploratory, Main and Supplementary Investigations described in BS 10175:2011+A1 2013. The results of the Ground Investigation reduces uncertainty in the geotechnical and geo-environmental risks. Depending on the findings more detailed investigations or assessments may be required.

PRELIMINARY RISK ASSESSMENT

Current practice recommends that the determination of potential liabilities that could arise from land contamination be carried out using the process of risk assessment, whereby “risk” is defined as:

- “(a) The probability, or frequency, or occurrence of a defined hazard; and*
- (b) The magnitude (including the seriousness) of the consequences.”*

The UK’s approach to the assessment of environmental risk is set out in by the Department of the Environment Transport and the Regions (2000) publication “A Guide to Risk Assessment and Risk Management for Environmental Protection” (also called Greenleaves II). This established an iterative, systematic staged process which comprises:

- (a) Hazard identification;
- (b) Hazard assessment;
- (c) Risk estimation;
- (d) Risk evaluation;
- (e) Risk assessment;

At each stage during the development process, the above steps are repeated as more detailed information becomes available for the site.

For an environmental risk to be present, all three of the following elements must be present:

- Source/Contaminant: hazardous substance that has the potential to cause adverse impacts;
- Receptor: target that may be affected by contamination: examples include human occupants/users of site, water resources (rivers or groundwater), or structures;
- Pathway: a viable route whereby a hazardous substance may come into contact with the receptor.

The absence of one or more of each component (contaminant, pathway, receptor) would prevent a contaminant linkage being established and there would be no significant environmental risk.

The identification of potential contaminant linkages is based on a Conceptual Model of the site, which is subject to continual refinement as additional data becomes available. As part of a Preliminary Risk Assessment (Desk Study and site walk over) a Preliminary Conceptual Site Model (PCSM) is formed. Based on the PCSM, potential contaminant linkages can be assessed. If the PCSM and hazard assessment indicate that a contaminant linkage is not of significance then no further assessment or action is required for this linkage. For each significant and potential linkage a risk assessment is carried out. The linkages which potentially pose significant risks may require a variety of responses ranging from immediate remedial action or risk management or, more commonly, further investigation and risk assessment. This next stage is termed a Phase II Main Site Investigation and should provide additional data to allow refinement of the Conceptual Site Model and assess the level of risk from each contaminant linkage.

Definition of Risk Assessment Terminology

The criteria used for risk assessment are broadly based on those presented in DETR’s “A Guide to Risk Assessment and Risk Management for Environmental Protection” (2000). The Severity of the risk is classified according to the criteria in Table B.1 below:

Table B.1 Severity/Consequence of Risk	
Severe	Acute risks to human health. Catastrophic damage to buildings/property (e.g. by explosion). Direct pollution of sensitive water receptors or serious pollution of other controlled water (watercourses or groundwater) bodies.
Medium	Harm to human health from long-term exposure. Slight pollution of sensitive controlled waters (surface waters or aquifers) or pollution of other water bodies. Significant effects on sensitive ecosystems or species.
Mild	No significant harm to human health in either short or long term. No pollution of sensitive controlled waters, no more than slight pollution of non-sensitive waters. Significant damage to buildings or structures. Requirement for protective equipment during site works to mitigate health effects.
Negligible	Damage to non-sensitive ecosystems or species. Minor damage to buildings or structures. No harm or pollution of water.

The probability of the risk occurring is classified according to criteria given in Table B.2 below:

Table B.2: Probability of Risk Occurring	
High likelihood	Contaminant linkage may be present, and risk is almost certain to occur in the long term, or there is evidence of harm to the receptor.
Medium/Reasonably Foreseeable	Contaminant linkage may be present, and it is probable that the risk will occur over the long term.
Low/Unlikely	Contaminant linkage may be present and there is a possibility of the risk occurring, although there is no certainty that it will do so.
Negligible/Not credible	Contaminant linkage may be present but the circumstances under which harm would occur are improbable.

An overall evaluation of the level of risk is gained from a comparison of the severity and probability, as shown in Table B.3 below:

Table B.3: Comparison of Severity and Probability					
		Severity			
		Severe	Medium	Mild	Negligible
Probability	High likelihood	Very High Risk	High Risk	Medium/Low Risk	Low Risk
	Medium/Reasonably Foreseeable	High Risk	Medium Risk	Low Risk	Near Zero
	Low/Unlikely	High/Medium Risk	Medium/Low Risk	Low Risk	Near Zero
	Negligible/Not credible	Medium/Low Risk	Low Risk	Low Risk	Near Zero

The various risk rankings provide guidance for recommended actions, whether this is:

- AR - Action Required, Remediation or mitigation or site investigation works required
- SIR - Site Investigation Required, further assessment is required.
- NAR - No Action Required.

A description of the evaluated risk is as follows:

Table B.4 – Description of the Classified Risks and Likely Action Required	
Evaluated Risk	Recommended Actions
Very High Risk	AR: There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High Risk	AR: Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the long term.
Moderate Risk	SI: It is possible that harm could arise to a designated receptor from an identified hazard. However, it is relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer term.
Low Risk	NAR: It is possible that harm could arise to a designated receptor from an identified hazard, but there is a low likelihood of this hazard occurring and if realised, harm would at worst normally be mild.
Near Zero	NAR: There is a negligible possibility that harm could arise to a receptor. In the event of such harm being realised, it is not likely to be severe.

GENERIC QUANTITATIVE RISK ASSESSMENT

In the following sections the current UK guidance on risks to the following receptors are discussed: human health, plant life and controlled waters

• Human Health

The overall methodology for assessing the risk to human health from potential contaminants in soil is set out in the Environment Agency’s guidance “Using Soil Guideline Values” SC050021/SGV Introduction, March 2009 and using the CLEA 1.06 model software (and CLEA 1.071 for nickel). The generic assessment criteria are in accordance with the following:

- Science Report SC050021/SR2: Human health toxicological assessment of contaminants in soil;
- Science Report SC050021/SR3: Updated technical background to the CLEA model;
- Science Report SC050021/SR4: CLEA Software (Version) Handbook;
- Toxicological reports and SGV technical notes;
- Toxicological data published by LQM/CIEH (2009) and CL:AIRE/EIC/AGS (2009)
- DEFRA Development of Category 4 Screening Levels for assessment of land affected by contamination - SP1010 (December 2013).
- LQM/CIEH Suitable 4 Use Levels (S4ULs) for Human Health Risk Assessment
- Toxicology review published by the European Food Safety Authority for nickel (2015)

In March 2014 six ‘proposed’ Category 4 Screening Levels (pC4SL) were issued by Defra. These screening values are considered to be within Category 4 as defined in the Contaminated Land Statutory Guidance and indicate safe levels for new developments passing through the planning system. The SGV for lead has been withdrawn, and the pC4SL for lead has been derived using current best practice. In January 2015 LQM/CIEH published S4ULs for 89 contaminants in accordance with the C4SL methodology.

Note that groundwater contamination may pose a risk to human health but that there are no relevant generic assessment criteria available for comparison. TerraConsult has derived our own assessment criteria for this.

• Phytotoxic Risks

Generic assessment of phytotoxicity is by comparison with guideline values presented in the British Standard for Topsoil and the MAFF document “Code of Good agricultural practice for the protection of soil”, October 1998. This is in accordance with CLR’s reference to DEFRA notice CLAN 4/04.

- **Controlled Waters**

Risks to controlled waters (groundwater and surface waters) from contaminants are assessed in accordance with the EA documents Groundwater Protection: Policy and Practice GP3 (2012) and Remedial Targets Methodology (RTM, 2006). Pollutant inputs from contaminated land sites are considered as passive inputs under the European Water Framework Directive (2000/60/EC) (WFD) and its daughter Directives, and as such are regulated under the Environment Agency's 'limit' pollution objective. Acceptable water quality targets (WQT) are defined for protection of human health (based on Drinking Water Standards (DWS)) and for protection of aquatic ecosystems (Environmental Quality Standards (EQS)). The risk posed to controlled waters from total soil concentrations cannot be directly assessed. The risk is assessed either by comparison of results of leachate tests carried out on soil samples, or from the direct testing of samples of groundwater to screening criteria. Leachate testing generally forms a conservative assessment and is not appropriate for organic contaminants.

CURRENT GUIDANCE ON INTERPRETATION OF CHEMICAL ANALYSIS OF SOILS

Contaminated land is defined under law through Part IIA of the Environmental Protection Act 1990, implemented through Section 57 of the Environment Act 1995. This supports a 'suitable for use' based approach to the risk assessment of potentially contaminated land. The site specific risk assessment is based upon assessment of plausible contaminant linkages, referred to as the contaminant-pathway- receptor model, based upon the current or proposed use of the site.

Before undertaking a risk assessment a conceptual site model is devised in order to identify the potential contaminants, pathways and receptors. The individual contaminants, pathways and receptors then need to be further investigated in order to refine the initial assessment and risk assessment undertaken.

In March 2002, the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency published the Contaminated Land Exposure Assessment (CLEA) Model and a series of related reports. These were designed to provide a scientifically based framework for the assessment of chronic risks to human health from contaminated land. These reports (CLR7-10) together with associated "SGV" documents were withdrawn and the following documents have been published as revised guidance to the CLEA assessment:

- Environment Agency : 2008: Using Soil Guideline Values SC050021/SGV Introduction, March 2008.
- Environment Agency : 2008: Science Report SC050021/SR2: Human health toxicological assessment of contaminants in soil.
- Environment Agency : 2008: Science Report SC050021/SR3: Updated technical background to the CLEA model.
- Environment Agency : 2008 : Compilation of Data for Priority Organic Contaminants for Derivation of Soil Guideline Values Science report SC050021/SR7
- Environment Agency : Science Report SC050021/SR4: CLEA Software (Version 1.05) Handbook.
- Environment Agency : CLEA Software Version 1.071, September 2015
- DEFRA Development of Category 4 Screening Levels for assessment of land affected by contamination - SP1010 (December 2013).
- LQM/CIEH Suitable 4 Use Levels for Human Health Risk Assessment

Additional guidance on statistical assessment replacing CLR 7 is partly provided in:

- CL:AIRE: 2009: Guidance on Comparing Data With a Critical Concentration

A different approach to the statistical appraisal of data is required depending on whether the assessment of risk is to assess whether land is Contaminated Land in accordance with regulations, or whether the assessment is to assess whether the site is suitable for new development in according with Planning guidance. This is discussed further in CL:AIRE: 2009 "Guidance on Comparing Data With a Critical Concentration".

The introduction of the Contaminated Land (England) (Amendment) Regulations 2012 and Contaminated Land Statutory Guidance (DEFRA, 2012) reassessed the CLEA Model and the derived SGVs (and associated GACs calculated using the model). This re-assessment concluded that the SGVs/GACs were conservative screening criteria for determining the suitability of soil with regard to the risk to human health under the planning regime and defined a new upper limit for planning purposes which is the boundary between the new Category 3 and 4. In March and September 2014 DEFRA issued guidance on these new Category 4 Screening Levels (C4SL) and these are discussed further below.

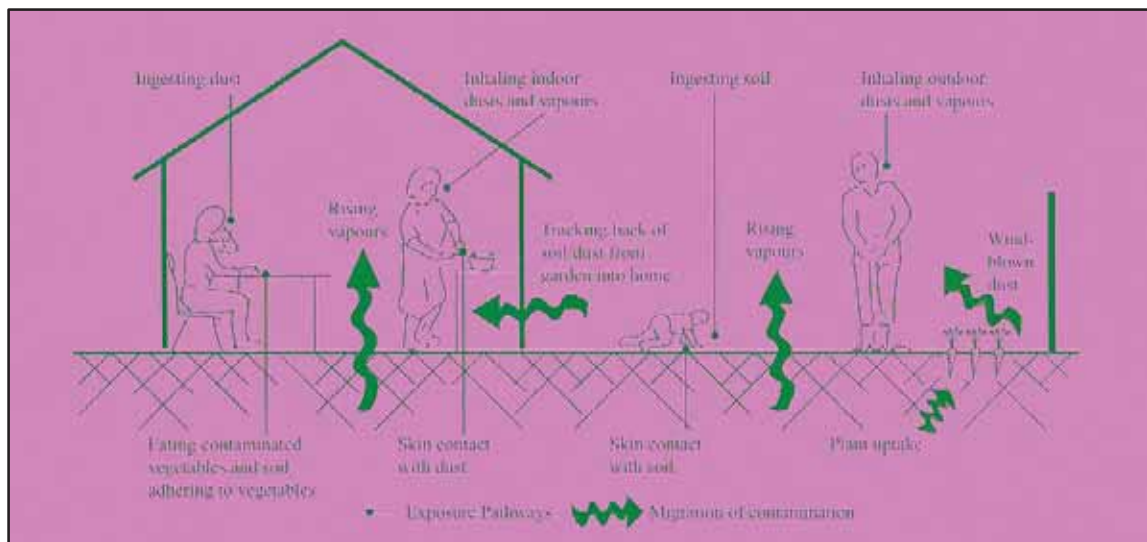
Soil Guideline Values

A program for the derivation of SGVs based on the above guidance is provided by the Environment Agency and is entitled "CLEA Software Version 1.06". These reports, together with supporting toxicology reviews ("Tox" or Supplementary Information Reports) for individual substances (which will be gradually updated), Soil Guideline Value Reports and other guidance referred to in the above documents, provide guidance and the scientific basis for assessing the risk to human health from potential contaminants. Soil Guideline Value Reports (SGV Reports) have been published for a number of contaminants and these are published on the Environment Agency website. Eventually the reports will include SGVs for:

- heavy metals and other inorganic compounds: arsenic, cadmium, chromium, cyanide, lead (now withdrawn), mercury nickel (now withdrawn), and selenium;
- benzene, ethylbenzene, toluene and xylenes;
- phenol;
- dioxins and dioxin-like polychlorinated biphenyls (PCBs);
- polycyclic aromatic hydrocarbons (PAHs) – 11 substances.

In addition CIEH through LQM and the EIC have published generic assessment criteria (GACs) for a wide variety of other parameters including metals, hydrocarbons, chlorinated aliphatic compounds, PAHs and explosive substances for three standard land uses. These have been produced to supplement the Environment Agency guidance. These GACs will be replaced by SGVs when or if the Environment Agency publishes any more SGVs.

The CLEA model has been developed to calculate an estimated tolerable daily soil intake (TDSI) for site users given a set 'default' exposure pathways. Ten human exposure pathways are covered in the CLEA model as presented below:



- **Ingestion**
 - ingestion of outdoor soil;
 - ingestion of indoor dust;
 - ingestion of home grown vegetables;

- ingestion of soil attached to home grown vegetables.
- **Dermal Contact**
 - dermal contact with outdoor soil;
 - dermal contact with indoor dust.
- **Inhalation**
 - inhalation of outdoor dust;
 - inhalation of indoor dust;
 - inhalation of outdoor soil vapour;
 - inhalation of indoor soil vapour.

It should be noted that there are other potential exposure pathways on some sites not included in the CLEA model e.g. certain organic compounds can pass through plastic water pipes into drinking water supply.

The presence and/or significance of each of the above exposure pathways are dependent on the type of land use being considered and the nature of the contaminant under scrutiny. Accordingly, the CLEA model considers for principle 'default' land use types and makes a series of 'default' assumptions with regard to human exposure frequency, duration and critical human target groups for each land use considered:

- residential land use;
- allotments;
- commercial and industrial land use.

The land use categories defined in the CLEA are detailed below.

Residential: This land use category assumes that people live in a variety of dwellings including terraced, detached and semi-detached houses up to two storeys high. The structure of buildings varies. Default parameters for building materials and building design are included in CLEA documents to calculate the relevant multi-layer diffusion coefficients for vapour intrusion and to model indoor vapour intrusion. The CLEA model assumes that regardless of the style of housing the residents will have access to either a private garden or community open space nearby, and that soil tracked into the home will form indoor dust. It allows for the ingestion pathways from home grown vegetables.

Allotments: The CLEA model incorporates an assessment of land provided by local authorities specifically for people to grow fruit and vegetables for their own consumption. Consumption of such fruit and vegetables present several exposure pathways; plants absorb contaminants mainly via water uptake through roots, the contaminants move to edible portions of plants via translocation and contaminated soil particles become trapped in the skin and between leaves. At present the model fails to account for exposure through the consumption of animals, and their products (e.g. eggs), which have been reared on contaminated land.

Commercial/Industrial: Although there are a wide variety of workplaces and work-related activities, the CLEA assessment of this land-use assumes that work occurs in a permanent, three-storey structure, where employees spend most time indoors, conducting office-based or light physical work. The model assumes employees sit outside during breaks for most of the year. Limitations in applying this land-use to different industries is detailed in EA publication "Updated technical background to the CLEA model" (2011). The generic model assumes that the site would not be covered by hard standing. Risk of exposure to contaminants would be clearly less where commercial land is essentially all buildings and hard standing.

Based on the assumptions of each land use and the associated applicable exposure pathways, a 'Soil Guideline Value' (SGV) may be calculated for each contaminant under consideration for a particular land use in order to determine whether certain contaminant soil concentrations pose a significant risk to human health. The primary purpose of the CLEA SGVs are as 'trigger values' – indicators to a risk assessor that soil concentrations below this level require no further assessment as it can be assumed that the soil is suitable for the proposed use. Where soil concentrations occur above the SGV then further assessment of the results is required. The Contaminated Land (England) (Amendment) Regulations 2012 and Contaminated Land Statutory Guidance (DEFRA, 2012) which came into force in early April 2012 provides new clarity on the assessment of risk where soil concentrations exceed the SGV. The guidance

introduces a four stage classification system relating to concentration of contaminants and the assessed risk which indicates appropriate actions. Category 1 and 2 sites are classified as “Contaminated Land” as defined in Part IIA of The Environmental Protection Act (1990). Category 3 and 4 sites are not considered as “Contaminated Land” in accordance with the Act. This can be explained using the figure on the following page.

There are also difficulties in establishing soil concentrations of contaminants beyond which risks from exposure to these contaminants would be ‘unacceptable’ and that they would lead to “significant possibility of significant harm” as defined in Part IIA of The Environmental Protection Act (1990) and determine that the land is “contaminated.” This ultimately requires detailed ‘toxicological’ information of the health effects of individual contaminants and also a scientific judgement on what constitutes an ‘unacceptable’ risk. It is for local authorities or the Environment Agency to determine whether a particular site is contaminated land and it is for local Planning Authorities to determine whether land affected by contamination can be redeveloped.

Given the SGVs have been derived only for a limited number of contaminants and there was little prospect of further SGVs being published, two professional groupings have produced Generic Assessment Criteria (GACs) in accordance with the CLEA model for a large number of additional contaminants. These GACs were recognised in the new Contaminated Land Statutory Guidance (DEFRA, 2012) and have been produced as follows:

LQM/CIEH : 2009 Nathaniel CP, McCaffrey C, Ashmore MH, Cheng NPS GROUP, Gillett A, Ogden R & Scott D : 2009 . The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd edition). Land Quality Press, Nottingham.
CL:AIRE/EIC/AGS: 2009 : Soil Generic Assessment Criteria (GAC) for Human Health Risk Assessment. Contaminated Land: Applications in Real Environments, Environment Industries Commission & Association of Geotechnical and Environmental Specialists. December 2009.

Category 4 Screening Levels and LQM/CIEH Suitable 4 Use Levels

For new developments progressing through the planning regime, it is desirable that the soil concentrations are within Category 4 where there is a valid contaminant linkage. The upper boundary between Category 4 and 3 is not defined in the guidance. This boundary can also be better defined by carrying out a Detailed Quantified Risk Assessment (DQRA) and this is discussed later in this appendix.

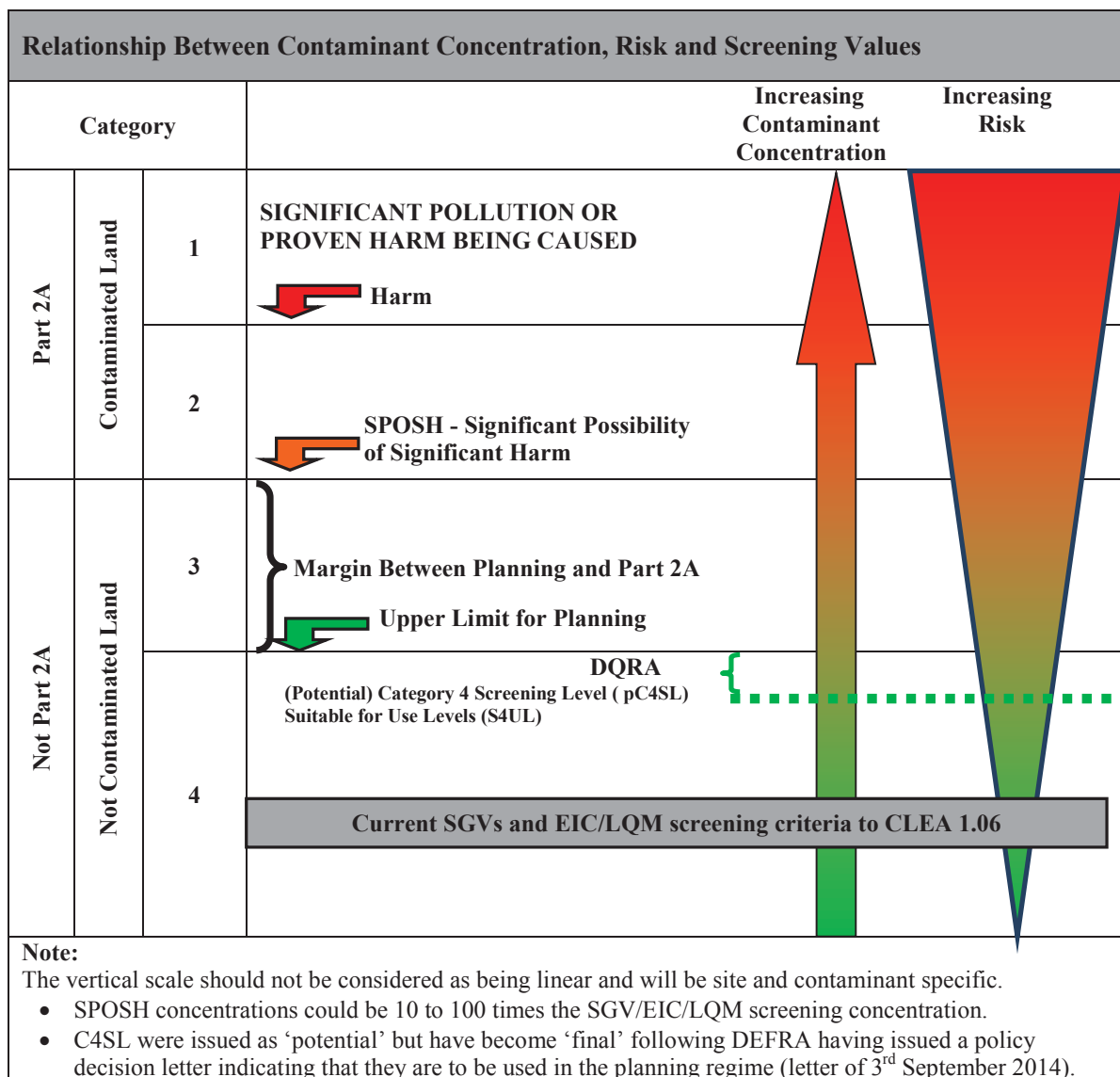
In December 2013 Defra issued the findings of a research project undertaken by CL:AIRE to set out the framework by which potential Category 4 Screening Levels (pC4SL) may be derived. The report was not designed to produce ‘final’ C4SL as the steering group producing the report believes that final C4SL should be set by a ‘relevant authority’ (e.g. Defra), the toxicological framework proposed has not been reviewed by the Committee on Toxicity and the document has yet to be subject to peer review.

In March 2014, appendices to the main Defra report were published detailing the derivation of pC4SL for 6 contaminants and other appendices regarding a review of the CIEH/CL:AIRE statistics guidance and sensitivity analysis. For each contaminant, a range of pC4SL have been produced relating to modifying toxicological parameters only, modifying exposure parameters only or by modifying both. It should be noted that the pC4SL produced for lead (the SGV was withdrawn in 2011) has undertaken a relatively large toxicological review in relation to modelling blood lead concentrations. pC4SL have been produced for:

- Arsenic;
- Benzene;
- Benzo(a)pyrene (as a surrogate marker for PAHs);
- Cadmium;
- Chromium (VI); and
- Lead

As previously discussed the values were initially published as ‘potential’ C4SL but have become ‘final’ following DEFRA having issued a policy decision letter indicating that they are to be used in the planning regime (letter of 3rd September 2014). It is considered that the pC4SL provide a simple test for deciding whether land is suitable for use without any remediation. The pC4SL represent a new set of screening levels that are more pragmatic (but strongly precautionary) compared to the existing soil guideline values (SGVs and the other GACs calculate in accordance with

the existing CLEA methodology). The pC4SL provide cautious estimates of contaminant concentrations in soil that are still considered to present an acceptable level of risk, within the context of Part 2A, by combining information on toxicology, exposure assessment and normal levels of exposure to these contaminants. pC4SL values should not be seen as 'SPOH values.' Exceeding a pC4SL means that further investigation is required, not that the land is necessarily contaminated. In January 2015, LQM published Suitable 4 Use Levels (S4ULs) for a further 89 contaminants using the Defra C4SL methodology. In a similar manner to the pC4SLs, no authoritative review has been undertaken although the approach and quality of the work undertaken is widely accepted as being of high quality.



Lead

The SGV for lead was withdrawn in 2011 and is not used in this report. The pC4SL for lead provides a technically robust and conservative assessment tool using significantly updated toxicological modelling in line with current scientific understanding of lead toxicology.

Nickel

The SGV for nickel was withdrawn in 2015 and is not used in this report. In-house GACs for nickel have been produced using the updated toxicological review by the EFSA and the CLEA 1.071 software.

Public Open Space

The Defra report (December 2013) has also introduced exposure scenarios for two other commonly occurring land uses which require assessment (under the planning and Part 2A regimes) on a relatively frequent basis. These exposure scenarios are:

- Public Open Space – Space Near Residential Housing (POS_{resi}); and
- Public Open Space – Public Park (POS_{park}).

Potential use of pC4SL relating to Public Open Space (POS) require care due to the significant variability in exposure characteristics. For example, POS may include:

- Children's play areas, public parks where children practise sport several times a week and teenagers only once a week;
- Grassed areas adjacent to residential properties which are rarely used;
- Dedicated sports grounds where exposure is only to players and groundworkers; and
- Nature reserves or open ground with low level activity (for example, dog walking).

Within the Defra report (December 2013) the following exposure scenarios have been modelled as these are considered the most important for potential exposure for the critical receptor i.e. young children:

- Green open space close to housing, including tracking back of soil (POS_{resi}); and
- Park-type scenario where distance is considered sufficient to discount tracking back of soil (POS_{park}).

Detailed Quantified Risk Assessment (DQRA)

SGVs, GACs, pC4SL and S4ULs are based on a number of basic assumptions. There are two main options for developing Site Specific Assessment Criteria (SSAC) by adjusting the CLEA model so that they have greater relevance to the site:

- **Simple adjustment of the generic SGV / C4SL model.** Such adjustment is restricted to the choice of exposure routes selected for the generic land use, building type, soil type and soil organic matter content within the CLEA software.
- **Detailed adjustment.** It may be relevant to make greater modifications to the model due to the specific use of the land in question. This can include modification to any parameter value, including exposure assumptions, building parameters, and the choice and application of fate and transport models. This is equally relevant to site-specific modifications of existing generic land uses, the development of new land uses, and the inclusion of additional exposure pathways. Much of this can be undertaken using the CLEA software. Depending on the complexity of the detailed adjustments required, it may be necessary to use other tools either alone or in conjunction with the CLEA software. Both options should follow established protocols for DQRA and require sufficient justification and supporting information for the adjustments made. Detailed adjustments are likely to require substantially greater technical justification and supporting documentation, especially if modifications are based on information not contained within the SGV framework documents.

The two choices present the risk assessor with three options/decisions:

- (1) Use a published SGV/GAC/pC4SL/S4UL if it can be demonstrated that the assumptions inherent in the value are appropriate to the site in question. If they are not, proceed to either option 2 or 3 below.

- (2) Make simple site-specific adjustments to the generic exposure model used to derive the SSAC. Three examples of when this could be appropriate are:
 - a. High density residential development with no exposed contaminated soil at surface. It is appropriate in this case to consider the relevance of direct contact pathways and consumption of homegrown produce.
 - b. Soil type is significantly different (specifically when soil type is likely to be less protective e.g. made ground) to that assumed in the SGV/GAC/pC4SL/S4UL.
 - c. Soil organic matter content is significantly different to that assumed in the derivation of the SGV/GAC/pC4SL/S4UL.
- (3) If simple adjustments are not sufficient to reflect site conditions, undertake a DQRA. This may be undertaken using the CLEA software or by using an alternative risk assessment methodology that is relevant, appropriate, authoritative and scientifically based. Changes to toxicological end points may also be considered, although this should only be undertaken by a toxicology expert. In the context of this guidance, simple adjustments of a generic land use scenario for soil type or SOM content for example are not considered sufficient to be classed as a DQRA.

DQRAs should be conducted with the agreement of the local authority (or the Environment Agency) since it is the authority that determines whether land is Contaminated Land or whether Planning Permission for a new development may be granted.

Representative Data

The type, quantity and quality of the available soil data influence the method chosen to obtain a site representative soil concentration that is compared with a SGV/GAC/pC4SL/S4UL in the screening process. The soil data should be representative of the exposure scenario being considered. This can include factors such as:

- averaging area over which exposure occurs;
- sample depth;
- heterogeneity of soil

where the 'averaging area' is defined as:

That area (together with a consideration of depth) of soil to which a receptor is exposed or which otherwise contributes to the creation of hazardous conditions'.

Site investigations take discrete samples from a given area (and to a certain depth). It has to be assumed that these samples are to some degree representative of the contaminant concentration throughout that volume of soil. The critical soil volume (taking into account area and depth) which might be usefully compared with a SGV/GAC/pC4SL/S4UL is a site-specific decision, but a starting point is the generic land use scenarios used in the derivation of the SGV/GAC/pC4SL/S4UL. The critical soil volume depends on two factors:

- Contaminant distribution and vertical profile (bands of highly contaminated material or lateral hot spots should not necessarily be averaged out with more extensive cleaner areas of soil without justification)
- Contribution to average exposure underpinning the SGV. Direct contact exposure pathways depend on the adult or child coming into contact with near-surface soils and the area over which that exposure occurs is usually important (i.e. the averaging area). Vapour pathways are less dependent on surface area, for example vapour intrusion may result from a highly concentrated hot spot beneath a building leading to elevated average indoor air concentrations. For the three standard land uses for which SGVs are derived, relevant considerations are:
- For the standard **residential or allotment land use**, the critical soil volume is the area of an individual garden, communal play area or working plot from the surface to a depth of between 0.5m and 1.0m. This is

the ground over which children are most likely to come into contact with soil or from which vegetable and fruit produce will be harvested. In the case of volatile contaminants, it may also be appropriate to consider the volume of soil underneath the footprint of the building although vapour intrusion may be driven by a soil volume much smaller than this if the contaminant source is highly concentrated.

- For the standard **commercial land use**, the critical soil volume has to be decided on a case-by-case basis due to the wide range of possible site layouts. However, for non-volatile contaminants, landscaped and recreational areas around the perimeter of office buildings are likely to be most important. For volatile contaminants, the footprint occupied by the building itself should also be considered.
- For **most exposure pathways**, the contamination is assumed to be at or within one metre of the surface.

The use of averaging areas must be justified on the basis of relevance to the exposure scenario. SGVs are relevant only when the exposure assumptions inherent in them are appropriate for the identified exposure averaging area. Further guidance on critical soil volumes and the consideration of averaging exposure areas can be found in:

- *Secondary model procedure for the development of appropriate soil sampling strategies for land contamination (Environment Agency, 2000);*
- *Guidance on comparing soil contamination data with a critical concentration (CIEH/CL:AIRE, 2009); and*
- *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Appendix I (Defra December 2013, March 2014)*

It is the mean soil concentration for the individual contaminant within an individual averaging area, which is compared to the SGV. However, as contaminant concentrations vary across a site, and sampling and analysis will introduce measurement errors, the comparison between measured mean concentration and the SGV must take this uncertainty into account.

There are two principal options available to obtain site representative soil concentrations from a site investigation dataset; statistical and non-statistical methods. Data objectives, quality and quantity are likely to determine which approach is most appropriate. If statistical methods such as those presented in CIEH/CL:AIRE (2011) are to be used, sufficient data need to be available or obtained. No one single statistical approach is applicable to all sites and circumstances. The wider range of robust statistical techniques developed by organisations including the US Environmental Protection Agency (USEPA) are also important tools. Risk assessors should choose an appropriate statistical approach on the basis of the specific site and the decision that is being made. For further guidance on the appropriate use of statistical approaches, refer to USEPA 2006 or good environmental monitoring statistics textbooks.

When statistical approaches are inappropriate (this will depend on the objectives of the site investigation), individual or composite samples should be compared directly to the SGV. Guidance on use of alternative data handling approaches such as the use of composite sampling can be found in documents such as:

- *Verification of remediation of land contamination (Environment Agency, 2010);*
- *Sampling and testing of wastes to meet landfill Waste Acceptance Criteria (Environment Agency, 2005);*
- *Guidance on choosing a sampling design for environmental data collection (USEPA, 2002);*
- *Soil Quality – Sampling, ISO 10381 series (ISO, 2002–2007).*

The statistical tests should not be used as arbiters for decisions under Part 2A. They are an additional, useful line of evidence to assist in decision-making. The implications of the basis for the derivation of the site representative soil concentration must be taken into account in any decision-making process and clearly documented.

Where the statistical tests are conducted in accordance with the method described in CL:AIRE 2009:

- For the Planning situation, it has to be demonstrated that the concentration of contaminants is low compared to the pC4SL/S4UL or SSAC. All of the test data should be below the screening criteria and no statistical analysis is required or if there are exceedances of the criteria then a statistical assessment is required. For the statistical assessment this decision is based on whether there is at least a 95% confidence level that the true mean of the dataset is lower than the screening criteria.

- For the Part 2A scenario the regulator needs to determine whether the concentration of contaminants is greater than the SGV/GAC/pC4SL/S4UL or SSAC. This decision is based on whether there is at least a 95% confidence level that the true mean of the dataset is higher than the SSAC. However, the regulator may proceed with determination if there is just a 51% probability, “on the balance of probabilities.”

If the screening levels are exceeded then more sophisticated quantitative risk assessment can be undertaken or remedial action may be taken to break the contaminant linkages. The benefits of undertaking a quantitative risk assessment must be weighed against the likelihood that it will bring about cost savings in the proposed remediation. Further information about the use of soil guideline values is provided in Environment Agency : 2008: Using Soil Guideline Values SC050021/SGV Introduction, March 2008.

GENERIC RISK ASSESSMENT CRITERIA FOR RISK TO PLANTS

Soil contaminants, if present at sufficient concentrations, can have an adverse effect on the plant population. Phytotoxic effects can be manifested by a variety of responses, such as growth inhibition, interference with plant processes, contaminant-induced nutrient deficiencies and chlorosis (yellowing of leaves). All chemicals are probably capable of causing phytotoxic effects. Thus the phytotoxic potential of substances is dependent on the concentrations capable of having adverse effects on plants and the concentrations likely to be found at contaminated sites. Phytotoxicity is a difficult parameter to quantify given that experimental techniques vary widely and variations exist in plant tolerances, soil effects and synergistic/antagonistic reactions between chemicals. Contaminants may be taken up and accumulated by plants through a range of mechanisms. The principal pathways are active and/or passive uptake through the plant root, adsorption to root surfaces and volatilisation from the soil surface followed by foliar uptake. After plant uptake, contaminants may be metabolised or excreted, or they may be bioaccumulated and this is highly species dependant. Many of the substances capable of adversely affecting vegetation exert this effect because of their water solubility, a characteristic that could result in their transport from contaminated sites into adjacent locations where the chemical may generate a phytotoxic response. This could be important if, for example, the adjacent site has important conservation status.

The concentration in soil at which substances become phytotoxic depend on a range of factors including plant type, soil type, pH, the form and availability of the contaminant and other vegetation stress factors that may be present (such as drought). Some plants (including some rare plants will only grow in soils where there are relatively high concentrations which would be phytotoxic to other species. Whilst many contaminants may be phytotoxic, data are limited. Some heavy metals are essential as trace elements for plant growth but may become toxic at higher concentrations.

TerraConsult has carried out a review of a number of current and former guidance documents and other texts on phytotoxicity. It is not possible to produce a definitive list of phytotoxic substances on account of the variables mentioned above. However, a number of metals are repeatedly cited as commonly occurring priority pollutants. As a result, the following list is adopted by TerraConsult as indicators of the potential for phytotoxicity: As, Cr, Cu, Ni and Zn (note that Boron has been excluded from this list because the more modern studies do not assess this).

As the CLEA framework is a risk based approach, applied to humans, an alternative strategy is required to assess the risk to plants from substances that are phytotoxic. Reference to published criteria and background concentrations can help put site data into context. Published assessment criteria for the protection of plant life from a number of countries are given in the following Table. The most authoritative source is the British Standard for topsoil, but this only lists three elements. CLR 11 states that the ICRCL Guidance Note 70/90 can be used for initial screening criteria. This approach has been adopted by TerraConsult where BS3882 is lacking, but where an ICRCL 70/90 criterion is lacking, the lowest criterion in Table below from, firstly UK, and, secondly, European and then other worldwide criteria. The adopted criteria are highlighted in the table 3.8. The MAFF value of 250 mg/kg has been chosen for As over the ICRCL value of 50 mg/kg as MAFF explains the 50 is applicable to vegetables and human health, whereas 250 is applicable to the plants themselves.

Table B.5: Published Assessment Criteria for Phytotoxic Elements (mg/kg)							
Reference	As	CR (Total)	Cr (III)	Cr (VI)	Cu	Ni	Zn
British Standard for topsoil (BS3882:2007)	-	-	-	-	200 (pH >7) 135 (pH 6-7) 100 (pH 5.5-6.0)	110 (pH >7) 75 (pH 6-7) 60 (pH 5.5-6.0)	300 (pH >7) 200 (pH 6-7) 200 (pH 5.5-6.0)
MAFF Code of Good Agricultural Practice for the Protection of Soil (1998)	250	-	400 for sites containing sewage and sludge	-	500 (grass) but may fall to 250 for clover and sensitive species (at pH >6)	110 (pH >7) 75 (pH 6-7) 60 (pH 5.5-6.0)	1000 (clover & grass at pH 6), may fall to 300 for sensitive species (at pH 6-7)
ICRCL 59/83 (1987) now withdrawn for human health assessment	-	-	-	-	130	70	300
ICRCL 70/90 (1990) threshold trigger value	50	-	-	25 *	250	-	1000
Dutch ecotoxicological intervention value (Swartjes 1993 & 1994)	40	230	-	7	190	-	-
Australian Guideline B(1) (1999), Interim Urban Ecological Investigation Level (EIL). Soils not generally considered phytotoxic below these EILs.	20	-	400	1	100	60	200
New Zealand guidelines for timber treatment sites (1977), estimated based on Cu bioavailability *	-	-	-	-	500 - 1000 clay soils	-	-
New Zealand guidelines for timber treatment sites (1977), soil criteria for protection of plant life (residential/ agricultural setting)	10-20	-	600	25	130	-	-
Note: * Cr (VI) is only likely to be present in as a significant proportion of total Cr where pH >12 so this does not routinely need to be tested for regarding plant health.							

CURRENT GUIDANCE FOR CONTROLLED WATERS RISK ASSESSMENT

Summary of Regulatory Context

Government policy is based upon a “suitable for use approach,” which is relevant to both the current use of land and also to any proposed future use. When considering the current use of land, Part IIA of the Environment Protection Act 1990^[4] (EPA 1990) provides the regulatory regime, which was introduced by Section 57 of the Environment Act 1995^[5], which came into force in England on 1 April 2000. The main objective of introducing the Part IIA regime is to provide an improved system for the identification and remediation of land where contamination is causing unacceptable risks to human health, controlled waters or the wider environment given the current use and circumstances of the land. Part IIA provides a statutory definition of contaminated land under Section 78A(2) as:

“any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on, or under the land, that:

- (a) Significant harm is being caused or there is a significant possibility of such harm being caused; or*
- (b) Pollution of controlled waters is being, or is likely to be, caused.”*

Part IIA provides a statutory definition of the pollution of controlled waters under Section 78A(9) as:

*“the entry into controlled waters of **any** poisonous, noxious or polluting matter or **any** solid waste matter”*

Part IIA is supported by a substantial quantity of guidance and other Regulations, especially for England, The Contaminated Land (England) (Amendment) Regulations 2012 and Contaminated Land Statutory Guidance (DEFRA, 2012) which came into force in early April 2012. The document re-confirms the duties of Enforcing Authorities in dealing with contamination including the role of the Environment Agency which has powers under Part 7 of The Water Resources Act (1991) to take action to prevent or remedy the pollution of controlled waters, including circumstances where the pollution arises from contamination in the land.

Part IIA introduces the concept of a contaminant linkage; where for potential harm to exist there must be a connection between the source of the hazard and the receptor via a pathway. Risk assessment in contaminated land is therefore directed towards identifying the contaminants, pathways and receptors that can provide contaminant linkages. This is known as the contaminant-pathway-receptor link (CPR or contaminant linkage).

Part IIA places contaminated land responsibility as a part of the planning and redevelopment process rather than Local Authority or Environment Agency taking direct action except in situations of very high pollution risk or where harm is occurring. In the planning process guidance is provided by National Planning Policy Framework (NPPF) of March 2012. This requires that a site which has been developed shall not be capable of being determined “contaminated land” under Part IIA. Therefore, appropriate risk-based investigation is required to identify the contaminant linkages that can then be assessed, and then mitigated using methods that can be readily agreed with the planners.

Environment Agency Guidance

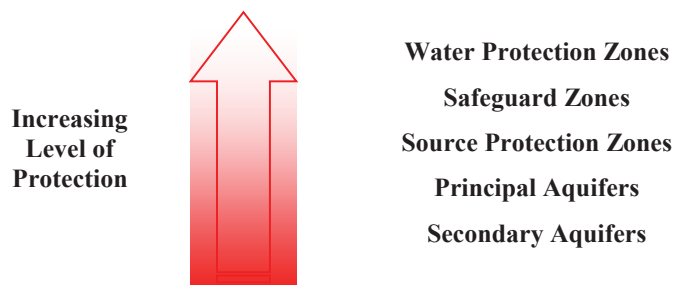
Legislation and guidance surrounding the protection of controlled waters in the UK is numerous and can be complex. The Environment Agency’s overall position on groundwater is “*To protect and manage groundwater resources for present and future generation in ways that are appropriate for the risks that we identify*” (Groundwater Protection : Policy and Practice GP3, 2012). In brief, the core objectives of the existing legislation serve to enforce this position.

In 1992, the National Rivers Authority published their Policy and Practice for the Protection of Groundwater (PPPG), this document was influential as it provided a focus for key developments such as Source Protection Zones (SPZs) and Groundwater Vulnerability Maps. The Policy was then revised in 1998, since which there have been substantial changes in legislation, driven by Europe. Key European Directives relating to groundwater include the Groundwater Directive (80/68/EEC) and the Water Framework Directive (2000/60/EC). Aspects of these directives are controlled

by primary UK legislation such as the Water Resources Act 1991 as amended by the Water Act 2003. Further to legislative changes, gaps identified in the 1998 PPPG required addressing. These changes are reflected in the Environment Agency Policy document *Groundwater Protection: Policy and Practice (GP3)*, Version 1 of November 2012. The following diagram indicates the three main parts of GP3:



The Environment Agency follows a tiered, risk based approach to drinking water protection and this should be taken into account when carrying out controlled waters risk assessment:



Tools available for Risk Assessment of Controlled Waters

In order for a developer of a potentially contaminated site to fulfil their obligations under the legislation, a site assessment would be required to be undertaken in order to identify any potential risks to controlled waters and to derive suitable clean-up criteria if necessary to ensure the protection of controlled waters. A number of tools are available for this purpose and the general approach is detailed further in Part 3 of GP3.

Three main stages apply to any risk assessment of controlled waters, these are:

- i) Risk Screening (devise Conceptual Site Model, making reference to groundwater vulnerability maps, site setting etc)
- ii) Generic Risk Assessment (using the EA Remedial Targets Methodology – Tier 1 - Comparison of groundwater data with relevant standards)
- iii) Detailed Quantitative Risk Assessment (Consideration of aquifer properties and site specific parameters, using the EA Remedial Targets Methodology - Tiers 2 & 3)

The process is summarised below (Taken from the Environment Agency GP3 draft consultation document, 2006):

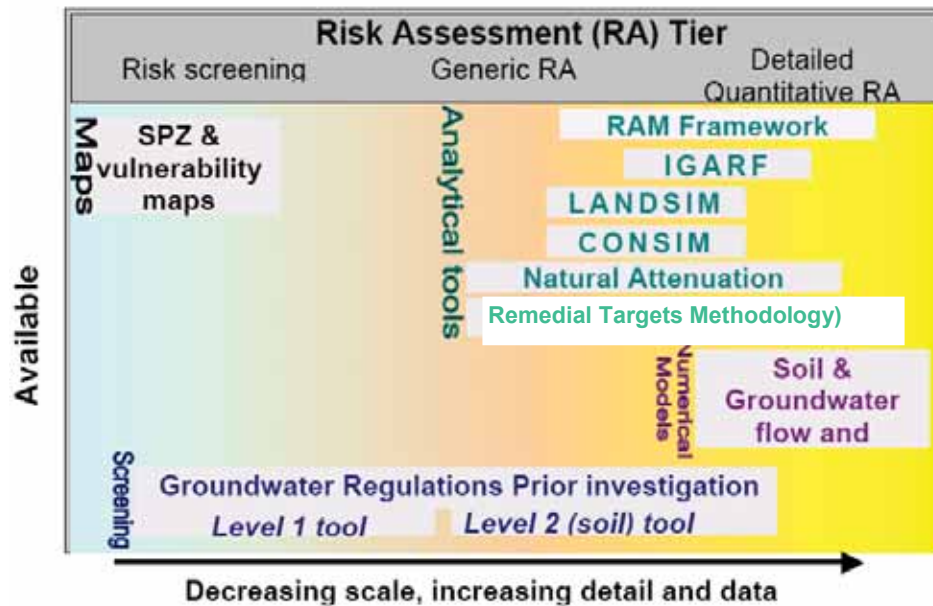


Figure 1-1 Environment Agency groundwater assessment tools, mapped against the different levels of risk assessment.

When assessing groundwater impact the Environment Agency advocate the application of their framework methodology “Remedial Targets Methodology – Hydrogeological Risk Assessment for Land Contamination” Environment Agency (2006). The methodology has four tiers of assessment:

Tier 1 utilises either a soil concentration (calculation of pore water concentrations based on partitioning calculations), leaching test or pore-water concentration of perched water as a source concentration input and these are contrasted directly to water quality standards. No dilution or attenuation is considered at Level 1.

Tier 2 (groundwater) considers dilution of the contaminant within the underlying receiving groundwater or surface water body. To determine a dilution factor the infiltration rate of pore water and the discharge of groundwater beneath the source must be determined. Level 2 Assessment is comprises a comparison between measured groundwater concentrations with to water quality standards.

Tier 3 considers natural attenuation in the form of dispersion, retardation and degradation of the contaminant. As the levels are progressed, the assessment becomes increasingly more detailed and less conservative as the data requirements are increased with each successive tier. The Environment Agency has released Excel Worksheets to carry out basic calculations using a conservative approach up to Tier 3. However, in this case the conceptual model is a simple one and assumes there is a simple migration of contaminants from the source zone into the aquifer receptor. Using these worksheets requires a sensitivity analysis showing how by varying each parameter, what effect it might have on the outcome of the assessment. Groundwater conceptual models are not always this simple.

Tier 4 is for more complex conceptual models where multiple sources, multiple pathways, multiple receptors and complex water balances can be assessed.

The Environment Agency developed a spreadsheet based code to support the Remedial Target Methodology, and the code is capable of undertaking assessments for Tiers 1 to 3. Tier 4 assessment is not supported by the spreadsheet based code.

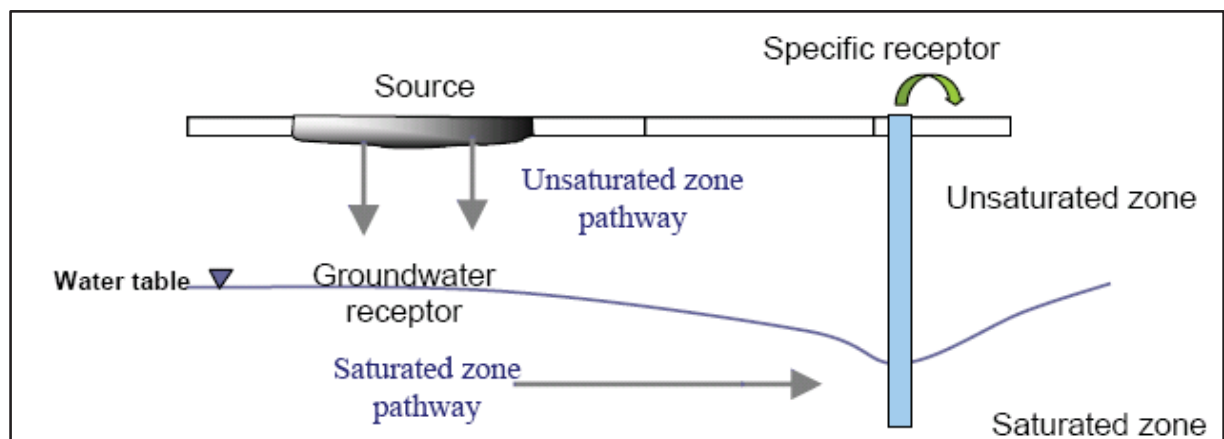
A more advanced code, ConSim 2, developed on behalf of the Environment Agency to support the Remedial Targets Methodology, allows for the introduction of additional geological horizons and is used mainly to determine the concentrations reaching a receptor and the timescales over which this may happen.

The codes assess only the dissolved phase contaminants. There are many further codes commercially available for use in controlled waters risk assessment, particularly for more complex situations, however, these should be used with caution and only once agreement has been obtained from the Environment Agency. All have the overall aim of the estimation of risk from contaminant linkages and the protection of controlled waters.

General notes on each stage of the controlled waters risk assessment process

Risk Screening

The understanding of the Conceptual Site Model (CSM) is the key to assessing any site. Using a robust CSM, potential pathways or receptors may be screened out from any further assessment at an early stage. For example if the pathway through the unsaturated zone is blocked by the presence of a significant thickness of low permeability clay. A greater understanding of the CSM is achieved with each tier of risk assessment. An example of a basic Source-Pathway-Receptor concept is given below (taken from the Environment Agency GP3, 2012):



Generic Risk Assessment

When undertaking the Generic Hydrogeological Risk Assessment (EA Remedial Targets Methodology Tier 1), comparison of chemical analytical results is made with screening criteria. Published values of screening criteria with which chemical test results can be compared are published in the following guidance:

There is a hierarchy of screening criteria which is as follows:

- Updated Recommendations on Environmental Technical Standards, River Basin Management (2015-21), April 2012 by the UK Technical Advisory Group on the Water Framework Directive;
- Environmental Quality Standards (EQS) for freshwaters based on The EC Dangerous Substances Directive (76/464/EEC and Daughter Directives);
- Surface Waters (Abstraction for Drinking Water)(Classification) Regulations (1996)
- Surface Waters (Fishlife) (Classification) Regulations (1997)
- UK Drinking Water Standards (DWS) (Water Supply (Water Quality) Regulations 2000);
- Dutch Ministry of Housing, Spatial Planning and Environment (2001) Intervention Values and Target Values – soil quality standards;
- World Health Organisation Guidelines for Drinking Water (2004)

Should the Level 1 or 2 assessments indicate threshold levels to be exceeded, then there are three alternative ways in which to proceed:

- To devise suitable remedial solutions;
- To carry out more investigation, sampling and analysis;
- To conduct a site-specific Detailed Quantitative Risk Assessment (DQRA) to whether or not the soil materials are suitable for their site-specific intended use or to devise a site-specific clean-up level.

Detailed Quantitative Risk Assessment (DQRA)

The decision to carry out a DQRA will be dependent on the extent and implications of the initial qualitative and generic assessment. The scope of any such assessment will be accurately defined by the outcomes of the former two stages. The CSM will be sufficiently refined by this stage that only certain contaminants of concern, certain pathways and certain receptors will require further assessment, the remainder having been screened out.

Additional site specific data is normally required for this stage of assessment, as explained above, more processes that are capable of affecting contaminant concentrations are considered (such as dilution and attenuation).

Remediation criteria derived will therefore be specific to each site and will be based on a detailed assessment of the potential impact at the identified receptor or *compliance point*. A greater level of confidence can be placed on the predicted impact on the compliance point following a DQRA.

Definition of Controlled Waters

The term ‘controlled waters’ is defined in Section 104 of the Water Resources Act 1991 as:

“Territorial Waters...which extend seawards for three miles..., coastal waters..., inland freshwaters, waters in any relevant lake or pond or of so much of any relevant river or watercourse as is above the freshwater limit, and ground waters, that is to say, any waters contained in underground strata.”

Note that the definition of groundwater under the Water Resources Act 1991 includes all water within underground strata (including soil / pore water in the unsaturated zone). The definition of groundwater under the Groundwater Directive however is limited to water in the saturated zone. For the purposes of Part IIA of the Environmental Protection Act 1990, the Environment Agency recommends that the groundwater within the saturated zone only is considered as the receptor (rather than soil / pore water).

Environment Agency’s Aquifer Designations

The Environment Agency have classified different types of aquifer from which groundwater can be extracted. The aquifer designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetland ecosystems. The aquifer designation data is based on geological mapping provided by the British Geological Survey.

The maps are split into two different types of aquifer designation:

- **Superficial (Drift)** – permeable unconsolidated (loose) deposits.
- **Bedrock (Solid)**– solid permeable formations e.g. sandstone, chalk, limestone.

The aquifer designations displayed on the Environment Agency maps are as follows:

- **Principal Aquifers (formerly termed Major Aquifers)** – These are 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 a major aquifer.
- **Secondary Aquifers (formerly termed Minor Aquifers)** – These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into two types:
 - **Secondary A** - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers;
 - **Secondary B** - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.
 - **Secondary Undifferentiated** - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
- **Unproductive Strata (formerly termed Non-Aquifer)** – These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Hazardous and Non Hazardous Substances

The Groundwater (England and Wales) Regulations 2009 control the disposal to the hydrogeological environment of potentially polluting substances which are divided into Hazardous Substances and Non-hazardous Contaminants (this roughly approximates to the former List 1 and List 2 substances).

Hazardous Substances are the most damaging and toxic and must be prevented from directly or indirectly entering the groundwater environment. Hazardous Substances include mineral oils and hydrocarbons, pesticides, biocides, herbicides, solvents and some metals. Discharge of Hazardous Substances to Controlled Waters must be prevented.

Non-hazardous Pollutants are any contaminants other than Hazardous Substances. Non-hazardous Pollutants are potentially toxic but are less harmful than Hazardous Substances, but their direct discharge to groundwater is generally not permitted and any indirect discharge to groundwater must be limited and be controlled by technical precautions in order to prevent pollution. Non-hazardous Pollutants include ammonia and nitrites, many metals and fluorides.

MANAGEMENT OF CONTAMINATED LAND

When risk assessment of the site has been completed and this indicates that remedial works are required, the main guidance in managing this process is set out in the DEFRA/EA publication CLR11 (2004) "Model Procedures for the Management of Land Contamination." The stages of managing remediation are as follows:

- (a) Options Appraisal and develop Remediation Strategy;
- (b) Develop Implementation Plan and Verification Plan;
- (c) Remediation, Verification and Monitoring.

The Remediation Strategy sets out the remediation targets, identifies technically feasible remedial solutions and presents an evaluation of the options so that these can be assessed enabling that the most suitable solution is

adopted. An outline of the proposed remedial method should be presented. Agreement should be sought of the appropriate statutory bodies for the Remediation Strategy before proceeding to the next stage.

The Implementation Plan is a detailed method statement setting out how the remediation is to be carried out including stating how the site will be managed, welfare procedures, health and safety considerations together with practical measures such as details of temporary works, programme of works, waste management licences and regulatory consents required. Agreement should again be sought of the appropriate statutory bodies for this Plan.

The Verification Plan sets out the requirements for gathering data to demonstrate that the remediation has met the required remediation objectives and criteria. The Verification Plan presents the requirements for a wide range of issues including the level of supervision, sampling and testing regimes for treated materials, waste and imported materials, required monitoring works during and post remediation, how compliance with all licenses and consents will be checked etc. Agreement should again be sought of the appropriate statutory bodies for the Verification Plan. On completion of the remediation a Verification Report should be produced to provide a complete record of all remediation activities on site and the data collected as required in the Verification Plan. The Verification Report should demonstrate that the remediation has met the remedial targets to show that the site is suitable for the proposed use.

GLOSSARY

TERMS		UNITS	
AST	Above Ground Storage Tank	m	Metres
BGS	British Geological Survey	km	Kilometres
BSI	British Standards Institute	%	Percent
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes	%v/v	Percent volume in air
CIEH	Chartered Institute of Environmental Health	mb	Milli Bars
CIRIA	Construction Industry Research Association		(atmospheric pressure)
CLEA	Contaminated Land Exposure Assessment	l/hr	Litres per hour
CSM	Conceptual Site Model	ha	Hectare (10,000 m ²)
DNAPL	Dense Non-Aqueous Phase Liquid (chlorinated solvents, PCB)	µg/l	Micrograms per Litre
DWS	Drinking Water Standard		(parts per billion)
EA	Environment Agency	ppb	Parts Per Billion
EQS	Environmental Quality Standard	mg/kg	Milligrams per kilogram
GAC	General Assessment Criteria		(parts per million)
GL	Ground Level	ppm	Parts Per Million
GSV	Gas Screening Value	mg/m ³	Milligram per metre cubed
HCV	Health Criteria Value	Mg/m ³	Megagram per metre cubed
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel)	µg/m ³	Microgram per metre cubed
ND	Not Detected	m bgl	Metres Below Ground Level
LMRL	Lower Method Reporting Limit	m bcl	Metre Below Cover Level
NR	Not Recorded	mOD	Metres Above Ordnance
OD	Ordnance Datum		Datum (sea level)
PAH	Poly Aromatic Hydrocarbon	kN/m ²	Kilo Newtons per metre
PCB	Poly-Chlorinated Biphenyl		squared
PID	Photo Ionisation Detector	kPa	Kilo Pascal – same as kN/m ²
PCSM	Preliminary Conceptual Site Model	µm	Micro metre
SGV	Soil Guideline Value		
TPH (CWG)	Total Petroleum Hydrocarbon (Criteria Working Group)		
SPT	Standard Penetration Test		
SVOC	Semi Volatile Organic Compound		
UST	Underground Storage Tank		
VCCs	Vibro Concrete Columns		
VOC	Volatile Organic Compound		
VSCs	Vibro Stone Columns		

APPENDIX C

Site Photographs



Photograph 1: WS101 showing thin groundwater seepage between Made Ground and bedrock



Photograph 2: Weathered Bollin Mudstone Formation



Photograph 3: TP127 including spoil

APPENDIX D

Exploratory Hole Records

Borehole Log

TerraConsult

Borehole formation details:											Location details:	
Type: RO RC	From: 0.00 3.00	To: 3.00 10.00	Start date: 21-06-16 21-06-16	End date: 21-06-16 21-06-16	Crew: DP DP	Plant: Komacchio 205 Komaccio 205	Barrel type: PWF	Drill bit: PCD	Logger: LM LM	Logged: 21-06-16 27-06-16	Remarks:	mE: 382068.21 mN: 387127.66 mAOD: 57.26 Grid: OSGB

Backfill/ Instal'n	Water- strike	Legend	Level	Depth (thick- ness)	Stratum Description	Samples & In Situ Testing					
						Water	Casing	Depth/Core Run	TCR SCR ROD	If	Results/remarks/ samples
			57.11	0.15 (0.55)	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone and brick fragments. (TOPSOIL)						
			56.56	0.70	Dark greyish brown very gravelly very clayey fine to coarse SAND. Gravel is angular to subangular fine to coarse of brick fragments, mudstone, sandstone and concrete. (MADE GROUND)						
					Firm becoming stiff reddish brown mottled greyish brown slightly gravelly sandy CLAY. Gravel is subangular fine to coarse of mudstone. (GRADE IVa)						
					(MERCIA MUDSTONE)						
			54.26	3.00	Partial recovery. Core loss presumed to be more weathered material. Recovered core comprises very weak light grey mottled reddish brown thinly laminated MUDSTONE. Gravel and occasional cobble size fragments recovered. (GRADE III - II)			3.00 - 3.80	31 6 0		
								3.80 - 4.50	43 10 0		
								5.50 - 5.80	67		
								5.80 - 6.50	43 4 0		
								6.50 - 7.00	42 16 0		
			50.26	7.00	Very stiff reddish brown slightly sandy gravelly CLAY. Gravel is angular fine to coarse of mudstone. (GRADE III)						
					(MERCIA MUDSTONE)			7.00 - 9.00	42 0 0		
								9.00 - 10.00	91 11 0		
			47.26	10.00							

Groundwater entries:				Diameter & casing:			Depth related remarks:			Flush details:			
Struck:	Rose to:	Casing:	Sealed:	Dia (mm):	Depth:	Casing:	From	to:	Remarks:	From	to:	Type:	Return: Colour:
				94	10.00	6.00				1.20	10.00	air/mist	

 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters.		Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon				Exploratory position reference: RC100		
Log issue: DRAFT Scale: 1:50								

TerraConsult

Backfill/Instaln	Water-strike	Legend	Level	Depth (thick-ness)	Stratum Description	Samples & In Situ Testing						
						Water	Casing	Depth	Type & No	Results		
			59.17	0.20	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone and brick fragments. (TOPSOIL)	Dry		0.50	ES	N=16 (5,5/4,4,4,4)		
				(1.40)	Soft reddish brown slightly sandy gravelly CLAY with a low cobble content. Gravel is angular to subrounded fine to coarse of mudstone and brick fragments. Cobbles are angular of brick. (MADE GROUND)			1.20	S			
				57.77	1.60			Stiff light grey slightly sandy slightly gravelly thinly laminated CLAY. Gravel is fine to medium of mudstone. (GRADE IVa) (MERCIA MUDSTONE)	2.00 2.00		D	N=28 (7,7/5,5,9,9)
				(1.54)	2.80 - 3.14: Probably Grade III			2.80	50 (10,11/50 for 190mm)			
			56.23	3.14	Dynamic sample ends at 3.14m (Refusal)							

 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters. Log issue: DRAFT Scale: 1:50	Project: Manchester Enterprise Academy Project No: 2859 Client: Willmott Dixon	Exploratory position reference: WS101 Sheet 1 of 1
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Dynamic Sample Log

TerraConsult

Borehole formation details:										Location details:	
Type: WLS	From: 0.00	To: 2.03	Start date: 21-06-16	End date: 21-06-16	Crew: DP	Plant: Archway Dart	Logger: NHF	Logged: 21-06-16	Remarks: DART253 Er (%): 69	mE: 382081.39	
										mN: 387132.35	
										mAOD: 58.50	
										Grid: OSGB	

Backfill/ Instaln	Water- strike	Legend	Level	Depth (thick- ness)	Stratum Description	Samples & In Situ Testing				
						Water	Casing	Depth	Type & No	Results
			58.20	(0.30) 0.30	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone and brick fragments. (TOPSOIL)					
				(0.70)	Soft greyish brown sandy slightly gravelly CLAY with a low cobble content. Gravel is angular to subrounded fine to coarse of mudstone, concrete and brick fragments. Cobbles are angular of brick and concrete. (MADE GROUND)			0.60	ES	
			57.50	1.00	Stiff light grey slightly sandy slightly gravelly thinly laminated CLAY. Gravel is fine to medium of mudstone. (GRADE IVa)	Dry		1.20		N=19 (3,3/4,4,5,6)
				(1.03)	(MERCIA MUDSTONE)			1.60	D	
					1.75 - 2.03: Probably Grade III	Dry		1.70		50 (9,13/50 for 180mm)
			56.47	2.03	Dynamic sample ends at 2.03m (Refusal)					

Groundwater entries: Struck: Rose to: Casing: Sealed:		Diameter & casing: From: to: Dia: Casing:		Depth related remarks: From to: Remarks		Run details: From: to: Duration: Recovery:	
 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters. Log issue: DRAFT Scale: 1:50		Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon		Exploratory position reference: WS102 Sheet 1 of 1			

Dynamic Sample Log

TerraConsult

Borehole formation details:										Location details:	
Type: WLS	From: 0.00	To: 2.39	Start date: 21-06-16	End date: 21-06-16	Crew: DP	Plant: Archway Dart	Logger: NHF	Logged: 21-06-16	Remarks: DART253 Er (%): 69	mE: 382081.88	
										mN: 387119.04	
										mAOD: 58.13	
										Grid: OSGB	

Backfill/ Instaln	Water- strike	Legend	Level	Depth (thick- ness)	Stratum Description	Samples & In Situ Testing				
						Water	Casing	Depth	Type & No	Results
			58.03	0.10	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone.	Dry		1.00 1.00 1.00 - 1.45	ES D	N=16 (3,3/4,4,4,4)
			57.73	(0.30)	(TOPSOIL)					
			57.53	0.40	Firm grey mottled black slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of brick fragments and concrete.					
				0.60	(MADE GROUND)					
					Light grey angular to subrounded medium to coarse GRAVEL of limestone and concrete.	Dry		2.00 2.00 - 2.45	D	50 (8,12/50 for 235mm)
					(MADE GROUND)					
			(1.79)		Stiff reddish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to medium of mudstone. (GRADE IVa)					
					(MERCIA MUDSTONE)					
					2.10 - 2.39: Probably Grade III	Dry		2.00 2.00 - 2.45	D	50 (8,12/50 for 235mm)
						Dry		2.00 2.00 - 2.45	D	50 (8,12/50 for 235mm)
						Dry		2.00 2.00 - 2.45	D	50 (8,12/50 for 235mm)
						Dry		2.00 2.00 - 2.45	D	50 (8,12/50 for 235mm)
						Dry		2.00 2.00 - 2.45	D	50 (8,12/50 for 235mm)
						Dry		2.00 2.00 - 2.45	D	50 (8,12/50 for 235mm)
						Dry		2.00 2.00 - 2.45	D	50 (8,12/50 for 235mm)
						Dry		2.00 2.00 - 2.45	D	50 (8,12/50 for 235mm)
						Dry		2.00 2.00 - 2.45	D	50 (8,12/50 for 235mm)
						Dry		2.00 2.00 - 2.45	D	50 (8,12/50 for 235mm)
						Dry		2.00 2.00 - 2.45	D	50 (8,12/50 for 235mm)
						Dry		2.00 2.00 - 2.45	D	50 (8,12/50 for 235mm)
						Dry		2.00 2.00 - 2.45	D	50 (8,12/50 for 235mm)
						Dry		2.00 2.00 - 2.45	D	50 (8,12/50 for 235mm)
						Dry		2.00 2.00 - 2.45	D	50 (8,12/50 for 235mm)
						Dry		2.00 2.00 - 2.45	D	50 (8,12/50 for 235mm)
						Dry		2.00 2.00 - 2.45	D	50 (8,12/50 for 235mm)

Groundwater entries: Struck: Rose to: Casing: Sealed:		Diameter & casing: From: to: Dia: Casing:		Depth related remarks: From to: Remarks		Run details: From: to: Duration: Recovery:	
 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters. Log issue: DRAFT Scale: 1:50		Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon				Exploratory position reference: WS103 Sheet 1 of 1	

Dynamic Sample Log

TerraConsult

Borehole formation details:										Location details:	
Type: WLS	From: 0.00	To: 2.33	Start date: 21-06-16	End date: 21-06-16	Crew: DP	Plant: Archway Dart	Logger: LM	Logged: 22-06-16	Remarks: DART253 Er (%): 69	mE: 382082.81	
										mN: 387102.94	
										mAOD: 57.44	
										Grid: OSGB	

Backfill/ Instal'n	Water- strike	Legend	Level	Depth (thick- ness)	Stratum Description	Samples & In Situ Testing					
						Water	Casing	Depth	Type & No	Results	
		    	57.14	(0.30) 0.30	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, brick fragments and ceramic. (TOPSOIL)	Dry		0.40	ES	N=15 (3,4/4,3,4,4)	
			56.74	(0.40) 0.70	Dark greyish brown very gravelly very clayey fine to coarse SAND. Gravel is angular to subangular fine to coarse of concrete, mudstone, limestone and brick fragments. (MADE GROUND)			1.00	D		50 (10,10/50 for 180mm)
			(0.90)	Firm becoming stiff reddish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to medium of mudstone. (GRADE IVa) (MERCIA MUDSTONE)	1.20 - 1.65						
			55.84	1.60	Stiff becoming very stiff light brownish grey slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to medium of lithorelicts. (GRADE IVa) (MERCIA MUDSTONE)	Dry		2.00	D	50 (10,10/50 for 180mm)	
			(0.75)	(MERCIA MUDSTONE)	2.00 - 2.45						
			54.99	2.45	Dynamic sample ends at 2.33m (Refusal)						

						Water	Casing		Depth	Type & No	Results
Groundwater entries: Struck: Rose to: Casing: Sealed:				Diameter & casing: From: to: Dia: Casing:		Depth related remarks: From to: Remarks				Run details: From: to: Duration: Recovery:	
 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters.				Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon				Exploratory position reference: WS104			
Log issue: DRAFT Scale: 1:50											
								Sheet 1 of 1			

Dynamic Sample Log

TerraConsult

Borehole formation details:										Location details:	
Type: WLS	From: 0.00	To: 2.76	Start date: 21-06-16	End date: 21-06-16	Crew: DP	Plant: Archway Dart	Logger: LM	Logged: 22-06-16	Remarks: DART253 Er (%): 69	mE: 382057.35	
										mN: 387097.36	
										mAOD: 56.94	
										Grid: OSGB	

Backfill/ Instal'n	Water- strike	Legend	Level	Depth (thick- ness)	Stratum Description	Samples & In Situ Testing				
						Water	Casing	Depth	Type & No	Results
			56.64	(0.30) 0.30	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, brick fragments and ceramic. (TOPSOIL)			0.30 - 1.20 0.30 - 1.20	D ES	
				(1.70)	Dark greyish brown very gravelly very clayey fine to coarse SAND. Gravel is angular to subangular fine to coarse of concrete, mudstone, limestone and brick fragments. (MADE GROUND)	Dry		1.20 1.20 - 1.65	D	N=10 (3,3/2,3,2,3)
			54.94	2.00	Firm light orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of mudstone. (GRADE IVa)	Dry		2.00 2.00 - 2.45	D	N=37 (7,7/9,10,9,9)
			(0.76)		(MERCIA MUDSTONE) 2.40 - 2.76: Probably Grade III	Dry		2.50 2.50 - 2.95	D	50 (10,13/50 for 105mm)
			54.18	2.76	Dynamic sample ends at 2.76m (Refusal)					

Groundwater entries:		Diameter & casing:		Depth related remarks:		Run details:	
Struck:	Rose to:	Casing:	Sealed:	From:	to: Dia: Casing:	From:	to: Duration: Recovery:
 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters.		Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon				Exploratory position reference: WS105	
Log issue: DRAFT							
Scale: 1:50							

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Backfill/ Install'n	Water- strike	Legend	Level	Depth (thick- ness)	Stratum Description	Samples & In Situ Testing				
						Water	Casing	Depth	Type & No	Results
					Asphalt (MADE GROUND)	Dry		1.00		50 (4,7/50 for 245mm)
			56.78	0.50	Stiff reddish brown mottled greyish brown slightly gravelly sandy CLAY. Gravel is subangular fine to coarse of mudstone. (GRADE IVa) (MERCIA MUDSTONE)					
				(0.95)						
			55.83	1.45	Dynamic sample ends at 1.40m (Refusal) 1.30 - 1.40: Probable Grade III					

 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters. Log issue: DRAFT Scale: 1:50	Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon	Exploratory position reference: WS106 Sheet 1 of 1
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TerraConsult

Backfill/ Instaln	Water- strike	Legend	Level	Depth (thick- ness)	Stratum Description	Samples & In Situ Testing				
						Water	Casing	Depth	Type & No	Results
		                              	57.60	0.25	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone and brick fragments. (TOPSOIL)	Dry		0.30	ES	N=35 (3,6/9,10,8,8)
			57.40	0.45 (0.45)	Light greyish brown clayey very gravelly fine to coarse SAND. Gravel is angular to subangular fine to medium of concrete, limestone and brick fragments. (MADE GROUND)					
			56.95	0.90	Stiff light orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of mudstone. (GRADE IVa) (MERCIA MUDSTONE)					
			(1.27)		Stiff becoming very stiff light brownish grey mottled orange slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of mudstone lithorelicts. (GRADE IVa) (MERCIA MUDSTONE)					
			55.68	2.17	2.00 - 2.17: Probably Grade III					
					Dynamic sample ends at 2.17m (Refusal)					

 Notes: For explanation of symbols and abbreviations see Key Sheet All depths and reduced levels are in meters. Log issue: DRAFT Scale: 1:50	Project: Manchester Enterprise Academy Project No: 2859 Client: Willmott Dixon	Exploratory position reference: WS107 Sheet 1 of 1
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Backfill/Instaln	Water-strike	Legend	Level	Depth (thick-ness)	Stratum Description	Samples & In Situ Testing				
						Water	Casing	Depth	Type & No	Results
			59.32	0.15	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone and brick fragments. (TOPSOIL)	Dry		0.50	ES	N=17 (3,3/4,5,4,4)
			(0.95)	Firm light greyish brown sandy gravelly CLAY. Gravel is angular to subangular fine to coarse of concrete, ceramic and brick fragments. (MADE GROUND)	1.00					
			58.37	1.10	Stiff light bluish grey slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to medium of mudstone.(GRADE IVa) (MERCIA MUDSTONE)			1.50	D	
			(1.35)		Dry	2.00	D	N=45 (5,9/10,10,11,14)		
						57.02	2.45	Dynamic sample ends at 2.45m (Refusal)		

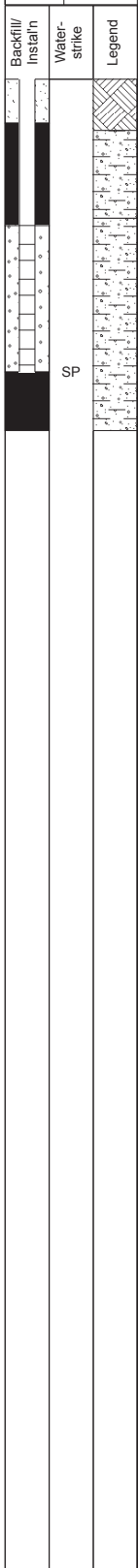
 Notes: For explanation of symbols and abbreviations see Key Sheet All depths and reduced levels are in meters. Log issue: DRAFT Scale: 1:50	Project: Manchester Enterprise Academy Project No: 2859 Client: Willmott Dixon	Exploratory position reference: WS108 Sheet 1 of 1
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TerraConsult

Backfill/ Instal'n	Water- strike	Legend	Level	Depth (thick- ness)	Stratum Description	Samples & In Situ Testing				
						Water	Casing	Depth	Type & No	Results
			58.99	0.15	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone and brick fragments. (TOPSOIL)	Dry		0.40	ES	N=13 (3,3/3,3,4,3)
			(1.15)	Firm light greyish brown sandy gravelly CLAY. Gravel is angular to subangular fine to coarse of concrete, ceramic and brick fragments. (MADE GROUND)	1.00					
			57.84	1.30	Stiff reddish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to medium of mudstone. (GRADE IVa) (MERCIA MUDSTONE)			1.40	D	
			(1.55)		2.00			D	N=22 (3,3/4,4,7,7)	
					2.00					
					2.40			D		
					2.60				50 (10,11/50 for 95mm)	
			56.29	2.85	Dynamic sample ends at 2.85m (Refusal)					

 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters. Log issue: DRAFT Scale: 1:50	Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon	Exploratory position reference: WS109 Sheet 1 of 1
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TerraConsult

Backfill/Install	Water-strike	Legend	Level	Depth (thickness)	Stratum Description	Samples & In Situ Testing					
						Water	Casing	Depth	Type & No	Results	
	SP		55.74	(0.35)	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone and brick fragments.	Dry		0.25	ES	N=12 (2,3/3,3,3,3)	
				0.35	(TOPSOIL)						
				(0.60)	Stiff light orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of mudstone. (GRADE IVb) (MERCIA MUDSTONE)						
				55.14	0.95						Stiff becoming very stiff light brownish grey mottled orange slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of mudstone lithorelicts. (GRADE IVa) (MERCIA MUDSTONE)
					(1.45)						
53.69	2.40	2.15 - 2.40: Probably Grade III	Dry	2.00	50 (6,9/50 for 245mm)						
	Dynamic sample ends at 2.40m (Refusal)										

 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters. Log issue: DRAFT Scale: 1:50	Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon	Exploratory position reference: WS110 Sheet 1 of 1
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Dynamic Sample Log

TerraConsult

Borehole formation details:										Location details:	
Type: WLS	From: 0.00	To: 2.27	Start date: 24-06-16	End date: 24-06-16	Crew: DP	Plant: Archway Dart	Logger: LM	Logged: 24-06-16	Remarks: DART253 Er (%): 69	mE: 382009.02	
										mN: 387346.51	
										mAOD: 55.96	
										Grid: OSGB	

Backfill/ Instal'n	Water- strike	Legend	Level	Depth (thick- ness)	Stratum Description	Samples & In Situ Testing				
						Water	Casing	Depth	Type & No	Results
				(0.35)	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone and brick fragments.					
			55.61	0.35	(TOPSOIL)			0.30	ES	
			55.46	0.50	Firm light greyish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to coarse of mudstone. (GRADE IVB) (MERCIA MUDSTONE)			0.80 0.90 1.00	ES D	N=16 (3,3/4,4,4,4)
				(1.45)	Stiff becoming very stiff light orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of mudstone with rare mudstone lithorelicts. (GRADE IVa) (MERCIA MUDSTONE)	Dry				
			54.01	1.95	Very stiff light bluish grey slightly sandy slightly gravelly CLAY. Gravel is angular fine to medium of mudstone lithorelicts. (GRADE III) (MERCIA MUDSTONE)	Dry		1.90 2.00	D	50 (7,13/50 for 115mm)
			53.69	2.27	Dynamic sample ends at 2.27m (Refusal)					

Groundwater entries:		Diameter & casing:		Depth related remarks:		Run details:	
Struck:	Rose to:	Casing:	Sealed:	From:	to: Dia: Casing:	From:	to: Duration: Recovery:
 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters.		Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon				Exploratory position reference: WS111	
Log issue: DRAFT							
Scale: 1:50							

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Backfill/ Inst. in	Water- strike	Legend	Level	Depth (thick- ness)	Stratum Description	Samples & In Situ Testing						
						Water	Casing	Depth	Type & No	Results		
			56.38	0.25	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, brick fragments and ceramic. (TOPSOIL)	Dry		0.15	ES	N=14 (3,3/4,3,3,4)		
			(1.10)	Firm to stiff light orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of mudstone. (GRADE IVb to IVa) (MERCIA MUDSTONE)	0.75			D				
				55.28	1.35			Light bluish grey slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of mudstone and mudstone lithorelicts. (GRADE IVa) (MERCIA MUDSTONE)	1.00			
			(1.00)					Dry		1.75	D	50 (10,11/50 for 200mm)
										2.00		
			54.28	2.35	2.20 - 2.35: Probably Grade III Dynamic sample ends at 2.35m (Refusal)							

 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters. Log issue: DRAFT Scale: 1:50	Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon	Exploratory position reference: WS112 Sheet 1 of 1
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Dynamic Sample Log

TerraConsult

Borehole formation details:										Location details:	
Type: WLS	From: 0.00	To: 2.33	Start date: 24-06-16	End date: 24-06-16	Crew: DP	Plant: Archway Dart	Logger: LM	Logged: 24-06-16	Remarks: DART253 Er (%): 69	mE: 382135.09	
										mN: 387379.63	
										mAOD: 56.37	
										Grid: OSGB	

Backfill/ Instaln	Water- strike	Legend	Level	Depth (thick- ness)	Stratum Description	Samples & In Situ Testing				
						Water	Casing	Depth	Type & No	Results
			56.02	(0.35) 0.35	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, brick fragments and ceramic. (TOPSOIL)			0.30	ES	
				(0.75) 0.75	Firm light greyish brown mottled orangeish brown slightly sandy slightly gravelly CLAY. (GRADE IVb) (MERCIA MUDSTONE)			0.50	D	
			55.27	1.10	Stiff becoming very stiff light orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to medium of mudstone and mudstone lithorelicts. (GRADE IVa) (MERCIA MUDSTONE)	Dry		1.30		N=14 (2,3/3,3,4,4)
				(1.23) 1.23				1.50	D	
			54.04	2.33	Dynamic sample ends at 2.33m (Refusal)	Dry		2.00		50 (8,12/50 for 180mm)

						Water	Casing		Depth	Type & No	Results
Groundwater entries: Struck: Rose to: Casing: Sealed:				Diameter & casing: From: to: Dia: Casing:		Depth related remarks: From to: Remarks				Run details: From: to: Duration: Recovery:	
 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters.				Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon				Exploratory position reference: WS113			
Log issue: DRAFT Scale: 1:50											
								Sheet 1 of 1			

Dynamic Sample Log

TerraConsult

Borehole formation details:										Location details:	
Type: WLS	From: 0.00	To: 2.45	Start date: 24-06-16	End date: 24-06-16	Crew: DP	Plant: Archway Dart	Logger: LM	Logged: 24-06-16	Remarks: DART253 Er (%): 69	mE: 382167.27	
										mN: 387236.62	
										mAOD: 58.52	
										Grid: OSGB	

Backfill/ Instal'n	Water- strike	Legend	Level	Depth (thick- ness)	Stratum Description	Samples & In Situ Testing				
						Water	Casing	Depth	Type & No	Results
			58.22	(0.30) 0.30	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, brick fragments and ceramic. (TOPSOIL)			0.25	ES	
				(0.60)	Firm light orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of mudstone. (GRADE IVb) (MERCIA MUDSTONE)			0.50	ES	
			57.62	0.90	Stiff light orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular fine of mudstone with rare mudstone lithorelicts. (GRADE IVa) (MERCIA MUDSTONE)	Dry		1.00 1.00 1.00	D ES	N=11 (2,2/2,3,3,3)
				(1.55)						
			56.07	2.45	Dynamic sample ends at 2.45m (Refusal)	Dry		2.00 2.00 2.00	D ES	N=40 (7,8/10,8,8,14)

Groundwater entries: Struck: Rose to: Casing: Sealed:		Diameter & casing: From: to: Dia: Casing:		Depth related remarks: From to: Remarks		Run details: From: to: Duration: Recovery:	
 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters. Log issue: DRAFT Scale: 1:50		Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon		Exploratory position reference: WS114 Sheet 1 of 1			

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 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters. Log issue: DRAFT Scale: 1:50	Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon	Exploratory position reference: WS115 Sheet 1 of 1
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TerraConsult

Backfill/ Instal'n	Water- strike	Legend	Level & Depth (Thickness)	Stratum Description	Samples & In Situ Testing		
					Depth	Type & No	Results
			(0.30)	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, brick fragments and ceramic. (TOPSOIL)	0.60	ES	
			0.30	Firm becoming stiff light brownish grey slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of mudstone, brick fragments and coal. (REWORKED MERCIA MUDSTONE)			
			(0.70)				
			1.00	Trial pit ends at 1.00m (Hard dig)			
Groundwater entries: Depth: Rose to: Remarks:				Depth related remarks: From to: Remarks:		General remarks: Weather: Sunny Stability: Stable Remarks: Termination: Hard dig	
 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters. Log issue: DRAFT Scale: 1:10				Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon		Exploratory position reference: TP116	
Sheet 1 of 1							

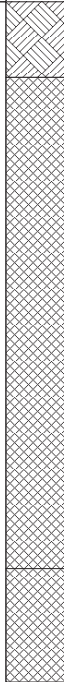
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Sheet 1 of 1

Trial Pit Log

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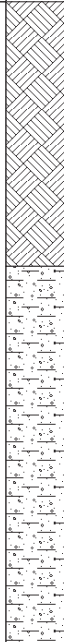
Personnel:		Equipment & methods:		Dimensions:	Coordinates & level:	Dates:
Logged by:	JP	Method:		Width: 0.30	mE:	Start: 24/06/2016
Checked by:	NHF	Plant: N/A		Length: 0.30	mN:	End: 24/06/2016
		Shoring: N/A		Orientation:	mAOD:	Logged: 24/06/2016
				Bearing =	Grid:	

Backfill/ Instal'n	Water- strike	Legend	Level & Depth (Thickness)	Stratum Description	Samples & In Situ Testing		
					Depth	Type & No	Results
			0.10	Soft dark brown slightly gravelly sandy CLAY. Gravel is angular to subrounded fine to coarse of mudstone, concrete, brick fragments and coal. (TOPSOIL)	0.40	ES	
			(0.65)	Firm to stiff brown slightly sandy gravelly CLAY with a medium cobble content. Gravel is angular to subangular fine to coarse of brick fragments, concrete, ceramic and plastic. Cobbles are angular of concrete. (MADE GROUND)			
			0.75	Stiff brown mottled brownish grey slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of brick fragments, concrete and plastic. (MADE GROUND)			
			0.90	Trial pit ends at 0.90m (Hard dig)			
					Depth	Type & No	Results
Groundwater entries: Depth: Rose to: Remarks:				Depth related remarks: From to: Remarks:		General remarks: Weather: Sunny Stability: Stable Remarks: Termination: Hard dig	
 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters. Log issue: DRAFT Scale: 1:10				Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon		Exploratory position reference: TP118	

Trial Pit Log

TerraConsult

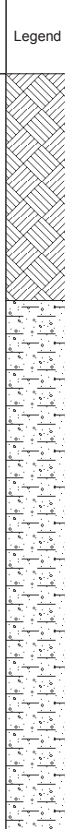
Personnel:		Equipment & methods:		Dimensions:	Coordinates & level:	Dates:
Logged by:	LM	Method:		Width: 0.30	mE:	Start: 22/06/2016
Checked by:	NHF	Plant: N/A		Length: 0.30	mN:	End: 22/06/2016
		Shoring: N/A		Orientation:	mAOD:	Logged: 22/06/2016
				Bearing =	Grid:	

Backfill/ Instal'n	Water- strike	Legend	Level & Depth (Thickness)	Stratum Description	Samples & In Situ Testing		
					Depth	Type & No	Results
			(0.35)	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, brick fragments and ceramic. (TOPSOIL)	0.70	ES	
			0.35	Stiff becoming very stiff light orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to medium of mudstone. (GRADE IVB) (MERCIA MUDSTONE)			
			(0.50)				
			0.85	Trial pit ends at 0.85m (Hard dig)			
					Depth	Type & No	Results
Groundwater entries: Depth: Rose to: Remarks:				Depth related remarks: From to: Remarks:		General remarks: Weather: Sunny Stability: Stable Remarks:	
						Termination: Hard dig	
 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters. Log issue: DRAFT Scale: 1:10				Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon		Exploratory position reference: TP119 Sheet 1 of 1	

TerraConsult

Backfill/ Instal'n	Water- strike	Legend	Level & Depth (Thickness)	Stratum Description	Samples & In Situ Testing		
					Depth	Type & No	Results
			0.20	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, brick fragments and ceramic. (TOPSOIL)			
			0.22	CONCRETE (MADE GROUND) Trial pit ends at 0.22m (Hard dig)			
					Depth	Type & No	Results
Groundwater entries: Depth: Rose to: Remarks:				Depth related remarks: From to: Remarks:		General remarks: Weather: Sunny Stability: Stable Remarks: Termination: Hard dig	
Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters. Log issue: DRAFT Scale: 1:10				Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon		Exploratory position reference: TP120	

TerraConsult

Backfill/ Instal'n	Water- strike	Legend	Level & Depth (Thickness)	Stratum Description	Samples & In Situ Testing		
					Depth	Type & No	Results
			(0.30)	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, brick fragments and ceramic. (TOPSOIL)	1.00	ES	
			0.30	Stiff becoming very stiff light orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to medium of mudstone. (GRADE IVB) (MERCIA MUDSTONE)			
			(0.70)				
			1.00	Trial pit ends at 1.00m (Hard dig)			
					Depth	Type & No	Results
Groundwater entries: Depth: Rose to: Remarks:				Depth related remarks: From to: Remarks:		General remarks: Weather: Sunny Stability: Stable Remarks: Termination: Hard dig	
 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters.				Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon		Exploratory position reference: TP120A	
Log issue: DRAFT Scale: 1:10						Sheet 1 of 2	

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TerraConsult

Backfill/ Instal'n	Water- strike	Legend	Level & Depth (Thickness)	Stratum Description	Samples & In Situ Testing		
					Depth	Type & No	Results
			(0.60)	Soft to firm dark brown sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of mudstone, sandstone, concrete, brick fragments and ceramic. (MADE GROUND)	0.50	ES	
			0.60	Stiff becoming very stiff light orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to medium of mudstone. (GRADE IVB) (MERCIA MUDSTONE)			
			(0.30)				
			0.90	Trial pit ends at 0.90m (Hard dig)			
Groundwater entries: Depth: Rose to: Remarks:				Depth related remarks: From to: Remarks:	General remarks: Weather: Sunny Stability: Stable Remarks: Termination: Hard dig		

TP122

TerraConsult

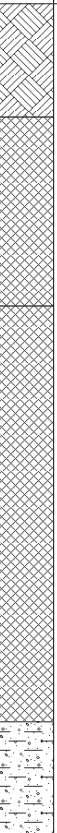
Backfill/ Instal'n	Water strike	Legend	Level & Depth (Thickness)	Stratum Description	Samples & In Situ Testing		
					Depth	Type & No	Results
		 	(0.70)	Soft to firm dark brown sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of mudstone, sandstone, concrete, brick fragments and ceramic. (MADE GROUND)			
			0.70	Stiff becoming very stiff light orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to medium of mudstone. (GRADE IVB) (MERCIA MUDSTONE)			
			0.90	Trial pit ends at 0.90m (Hard dig)			
Groundwater entries: Depth: Rose to: Remarks:				Depth related remarks: From to: Remarks:		General remarks: Weather: Sunny Stability: Stable Remarks: Termination: Hard dig	

 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters.	Project: Manchester Enterprise Academy	Exploratory position reference: TP123
	Project No: 2859 Client: Wilmott Dixon	
Log issue: DRAFT		
Scale: 1:10		

Trial Pit Log

TerraConsult

Personnel:		Equipment & methods:		Dimensions:	Coordinates & level:	Dates:
Logged by:	JP	Method:		Width: 0.30	mE:	Start: 20/06/2016
Checked by:	NHF	Plant: N/A		Length: 0.30	mN:	End: 20/06/2016
		Shoring: N/A		Orientation:	mAOD:	Logged: 20/06/2016
				Bearing =	Grid:	

Backfill/ Instal'n	Water- strike	Legend	Level & Depth (Thickness)	Stratum Description	Samples & In Situ Testing			
					Depth	Type & No	Results	
			0.15	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, brick fragments and ceramic. (TOPSOIL)	0.40	ES		
				Firm orangish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to coarse of mudstone, coal and brick fragments. (REWORKED MERCIA MUDSTONE)				
			0.40	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, brick fragments and ceramic. (MADE GROUND)				
			(0.55)		0.85	D		
			0.95	Firm orangish brown slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded fine to coarse of mudstone. (GRADE IVB) (MERCIA MUDSTONE)				
1.10	Trial pit ends at 1.10m (Hard dig)							

TerraConsult

Sheet 1 of 1

TerraConsult

Backfill/ Instal'n	Water strike	Legend	Level & Depth (Thickness)	Stratum Description	Samples & In Situ Testing		
					Depth	Type & No	Results
			(0.30)	Soft dark brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone, brick fragments and ceramic. (TOPSOIL)	0.25	ES	
			0.30	Firm becoming stiff light brownish grey slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse of mudstone, brick fragments and coal. (MADE GROUND)			
			0.45	Stiff light orangish brown slightly sandy slightly gravelly CLAY. Gravel is angular fine of mudstone. (GRADE IVB) (MERCIA MUDSTONE)			
			(0.55)				
			1.00	Very stiff light greyish brown slightly sandy slightly gravelly CLAY. Gravel is angular to subanguloar fine to medium of mudstone lithorelicts. (GRADE IVA) (MERCIA MUDSTONE)			
			1.20	Trial pit ends at 1.20m (Target depth)			
Groundwater entries: Depth: Rose to: Remarks:				Depth related remarks: From to: Remarks:		General remarks: Weather: Heavy Rain Stability: Stable Remarks: Termination: Target depth	

 Notes: For explanation of symbols and abbreviations see Key Sheet. All depths and reduced levels are in meters. Log issue: DRAFT Scale: 1:10	Project: Manchester Enterprise Academy Project No: 2859 Client: Wilmott Dixon	Exploratory position reference: TP126 Sheet 1 of 1
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TerraConsult

Backfill/ Instal'n	Water- strike	Legend	Level & Depth (Thickness)	Stratum Description	Samples & In Situ Testing		
					Depth	Type & No	Results
			0.25 (0.55) 0.80 (0.40) 1.20	Soft dark brown sandy slightly gravelly CLAY with frequent roots and rootlets. Gravel is angular to subangular fine to coarse of mudstone and brick fragments. (TOPSOIL)	0.70	ES	
				Stiff orangish brown mottled greyish brown slightly sandy CLAY. (GRADE IVB) (MERCIA MUDSTONE)			
				Stiff reddish brown mottled greyish brown slightly gravelly sandy CLAY. Gravel is subangular fine to coarse of mudstone and rare mudstone lithorelicts. (GRADE IVA) (MERCIA MUDSTONE)			
				Trial pit ends at 1.20m (Target depth)			
					Depth	Type & No	Results
Groundwater entries: Depth: Rose to: Remarks:				Depth related remarks: From to: Remarks:		General remarks: Weather: Heavy Rain Stability: Stable Remarks: Termination: Target depth	

TP127

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

ARCHWAY ENGINEERING (UK) LTD
AINLEYS INDUSTRIAL ESTATE
ELLAND
WEST YORKSHIRE
HX5 9JP

SPT Hammer Ref: AR601
Test Date: 17/12/2015
Report Date: 17/12/2015
File Name: AR601.spt
Test Operator: SH

Instrumented Rod Data

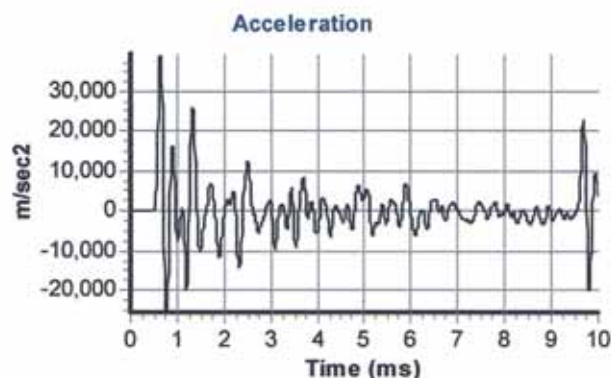
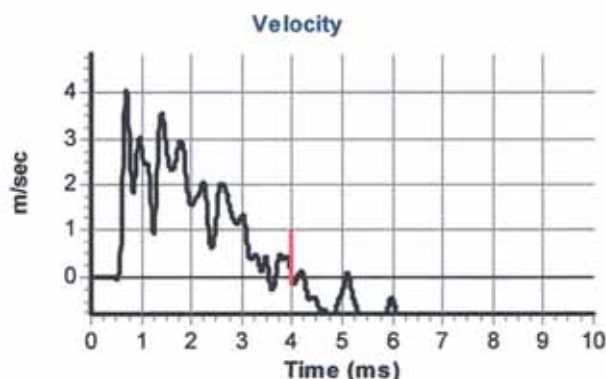
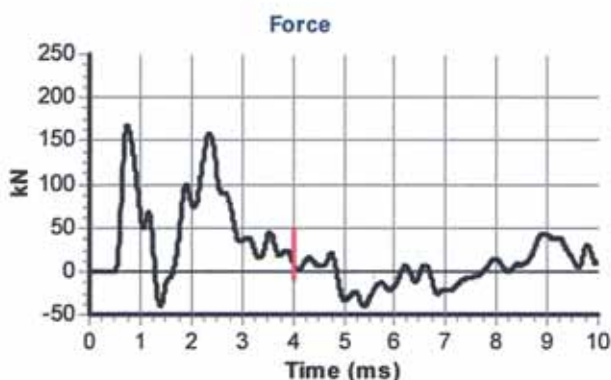
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.1
Assumed Modulus E_a (GPa): 200
Accelerometer No.1: 7079
Accelerometer No.2: 7080

SPT Hammer Information

Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
SPT String Length L (m): 10.0

Comments / Location

CALIBRATION



Calculations

Area of Rod A (mm²): 918
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 325

Energy Ratio E_r (%): **69**

Signed: S. HOWARTH
Title: FITTER

The recommended calibration interval is 12 months

Key To Exploratory Hole Records

SAMPLES

Undisturbed

U	Driven tube sample	} nominally 100 mm diameter and full recovery unless otherwise stated
TW	Pushed thin wall tube sample	
P	Pushed piston sample	
L	Liner sample (from windowless or similar sampler), full recovery unless otherwise stated	
CBR	CBR mould sample	
BLK	Block sample	
CS	Core sample (from rotary core) taken for laboratory testing	
AMAL	Amalgamated sample	

Disturbed

D	Small sample
B	Bulk sample

Other

W	Water sample
G	Gas sample
	Environmental chemistry samples (in more than one container where appropriate)
ES	Soil sample
EW	Water sample

Comments

Sample reference numbers are assigned to every sample taken. A sample reference of 'NR' indicates that attempt was made to take a tube sample; however, there was no recovery.

Monitoring samples taken after completion of hole construction are not shown on the exploratory hole logs.

TESTS

SPT S or SPT C	Standard Penetration Test, open shoe (S) or solid cone (C)
----------------	--

The Standard Penetration Test is defined in BS EN ISO 22476-3 (2005). The incremental blow counts are given in the Field Records column; each increment is 75 mm unless stated otherwise and any penetration under self-weight in mm (SW) is noted. Where the full 300 mm test drive is achieved the total number of blows for the test drive is presented as N = ** in the Test column. Where the test drive blows reach 50 (either in total or for a single increment) the total blow count beyond the seating drive is given (without the N = prefix).

IV	<i>in situ</i> Vane shear strength, peak (p) and remoulded (r), kPa
HV	Hand vane shear strength, peak (p) and remoulded (r), kPa
PP	Pocket penetrometer test, converted to shear strength, kPa
KFH, KRH, KPI	Variable head permeability tests (KFH = falling head test, KRH = rising head test, KPI = packer test), permeability value

Test results provided in Field Records column

DRILLING RECORDS

The mechanical indices (TCR/SCR/RQD & If) are defined in BS 5930 (1999) and BS EN ISO 22575-1 (2006)

TCR	Total Core Recovery, %
SCR	Solid Core Recovery, %
RQD	Rock Quality Designation, %
If	Fracture spacing, mm. Minimum, typical and maximum spacings are presented.
NI	Non-intact is used where the core is fragmented.

Flush returns, estimated percentage with colour where relevant, are given in the Records column

CRF	Core recovered (length in m) in the following run
AZCL	Assessed zone of core loss
NR	Not recovered

GROUNDWATER

▼	Groundwater strike
▽	Groundwater level after standing period

INSTALLATION

Standpipe/ piezometer

Details of standpipe/piezometer installations are given on the Record. Legend column shows installed instrument depths including slotted pipe section or tip depth, response zone filter material type and layers of backfill.

SP
SPIE
PPIE
EPIE



The type of instrument installed is indicated by a code in the Legend column at the depth of the response zone:
Standpipe
Standpipe piezometer
Pneumatic piezometer
Electronic piezometer

Inclinometer or Slip Indicator

The installation of vertical profiling instruments is indicated on the Record. The base of tubing is shown in the Legend column.

ICE
ICM
SLIP



The type of instrument installed is indicated by a code in the Legend column at the base of the tubing:
Biaxial inclinometer
Inclinometer tubing for use with probe
Slip indicator

Settlement Points or Pressure Cells

The installation of single point instruments is indicated on the Record. The location of the measuring device is shown in the Legend column.

ESET
ETM
EPCE
PPCE



The type of instrument installed is indicated by a code in the Legend column:
Electronic settlement cell/gauge
Magnetic extensometer settlement point
Electronic embedment pressure cell
Electronic push in pressure cell

INSTALLATION LEGENDS

A legend describing the installation is shown in the rightmost column. Legends additional to BS5930 are used to describe the backfill materials as indicated below.

Arisings



Concrete



Grout



Bentonite



Sand



Gravel



Tarmac



NOTES

- 1 Soils and rocks are described in accordance with BS 5930:2015.
- 2 Strata legends are in accordance with BS 5930:1999.
- 3 Water level observations of discernible entries during the advancing of the exploratory hole are given at the foot of the log and in the Legend column. The term "none observed" is used where no discrete entries are identified although this does not necessarily indicate that the hole has not been advanced below groundwater level. Under certain conditions groundwater cannot be observed, for instance, drilling with water flush or overwater, or boring at a rate much faster than water can make its way into the borehole (ref BS5930:2015, Clause 47.2.7). In addition, where appropriate, water levels in the hole at the time of recovering individual samples or carrying out in situ tests and at shift changes are given in the Records column.
- 4 Evidence of the occurrence of very coarse particles (cobbles and boulders) is presented on the logs, however, because of their size in relation to the exploratory hole these records may not be fully representative of their size and frequency in the ground mass.
- 5 The borehole logs present the results of Standard Penetration Tests recorded in the field without correction or interpretation. However, in certain ground conditions (e.g. high hydraulic head or where very coarse particles are present) some judgement may be necessary in considering whether the results are representative of in situ mass conditions.
- 6 The declination of bedding and joints is given with respect to the normal to the core axis. Thus in a vertical borehole this will be the dip.
- 7 The assessment of SCR, RQD and Fracture Spacing excludes artificial (non in situ) fractures.
- 8 Where "tarmac" is referred to in descriptions, this refers to bound bituminous paving materials which could be blacktop, asphalt, mastic asphalt, tarmac or other type of materials. The word "tarmac" is not intended to convey that tar has been used in the material.

APPENDIX E

Gas and Groundwater Monitoring

	No: 2859		GROUNDWATER AND GROUND GAS MONITORING																		TerraConsult			
	Site: Manchester Enterprise Academy, Wythenshawe																							
	Location	Date	Monitored by	Well Details		Groundwater			Gas										Weather					
				Standpipe diameter (mm)	Depth to Base (m bgl)	Water Depth (m bgl)	Purged (Y/N - litres)	Water Sample Taken?	Atmospheric Pressure (mbar)	Atmospheric Pressure Comment	Relative Pressure	Steady Flow (l/h)	Peak Flow (l/h)	CH ₄ (% v/v)	GSV CH ₄ (l/hr)	CO ₂ (% v/v)	GSV CO ₂ (l/hr)	O ₂ (% v/v)	CO (ppm)	H ₂ S (ppm)	PID	Conditions	Ambient Temp °C	Comments
School Extension	WS101	04/07/16	JNP	51	2.26	1.36	Y	Y	1010	Falling	0	0.1	0.1	0.1	0.0001	1.6	0.0016	16.1	1	1	-	Sunny	18	
		11/07/16	JNP	51	2.26	1.39	Y	Y	996	Steady	0	0.1	0.1	0.1	0.0001	1.8	0.0018	13.7	1	1	0.1	Overcast, rain	14	
		22/07/16	LM	51	2.28	2.15	N	N	1010	Rising	0	0.1	0.1	0.1	0.0001	1.8	0.0018	16.5	1	1	0.1	Sunny	16	
	WS103	04/07/16	JNP	51	1.96	DRY	N	N	1009	Falling	0	0.1	-0.2	0.1	0.0001	2.2	0.0022	17.6	1	1	-	Sunny	18	
		11/07/16	JNP	51	1.96	DRY	N	N	996	Steady	0	0.1	0.1	0.1	0.0001	2.2	0.0022	17.2	1	1	0.1	Overcast, rain	14	
		22/07/16	LM	51	1.96	DRY	N	N	1010	Rising	0	0.1	0.1	0.1	0.0001	2.2	0.0022	18.8	1	1	0.1	Sunny	16	
	WS105	04/07/16	JNP	51	1.79	DRY	N	N	1009	Falling	0	0.1	0.1	0.1	0.0001	0.1	0.0001	21.4	1	1	-	Sunny	18	
		11/07/16	JNP	51	1.79	DRY	N	N	996	Steady	0	0.1	0.1	0.1	0.0001	0.1	0.0001	20.7	1	1	0.1	Overcast, rain	14	
		22/07/16	LM	51	1.79	DRY	N	N	1010	Rising	0	0.1	0.1	0.1	0.0001	0.1	0.0001	20.8	1	1	0.1	Sunny	16	
MUGA	WS108	04/07/16	JNP	51	1.97	1.90	N	Y	1008	Falling	0	0.1	0.1	0.1	0.0001	0.1	0.0001	9.4	1	1	-	Sunny	18	
		11/07/16	JNP	51	1.97	1.95	N	N	996	Steady	0	0.1	0.1	0.1	0.0001	0.1	0.0001	9.1	1	1	0.1	Overcast, rain	14	
		22/07/16	LM	51	1.96	1.89	N	N	1010	Rising	0	0.1	0.1	0.1	0.0001	0.9	0.0009	6.7	1	1	0.1	Sunny	16	
Western Car Park	WS110	04/07/16	JNP	51	1.99	1.77	N	Y	1008	Falling	0	0.1	0.1	0.1	0.0001	2.0	0.0020	18.2	1	1	-	Sunny	18	
		11/07/16	JNP	51	1.99	1.61	N	N	996	Steady	0	0.1	0.1	0.1	0.0001	3.1	0.0031	16.3	1	1	0.1	Overcast, rain	14	
		22/07/16	LM	51	1.99	1.88	N	N	1010	Rising	0	0.1	0.1	0.1	0.0001	4.2	0.0042	15.7	1	1	0.1	Sunny	16	
Northern Area	WS111	04/07/16	JNP	51	2.05	0.77	Y	Y	1011	Falling	0	0.1	-26.4	0.1	0.0001	0.3	0.0003	20.2	1	1	-	Sunny	18	
		11/07/16	JNP	51	2.05	0.94	N	N	996	Steady	0	0.1	86.1	0.1	0.0001	0.6	0.0006	19.9	1	1	0.1	Overcast, rain	14	
		22/07/16	LM	51	2.05	0.51	N	N	1010	Rising	0	0.1	0.1	0.1	0.0001	0.1	0.0001	20.6	1	1	0.2	Sunny	16	
	WS114	04/07/16	JNP	51	2.00	1.20	N	Y	1011	Falling	0	0.1	0.1	0.1	0.0001	0.4	0.0004	20.2	1	1	-	Sunny	18	
		11/07/16	JNP	51	2.00	0.69	N	N	996	Steady	0	0.1	10.8	0.1	0.0001	0.4	0.0004	20.2	1	1	0.1	Overcast, rain	14	
		22/07/16	LM	51	2.00	1.34	N	N	1010	Rising	0	0.1	0.1	0.1	0.0001	1.5	0.0015	19.4	1	1	0.1	Sunny	16	
	WS115	04/07/16	JNP	51	2.03	0.82	Y	Y	1013	Falling	0	0.1	-50.0	0.1	0.0001	0.7	0.0007	19.6	1	1	-	Sunny	18	
		11/07/16	JNP	51	2.03	0.71	N	N	996	Steady	0	0.1	0.1	0.1	0.0001	0.8	0.0008	19.4	1	1	0.1	Overcast, rain	14	
		22/07/16	LM	51	2.03	0.61	N	N	1010	Rising	0	0.1	0.1	0.1	0.0001	0.2	0.0002	20.6	1	1	0.1	Sunny	16	
	Note: * = flow rate maximum indicated, flow rate reduced down to less than detection limit of 0.1 l/hr within 10 to 60 seconds of opening gas tap.																							
	Concentrations measured below the limits of detection of the monitoring equipment. Assumed to be 0.1 for calculation purposes for gases and flow or 1 for CO & H2S																							

NOTES:

NM = Not Measured.
 (x) = Peak value recorded.
 [grey] = Below detection limit.

$$\text{GSV (l/hr)} = [\text{gas concentration (\%v/v)}] \times [\text{gas well flow rate (l/hr)}]$$

Instrumentation Specifications

Gas Monitoring – Permanent Gases

Gas monitoring for permanent gases (e.g. methane, carbon dioxide, oxygen etc) at TerraConsult is carried out using a GasData GFM 400 series gas analyser with flow meter which measures borehole flow rates, bulk gas concentrations (methane, carbon dioxide and oxygen), barometric and differential pressure.

The specification range of the GFM 400 series is as follows:

Feature	Method/Type	Range	Resolution
Methane	Infrared	0 - 100%v/v	0.1%
Lower Detection Limit (LEL)	Infrared	0 - 100%v/v	0.1%
Carbon Dioxide	Infrared	0 - 100%v/v	0.1%
Oxygen	Electrochemical	0 - 25%v/v	0.1%
Hydrogen Sulphide	Electrochemical	0 - 5,000ppm	1ppm
Carbon monoxide	Electrochemical	0 - 2,000ppm	1ppm
Atmospheric Pressure	Absolute Pressure Sensor	800 – 1,200mb	1mb
Differential Pressure	Thermal Dissipation	±1,250Pa	0.1Pa
Temperature	Bi-metal	-10°C to +100°C	1°C
Flow	Thermal Dissipation	-60 – 100 l/hr	0.1 l/hr

Volatile Organic Compounds

TerraConsult uses a PhoCheck Tiger Photo Ionisation Detector (PID) to detect a large range of Volatile Organic Compounds (VOCs) which are potentially dangerous from both a poisoning and/or an explosive perspective.

The sensor specification is as follows:

Feature	Method/Type	Range	Resolution
Total VOCs	PID	1ppb – 10,000ppm & 1ppb to 20,000ppm for specific gases	+/- 5% displayed reading +/- one digit

Calibration

Measuring equipment owned by TerraConsult is maintained in good condition and regularly inspected to ensure that it is capable of accurate and effective operation and is calibrated in line with the manufacturer's recommendations. When equipment is hired for use, the hirer will be required to provide a calibration certificate with the equipment.

In accordance with TerraConsult's ISO 9001:2008 accreditation, the process of calibrating and maintenance of TerraConsult's own measuring equipment is carried out in accordance with our quality system procedures and a register of all measuring equipment is maintained and calibration certificates collated and stored accordingly.

Prior to the use of any measuring equipment, the user will undertake suitable checks to ensure that it is fit for use and within the calibration tolerances specified.

Should a copy of the relevant calibration certificate be required, please contact TerraConsult directly to request a copy.

APPENDIX F

Laboratory Chemical Test Results



Nick Frost
TerraConsult Ltd
Bold Business Centre
Bold Lane
Sutton
St Helens
Merseyside
WA9 4TX



QTS Environmental Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410
russell.jarvis@qtsenvironmental.com

QTS Environmental Report No: 16-46026

Site Reference: Manchester Enterprise Academy

Project / Job Ref: 2859

Order No: 15517

Sample Receipt Date: 23/06/2016

Sample Scheduled Date: 29/06/2016

Report Issue Number: 1

Reporting Date: 06/07/2016

Authorised by:

Russell Jarvis
Associate Director of Client Services
On behalf of QTS Environmental Ltd

Authorised by:

Kevin Old
Associate Director of Laboratory
On behalf of QTS Environmental Ltd



QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate						
QTS Environmental Report No: 16-46026	Date Sampled	21/06/16	22/06/16	21/06/16	22/06/16	24/06/16
TerraConsult Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Manchester Enterprise Academy	TP / BH No	WS105	TP116	WS103	TP121	TP118
Project / Job Ref: 2859	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 15517	Depth (m)	0.30	0.60	1.00	0.80	0.40
Reporting Date: 06/07/2016	QTSE Sample No	214292	214296	214297	214299	214300

Determinand	Unit	RL	Accreditation					
Asbestos Screen	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected
pH	pH Units	N/a	MCERTS	7.9	7.5	7.6	7.0	7.5
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Total Sulphate as SO ₄	mg/kg	< 200	NONE					
Total Sulphate as SO ₄	%	< 0.02	NONE					
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	1150	481	106	176	477
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	1.15	0.48	0.11	0.18	0.48
Organic Matter	%	< 0.1	MCERTS					
Total Organic Carbon (TOC)	%	< 0.1	MCERTS					
W/S Chloride (2:1)	mg/kg	< 1	MCERTS					
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS					
Arsenic (As)	mg/kg	< 2	MCERTS	5	11	6	7	7
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	0.3	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (Cr)	mg/kg	< 2	MCERTS	11	28	22	23	20
Copper (Cu)	mg/kg	< 4	MCERTS	13	23	6	12	16
Lead (Pb)	mg/kg	< 3	MCERTS	21	17	< 3	15	19
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	8	24	17	20	17
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	< 3	< 3
Zinc (Zn)	mg/kg	< 3	MCERTS	127	48	33	50	59
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
DRO (C10 - C24)	mg/kg	< 6	MCERTS					
Oil (C25 - C40)	mg/kg	< 6	MCERTS					
Mineral Oil (C10 - C40)	mg/kg	< 10	MCERTS					

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

Analysis carried out on the dried sample is corrected for the stone content

The samples have been examined to identify the presence of asbestiform minerals by polarising light microscopy and dispersion staining technique to In-House Procedures QTSE600 Determination of Asbestos in Bulk Materials; Asbestos in Soils/Sediments (fibre screening and identification)

This report refers to samples as received, and QTS Environmental Ltd, takes no responsibility for the accuracy or competence of sampling by others.

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Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.

Asbestos Analyst: Rosie Head

RL: Reporting Limit

Pinch Test: Where pinch test is positive it is reported "Loose Fibres - PT" with type(s).

Subcontracted analysis ⁽⁵⁾



QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
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Lenham Heath
Maidstone
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Soil Analysis Certificate						
QTS Environmental Report No: 16-46026	Date Sampled	24/06/16	24/06/16	22/06/16	22/06/16	24/06/16
TerraConsult Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Manchester Enterprise Academy	TP / BH No	WS108	WS110	TP120	TP122	WS112
Project / Job Ref: 2859	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 15517	Depth (m)	0.50	0.25	1.00	0.50	0.15
Reporting Date: 06/07/2016	QTSE Sample No	214301	214302	214303	214304	214305

Determinand	Unit	RL	Accreditation					
Asbestos Screen	N/a	N/a	ISO17025	Not Detected				
pH	pH Units	N/a	MCERTS	8.7	7.8	7.6	7.4	6.7
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Total Sulphate as SO ₄	mg/kg	< 200	NONE					
Total Sulphate as SO ₄	%	< 0.02	NONE					
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	610	15	35	< 10	< 10
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.61	0.01	0.03	< 0.01	< 0.01
Organic Matter	%	< 0.1	MCERTS					
Total Organic Carbon (TOC)	%	< 0.1	MCERTS					
W/S Chloride (2:1)	mg/kg	< 1	MCERTS					
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS					
Arsenic (As)	mg/kg	< 2	MCERTS	7	13	8	16	13
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	< 0.2	< 0.2	< 0.2	0.3	< 0.2
Chromium (Cr)	mg/kg	< 2	MCERTS	23	22	30	20	23
Copper (Cu)	mg/kg	< 4	MCERTS	15	35	6	30	35
Lead (Pb)	mg/kg	< 3	MCERTS	11	67	3	72	55
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	20	16	27	14	15
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	< 3	< 3
Zinc (Zn)	mg/kg	< 3	MCERTS	52	96	45	84	76
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
DRO (C10 - C24)	mg/kg	< 6	MCERTS					
Oil (C25 - C40)	mg/kg	< 6	MCERTS					
Mineral Oil (C10 - C40)	mg/kg	< 10	MCERTS					

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

Analysis carried out on the dried sample is corrected for the stone content

The samples have been examined to identify the presence of asbestiform minerals by polarising light microscopy and dispersion staining technique to In-House Procedures QTSE600 Determination of Asbestos in Bulk Materials; Asbestos in Soils/Sediments (fibre screening and identification)

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Soil Analysis Certificate						
QTS Environmental Report No: 16-46026	Date Sampled	24/06/16	20/06/16	24/06/16	24/06/16	21/06/16
TerraConsult Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Manchester Enterprise Academy	TP / BH No	WS111	TP126	TP127	WS115	WS102
Project / Job Ref: 2859	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 15517	Depth (m)	0.80	0.25	0.70	0.20	0.60
Reporting Date: 06/07/2016	QTSE Sample No	214306	214307	214308	214309	214310

Determinand	Unit	RL	Accreditation					
Asbestos Screen	N/a	N/a	ISO17025					
pH	pH Units	N/a	MCERTS	7.6	7.2	7.2	7.5	7.5
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Total Sulphate as SO ₄	mg/kg	< 200	NONE					557
Total Sulphate as SO ₄	%	< 0.02	NONE					0.06
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	15	12	< 10	< 10	56
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.02	0.01	< 0.01	< 0.01	0.06
Organic Matter	%	< 0.1	MCERTS					0.7
Total Organic Carbon (TOC)	%	< 0.1	MCERTS					0.4
W/S Chloride (2:1)	mg/kg	< 1	MCERTS					8
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS					4
Arsenic (As)	mg/kg	< 2	MCERTS	6	11	5	10	4
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (Cr)	mg/kg	< 2	MCERTS	25	19	18	19	12
Copper (Cu)	mg/kg	< 4	MCERTS	7	20	10	21	8
Lead (Pb)	mg/kg	< 3	MCERTS	< 3	33	5	43	8
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	22	14	18	15	10
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	< 3	< 3
Zinc (Zn)	mg/kg	< 3	MCERTS	41	49	28	61	34
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
DRO (C10 - C24)	mg/kg	< 6	MCERTS					30
Oil (C25 - C40)	mg/kg	< 6	MCERTS					48
Mineral Oil (C10 - C40)	mg/kg	< 10	MCERTS					< 10

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

Analysis carried out on the dried sample is corrected for the stone content

The samples have been examined to identify the presence of asbestiform minerals by polarising light microscopy and dispersion staining technique to In-House Procedures QTSE600 Determination of Asbestos in Bulk Materials; Asbestos in Soils/Sediments (fibre screening and identification)

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Subcontracted analysis ⁽⁵⁾



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Soil Analysis Certificate						
QTS Environmental Report No: 16-46026	Date Sampled	21/06/16	24/06/16	24/06/16	24/06/16	24/06/16
TerraConsult Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Manchester Enterprise Academy	TP / BH No	WS104	WS107	WS111	WS114	WS115
Project / Job Ref: 2859	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 15517	Depth (m)	0.40	0.30	0.30	0.25	0.75
Reporting Date: 06/07/2016	QTSE Sample No	214311	214312	214313	214314	214315

Determinand	Unit	RL	Accreditation					
Asbestos Screen	N/a	N/a	ISO17025					
pH	pH Units	N/a	MCERTS	7.6	7.8	6.7	6.9	6.5
Total Cyanide	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Total Sulphate as SO ₄	mg/kg	< 200	NONE	1293	205	544	464	224
Total Sulphate as SO ₄	%	< 0.02	NONE	0.13	0.02	0.05	0.05	0.02
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	251	23	14	< 10	< 10
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.25	0.02	0.01	< 0.01	< 0.01
Organic Matter	%	< 0.1	MCERTS	2	0.3	3.4	2.7	1.2
Total Organic Carbon (TOC)	%	< 0.1	MCERTS	1.2	0.2	2	1.5	0.7
W/S Chloride (2:1)	mg/kg	< 1	MCERTS	13	7	49	17	15
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS	6.6	3.4	24.3	8.6	7.6
Arsenic (As)	mg/kg	< 2	MCERTS	8	< 2	16	12	9
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	< 0.2	0.6	< 0.2	< 0.2	< 0.2
Chromium (Cr)	mg/kg	< 2	MCERTS	21	3	20	17	19
Copper (Cu)	mg/kg	< 4	MCERTS	19	5	31	23	10
Lead (Pb)	mg/kg	< 3	MCERTS	31	8	59	51	12
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	17	< 3	16	12	12
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	< 3	< 3
Zinc (Zn)	mg/kg	< 3	MCERTS	68	13	72	60	34
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
DRO (C10 - C24)	mg/kg	< 6	MCERTS	18	8	< 6	< 6	< 6
Oil (C25 - C40)	mg/kg	< 6	MCERTS	133	50	< 6	< 6	< 6
Mineral Oil (C10 - C40)	mg/kg	< 10	MCERTS	15	< 10	< 10	< 10	< 10

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

Analysis carried out on the dried sample is corrected for the stone content

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Soil Analysis Certificate						
QTS Environmental Report No: 16-46026	Date Sampled	24/06/16	20/06/16	20/06/16	22/06/16	
TerraConsult Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	
Site Reference: Manchester Enterprise Academy	TP / BH No	WS113	TP125	TP124	TP119	
Project / Job Ref: 2859	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	
Order No: 15517	Depth (m)	0.30	0.50	0.40	0.70	
Reporting Date: 06/07/2016	QTSE Sample No	214316	214317	214318	214319	

Determinand	Unit	RL	Accreditation				
Asbestos Screen	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected	Not Detected
pH	pH Units	N/a	MCERTS				
Total Cyanide	mg/kg	< 2	NONE				
Total Sulphate as SO ₄	mg/kg	< 200	NONE				
Total Sulphate as SO ₄	%	< 0.02	NONE				
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS				
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS				
Organic Matter	%	< 0.1	MCERTS				
Total Organic Carbon (TOC)	%	< 0.1	MCERTS				
W/S Chloride (2:1)	mg/kg	< 1	MCERTS				
W/S Chloride (2:1)	mg/l	< 0.5	MCERTS				
Arsenic (As)	mg/kg	< 2	MCERTS				
Cadmium (Cd)	mg/kg	< 0.2	MCERTS				
Chromium (Cr)	mg/kg	< 2	MCERTS				
Copper (Cu)	mg/kg	< 4	MCERTS				
Lead (Pb)	mg/kg	< 3	MCERTS				
Mercury (Hg)	mg/kg	< 1	NONE				
Nickel (Ni)	mg/kg	< 3	MCERTS				
Selenium (Se)	mg/kg	< 3	NONE				
Zinc (Zn)	mg/kg	< 3	MCERTS				
Total Phenols (monohydric)	mg/kg	< 2	NONE				
DRO (C10 - C24)	mg/kg	< 6	MCERTS				
Oil (C25 - C40)	mg/kg	< 6	MCERTS				
Mineral Oil (C10 - C40)	mg/kg	< 10	MCERTS				

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

Analysis carried out on the dried sample is corrected for the stone content

The samples have been examined to identify the presence of asbestiform minerals by polarising light microscopy and dispersion staining technique to In-House Procedures QTSE600 Determination of Asbestos in Bulk Materials; Asbestos in Soils/Sediments (fibre screening and identification)

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Asbestos Analyst: Rosie Head

RL: Reporting Limit

Pinch Test: Where pinch test is positive it is reported "Loose Fibres - PT" with type(s).

Subcontracted analysis ⁽⁵⁾



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Soil Analysis Certificate - Speciated PAHs						
QTS Environmental Report No: 16-46026	Date Sampled	21/06/16	22/06/16	21/06/16	22/06/16	24/06/16
TerraConsult Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Manchester Enterprise Academy	TP / BH No	WS105	TP116	WS103	TP121	TP118
Project / Job Ref: 2859	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 15517	Depth (m)	0.30	0.60	1.00	0.80	0.40
Reporting Date: 06/07/2016	QTSE Sample No	214292	214296	214297	214299	214300

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	0.20	0.12	< 0.1	< 0.1	0.44
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	< 0.1	MCERTS	0.50	0.22	< 0.1	< 0.1	0.65
Pyrene	mg/kg	< 0.1	MCERTS	0.45	0.21	< 0.1	< 0.1	0.61
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.19	< 0.1	< 0.1	< 0.1	0.27
Chrysene	mg/kg	< 0.1	MCERTS	0.20	< 0.1	< 0.1	< 0.1	0.27
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.25	0.14	< 0.1	< 0.1	0.35
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	0.12	< 0.1	< 0.1	< 0.1	0.15
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.17	< 0.1	< 0.1	< 0.1	0.22
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	0.15
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	0.11	< 0.1	< 0.1	< 0.1	0.13
Coronene	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total Oily Waste PAHs	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	1.4
Total Dutch 10 PAHs	mg/kg	< 1	MCERTS	1.5	< 1	< 1	< 1	2.3
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	2.2	< 1.6	< 1.6	< 1.6	3.2
Total WAC-17 PAHs	mg/kg	< 1.7	NONE	2.2	< 1.7	< 1.7	< 1.7	3.2

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - Speciated PAHs						
QTS Environmental Report No: 16-46026	Date Sampled	24/06/16	24/06/16	22/06/16	22/06/16	24/06/16
TerraConsult Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Manchester Enterprise Academy	TP / BH No	WS108	WS110	TP120	TP122	WS112
Project / Job Ref: 2859	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 15517	Depth (m)	0.50	0.25	1.00	0.50	0.15
Reporting Date: 06/07/2016	QTSE Sample No	214301	214302	214303	214304	214305

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	0.19	< 0.1	< 0.1	< 0.1	0.17
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	< 0.1	MCERTS	0.48	0.17	< 0.1	< 0.1	0.20
Pyrene	mg/kg	< 0.1	MCERTS	0.41	0.16	< 0.1	< 0.1	0.19
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.16	< 0.1	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	< 0.1	MCERTS	0.16	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.17	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.13	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Coronene	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total Oily Waste PAHs	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	< 1
Total Dutch 10 PAHs	mg/kg	< 1	MCERTS	1.1	< 1	< 1	< 1	< 1
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	1.7	< 1.6	< 1.6	< 1.6	< 1.6
Total WAC-17 PAHs	mg/kg	< 1.7	NONE	< 1.7	< 1.7	< 1.7	< 1.7	< 1.7

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - Speciated PAHs						
QTS Environmental Report No: 16-46026	Date Sampled	24/06/16	20/06/16	24/06/16	24/06/16	21/06/16
TerraConsult Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Manchester Enterprise Academy	TP / BH No	WS111	TP126	TP127	WS115	WS102
Project / Job Ref: 2859	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 15517	Depth (m)	0.80	0.25	0.70	0.20	0.60
Reporting Date: 06/07/2016	QTSE Sample No	214306	214307	214308	214309	214310

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	0.15
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	1.98
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	0.41
Fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	2.81
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	2.38
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	1.01
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	0.99
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	1.26
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	0.53
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	0.98
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	0.60
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	0.60
Coronene	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total Oily Waste PAHs	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	5.4
Total Dutch 10 PAHs	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	9.9
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6	< 1.6	< 1.6	13.7
Total WAC-17 PAHs	mg/kg	< 1.7	NONE	< 1.7	< 1.7	< 1.7	< 1.7	13.7

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - Speciated PAHs						
QTS Environmental Report No: 16-46026	Date Sampled	21/06/16	24/06/16	24/06/16	24/06/16	24/06/16
TerraConsult Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Manchester Enterprise Academy	TP / BH No	WS104	WS107	WS111	WS114	WS115
Project / Job Ref: 2859	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 15517	Depth (m)	0.40	0.30	0.30	0.25	0.75
Reporting Date: 06/07/2016	QTSE Sample No	214311	214312	214313	214314	214315

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	0.37	0.39	< 0.1	0.12	< 0.1
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	< 0.1	MCERTS	0.64	0.38	< 0.1	0.23	< 0.1
Pyrene	mg/kg	< 0.1	MCERTS	0.59	0.29	< 0.1	0.23	< 0.1
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.26	0.12	< 0.1	< 0.1	< 0.1
Chrysene	mg/kg	< 0.1	MCERTS	0.29	0.13	< 0.1	0.13	< 0.1
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.34	0.11	< 0.1	0.15	< 0.1
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	0.17	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.25	< 0.1	< 0.1	< 0.1	< 0.1
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.17	< 0.1	< 0.1	< 0.1	< 0.1
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	0.17	< 0.1	< 0.1	< 0.1	< 0.1
Coronene	mg/kg	< 0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total Oily Waste PAHs	mg/kg	< 1	MCERTS	1.5	< 1	< 1	< 1	< 1
Total Dutch 10 PAHs	mg/kg	< 1	MCERTS	2.3	1	< 1	< 1	< 1
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	3.2	< 1.6	< 1.6	< 1.6	< 1.6
Total WAC-17 PAHs	mg/kg	< 1.7	NONE	3.2	< 1.7	< 1.7	< 1.7	< 1.7

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Soil Analysis Certificate - TPH CWG Banded

QTS Environmental Report No: 16-46026	Date Sampled	21/06/16	21/06/16	24/06/16	24/06/16	24/06/16
TerraConsult Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Manchester Enterprise Academy	TP / BH No	WS102	WS104	WS107	WS111	WS114
Project / Job Ref: 2859	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 15517	Depth (m)	0.60	0.40	0.30	0.30	0.25
Reporting Date: 06/07/2016	QTSE Sample No	214310	214311	214312	214313	214314

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	< 3	< 3	< 3	< 3	< 3
Aliphatic >C16 - C21	mg/kg	< 3	MCERTS	< 3	< 3	< 3	< 3	< 3
Aliphatic >C21 - C34	mg/kg	< 10	MCERTS	< 10	15	< 10	< 10	< 10
Aliphatic (C5 - C34)	mg/kg	< 21	NONE	< 21	< 21	< 21	< 21	< 21
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	5	< 3	< 3	< 3	< 3
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	26	54	21	< 10	< 10
Aromatic (C5 - C35)	mg/kg	< 21	NONE	32	54	21	< 21	< 21
Total >C5 - C35	mg/kg	< 42	NONE	< 42	69	< 42	< 42	< 42

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - TPH CWG Banded

QTS Environmental Report No: 16-46026	Date Sampled	24/06/16				
TerraConsult Ltd	Time Sampled	None Supplied				
Site Reference: Manchester Enterprise Academy	TP / BH No	WS115				
Project / Job Ref: 2859	Additional Refs	None Supplied				
Order No: 15517	Depth (m)	0.75				
Reporting Date: 06/07/2016	QTSE Sample No	214315				

Determinand	Unit	RL	Accreditation				
Aliphatic >C5 - C6	mg/kg	< 0.01	NONE	< 0.01			
Aliphatic >C6 - C8	mg/kg	< 0.05	NONE	< 0.05			
Aliphatic >C8 - C10	mg/kg	< 2	MCERTS	< 2			
Aliphatic >C10 - C12	mg/kg	< 2	MCERTS	< 2			
Aliphatic >C12 - C16	mg/kg	< 3	MCERTS	< 3			
Aliphatic >C16 - C21	mg/kg	< 3	MCERTS	< 3			
Aliphatic >C21 - C34	mg/kg	< 10	MCERTS	< 10			
Aliphatic (C5 - C34)	mg/kg	< 21	NONE	< 21			
Aromatic >C5 - C7	mg/kg	< 0.01	NONE	< 0.01			
Aromatic >C7 - C8	mg/kg	< 0.05	NONE	< 0.05			
Aromatic >C8 - C10	mg/kg	< 2	MCERTS	< 2			
Aromatic >C10 - C12	mg/kg	< 2	MCERTS	< 2			
Aromatic >C12 - C16	mg/kg	< 2	MCERTS	< 2			
Aromatic >C16 - C21	mg/kg	< 3	MCERTS	< 3			
Aromatic >C21 - C35	mg/kg	< 10	MCERTS	< 10			
Aromatic (C5 - C35)	mg/kg	< 21	NONE	< 21			
Total >C5 - C35	mg/kg	< 42	NONE	< 42			

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - BTEX / MTBE						
QTS Environmental Report No: 16-46026	Date Sampled	21/06/16	21/06/16	24/06/16	24/06/16	24/06/16
TerraConsult Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Manchester Enterprise Academy	TP / BH No	WS102	WS104	WS107	WS111	WS114
Project / Job Ref: 2859	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: 15517	Depth (m)	0.60	0.40	0.30	0.30	0.25
Reporting Date: 06/07/2016	QTSE Sample No	214310	214311	214312	214313	214314

Determinand	Unit	RL	Accreditation					
Benzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
Toluene	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5
Ethylbenzene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
p & m-xylene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
o-xylene	ug/kg	< 2	MCERTS	< 2	< 2	< 2	< 2	< 2
MTBE	ug/kg	< 5	MCERTS	< 5	< 5	< 5	< 5	< 5

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C



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Soil Analysis Certificate - BTEX / MTBE						
QTS Environmental Report No: 16-46026	Date Sampled	24/06/16				
TerraConsult Ltd	Time Sampled	None Supplied				
Site Reference: Manchester Enterprise Academy	TP / BH No	WS115				
Project / Job Ref: 2859	Additional Refs	None Supplied				
Order No: 15517	Depth (m)	0.75				
Reporting Date: 06/07/2016	QTSE Sample No	214315				

Determinand	Unit	RL	Accreditation				
Benzene	ug/kg	< 2	MCERTS	< 2			
Toluene	ug/kg	< 5	MCERTS	< 5			
Ethylbenzene	ug/kg	< 2	MCERTS	< 2			
p & m-xylene	ug/kg	< 2	MCERTS	< 2			
o-xylene	ug/kg	< 2	MCERTS	< 2			
MTBE	ug/kg	< 5	MCERTS	< 5			

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C

Waste Acceptance Criteria Analytical Certificate - BS EN 12457 / 2

QTS Environmental Report No: 16-46026		Date Sampled	21/06/16					Landfill Waste Acceptance Criteria Limits		
TerraConsult Ltd		Time Sampled	None Supplied					Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Site Reference: Manchester Enterprise Academy		TP / BH No	WS101							
Project / Job Ref: 2859		Additional Refs	None Supplied							
Order No: 15517		Depth (m)	0.50							
Reporting Date: 06/07/2016		QTSE Sample No	214291							
Determinand	Unit	MDL								
TOC ^{MU}	%	< 0.1		0.7						
Loss on Ignition	%	< 0.01		2						
BTEX ^{MU}	mg/kg	< 0.05		< 0.05						
Sum of PCBs	mg/kg	< 0.1		< 0.1						
Mineral Oil ^{MU}	mg/kg	< 10		< 10						
Total PAH ^{MU}	mg/kg	< 1.7		< 1.7						
pH ^{MU}	pH Units	N/a		7.9						
Acid Neutralisation Capacity		mol/kg (+/-)	< 1		2.2					
Eluate Analysis			10:1 mg/l			Cumulative 10:1 mg/kg	Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)			
Arsenic ^U		< 0.01				< 0.1	0.5	2	25	
Barium ^U		0.06				0.6	20	100	300	
Cadmium ^U		< 0.0005				< 0.005	0.04	1	5	
Chromium ^U		< 0.005				< 0.05	0.5	10	70	
Copper ^U		< 0.01				< 0.1	2	50	100	
Mercury ^U		< 0.0005				< 0.01	0.01	0.2	2	
Molybdenum ^U		0.003				0.03	0.5	10	30	
Nickel ^U		< 0.007				< 0.07	0.4	10	40	
Lead ^U		< 0.005				< 0.05	0.5	10	50	
Antimony ^U		< 0.005				< 0.05	0.06	0.7	5	
Selenium ^U		< 0.005				< 0.05	0.1	0.5	7	
Zinc ^U		< 0.005				< 0.05	4	50	200	
Chloride ^U		1				11	800	15000	25000	
Fluoride ^U		< 0.5				< 5	10	150	500	
Sulphate ^U		21				211	1000	20000	50000	
TDS		110				1100	4000	60000	100000	
Phenol Index	< 0.01				< 0.1	1	-	-		
DOC	3.1				30.6	500	800	1000		
Leach Test Information										
Sample Mass (kg)		0.10								
Dry Matter (%)		86.6								
Moisture (%)		15.4								
Stage 1										
Volume Eluate L10 (litres)		0.89								
Results are expressed on a dry weight basis, after correction for moisture content where applicable										
Stated limits are for guidance only and QTS Environmental cannot be held responsible for any discrepancies with current legislation										
M Denotes MCERTS accredited test										
U Denotes ISO17025 accredited test										



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Waste Acceptance Criteria Analytical Certificate - BS EN 12457 / 2

QTS Environmental Report No: 16-46026		Date Sampled	21/06/16				Landfill Waste Acceptance Criteria Limits		
TerraConsult Ltd		Time Sampled	None Supplied				Inert Waste Landfill	Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill	Hazardous Waste Landfill
Site Reference: Manchester Enterprise Academy		TP / BH No	WS105						
Project / Job Ref: 2859		Additional Refs	None Supplied						
Order No: 15517		Depth (m)	0.30						
Reporting Date: 06/07/2016		QTSE Sample No	214292						
Determinand	Unit	MDL							
TOC ^{MU}	%	< 0.1	1	3%	5%	6%			
Loss on Ignition	%	< 0.01	3.22	--	--	10%			
BTEX ^{MU}	mg/kg	< 0.05	< 0.05	6	--	--			
Sum of PCBs	mg/kg	< 0.1	< 0.1	1	--	--			
Mineral Oil ^{MU}	mg/kg	< 10	31	500	--	--			
Total PAH ^{MU}	mg/kg	< 1.7	2.2	100	--	--			
pH ^{MU}	pH Units	N/a	7.9	--	>6	--			
Acid Neutralisation Capacity	mol/kg (+/-)	< 1	2.3	--	To be evaluated	To be evaluated			
Eluate Analysis		10:1 mg/l			Cumulative 10:1 mg/kg	Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)			
Arsenic ^U		< 0.01			< 0.1	0.5	2	25	
Barium ^U		0.09			0.9	20	100	300	
Cadmium ^U		< 0.0005			< 0.005	0.04	1	5	
Chromium ^U		0.005			0.05	0.5	10	70	
Copper ^U		< 0.01			< 0.1	2	50	100	
Mercury ^U		< 0.0005			< 0.01	0.01	0.2	2	
Molybdenum ^U		0.003			0.03	0.5	10	30	
Nickel ^U		< 0.007			< 0.07	0.4	10	40	
Lead ^U		< 0.005			< 0.05	0.5	10	50	
Antimony ^U		< 0.005			< 0.05	0.06	0.7	5	
Selenium ^U		< 0.005			< 0.05	0.1	0.5	7	
Zinc ^U		0.008			0.08	4	50	200	
Chloride ^U		< 1			< 10	800	15000	25000	
Fluoride ^U		< 0.5			< 5	10	150	500	
Sulphate ^U		1488			14892	1000	20000	50000	
TDS		1206			12067	4000	60000	100000	
Phenol Index		< 0.01			< 0.1	1	-	-	
DOC		2.8			27.8	500	800	1000	
Leach Test Information									
Sample Mass (kg)		0.10							
Dry Matter (%)		87							
Moisture (%)		15							
Stage 1									
Volume Eluate L10 (litres)		0.89							

Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and QTS Environmental cannot be held responsible for any discrepancies with current legislation
M Denotes MCERTS accredited test
U Denotes ISO17025 accredited test



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Waste Acceptance Criteria Analytical Certificate - BS EN 12457/2									
QTS Environmental Report No: 16-46026		Date Sampled	22/06/16		Landfill Waste Acceptance Criteria Limits				
TerraConsult Ltd		Time Sampled	None Supplied						
Site Reference: Manchester Enterprise Academy		TP / BH No	TP123						
Project / Job Ref: 2859		Additional Refs	None Supplied						
Order No: 15517		Depth (m)	None Supplied						
Reporting Date: 06/07/2016		QTSE Sample No	214293						
Determinand	Unit	MDL							
TOC ^{MU}	%	< 0.1		2.3					
Loss on Ignition	%	< 0.01		5					
BTEX ^{MU}	mg/kg	< 0.05		< 0.05					
Sum of PCBs	mg/kg	< 0.1		< 0.1					
Mineral Oil ^{MU}	mg/kg	< 10		< 10					
Total PAH ^{MU}	mg/kg	< 1.7		< 1.7					
pH ^{MU}	pH Units	N/A		7.7					
Acid Neutralisation Capacity	mol/kg (+/-)	< 1		< 1					
Eluate Analysis			10:1 mg/l			Cumulative 10:1 mg/kg	Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)		
Arsenic ^U		< 0.01			< 0.1	0.5	2	25	
Barium ^U		0.03			0.3	20	100	300	
Cadmium ^U		< 0.0005			< 0.005	0.04	1	5	
Chromium ^U		< 0.005			< 0.05	0.5	10	70	
Copper ^U		< 0.01			< 0.1	2	50	100	
Mercury ^U		< 0.0005			< 0.01	0.01	0.2	2	
Molybdenum ^U		0.004			0.04	0.5	10	30	
Nickel ^U		< 0.007			< 0.07	0.4	10	40	
Lead ^U		< 0.005			< 0.05	0.5	10	50	
Antimony ^U		< 0.005			< 0.05	0.06	0.7	5	
Selenium ^U		< 0.005			< 0.05	0.1	0.5	7	
Zinc ^U		< 0.005			< 0.05	4	50	200	
Chloride ^U		< 1			< 10	800	15000	25000	
Fluoride ^U		0.6			6.2	10	150	500	
Sulphate ^U		5			49	1000	20000	50000	
TDS		109			1090	4000	60000	100000	
Phenol Index		< 0.01			< 0.1	1	-	-	
DOC		9			89.7	500	800	1000	
Leach Test Information									
Sample Mass (kg)			0.11						
Dry Matter (%)			82.9						
Moisture (%)			20.8						
Stage 1									
Volume Eluate L10 (litres)			0.88						
Results are expressed on a dry weight basis, after correction for moisture content where applicable Stated limits are for guidance only and QTS Environmental cannot be held responsible for any discrepancies with current legislation M Denotes MCERTS accredited test U Denotes ISO17025 accredited test									



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Waste Acceptance Criteria Analytical Certificate - BS EN 12457 / 2									
QTS Environmental Report No: 16-46026		Date Sampled		24/06/16		Landfill Waste Acceptance Criteria Limits Inert Waste Landfill Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill Hazardous Waste Landfill			
TerraConsult Ltd		Time Sampled		None Supplied					
Site Reference: Manchester Enterprise Academy		TP / BH No		WS109					
Project / Job Ref: 2859		Additional Refs		None Supplied					
Order No: 15517		Depth (m)		0.40					
Reporting Date: 06/07/2016		QTSE Sample No		214294					
Determinand	Unit	MDL							
TOC ^{MU}	%	< 0.1		0.5					
Loss on Ignition	%	< 0.01		1.40					
BTEX ^{MU}	mg/kg	< 0.05		< 0.05					
Sum of PCBs	mg/kg	< 0.1		< 0.1					
Mineral Oil ^{MU}	mg/kg	< 10		< 10					
Total PAH ^{MU}	mg/kg	< 1.7		< 1.7					
pH ^{MU}	pH Units	N/A		8.8					
Acid Neutralisation Capacity	mol/kg (+/-)	< 1		1.6					
Eluate Analysis				10:1 mg/l		Cumulative 10:1 mg/kg		Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)	
Arsenic ^U				< 0.01		< 0.1		0.5	2
Barium ^U				0.03		0.3		20	100
Cadmium ^U				< 0.0005		< 0.005		0.04	1
Chromium ^U				< 0.005		< 0.05		0.5	10
Copper ^U				< 0.01		< 0.1		2	50
Mercury ^U				< 0.0005		< 0.01		0.01	0.2
Molybdenum ^U				0.044		0.44		0.5	10
Nickel ^U				< 0.007		< 0.07		0.4	10
Lead ^U				< 0.005		< 0.05		0.5	10
Antimony ^U				< 0.005		< 0.05		0.06	0.7
Selenium ^U				< 0.005		< 0.05		0.1	0.5
Zinc ^U				< 0.005		< 0.05		4	50
Chloride ^U				3		33		800	15000
Fluoride ^U				0.6		5.5		10	150
Sulphate ^U				39		388		1000	20000
TDS				124		1240		4000	60000
Phenol Index				< 0.01		< 0.1		1	-
DOC				5.1		50.9		500	800
Leach Test Information									
Sample Mass (kg)				0.11					
Dry Matter (%)				84.7					
Moisture (%)				18.2					
Stage 1									
Volume Eluate L10 (litres)				0.88					
Results are expressed on a dry weight basis, after correction for moisture content where applicable Stated limits are for guidance only and QTS Environmental cannot be held responsible for any discrepancies with current legislation M Denotes MCERTS accredited test U Denotes ISO17025 accredited test									

Waste Acceptance Criteria Analytical Certificate - BS EN 12457 / 2									
QTS Environmental Report No: 16-46026		Date Sampled		24/06/16		Landfill Waste Acceptance Criteria Limits Inert Waste Landfill Stable Non-reactive HAZARDOUS waste in non-hazardous Landfill Hazardous Waste Landfill			
TerraConsult Ltd		Time Sampled		None Supplied					
Site Reference: Manchester Enterprise Academy		TP / BH No		TP117					
Project / Job Ref: 2859		Additional Refs		None Supplied					
Order No: 15517		Depth (m)		0.35					
Reporting Date: 06/07/2016		QTSE Sample No		214295					
Determinand		Unit		MDL					
TOC ^{MU}		%		< 0.1		1.9			
Loss on Ignition		%		< 0.01		5.70			
BTEX ^{MU}		mg/kg		< 0.05		< 0.05			
Sum of PCBs		mg/kg		< 0.1		< 0.1			
Mineral Oil ^{MU}		mg/kg		< 10		< 10			
Total PAH ^{MU}		mg/kg		< 1.7		2.4			
pH ^{MU}		pH Units		N/A		7.5			
Acid Neutralisation Capacity		mol/kg (+/-)		< 1		< 1			
Eluate Analysis				10:1 mg/l		Cumulative 10:1 mg/kg		Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)	
Arsenic ^U				< 0.01		< 0.1		0.5 2 25	
Barium ^U				< 0.02		< 0.2		20 100 300	
Cadmium ^U				< 0.0005		< 0.005		0.04 1 5	
Chromium ^U				< 0.005		< 0.05		0.5 10 70	
Copper ^U				< 0.01		< 0.1		2 50 100	
Mercury ^U				< 0.0005		< 0.01		0.01 0.2 2	
Molybdenum ^U				0.001		0.01		0.5 10 30	
Nickel ^U				< 0.007		< 0.07		0.4 10 40	
Lead ^U				< 0.005		< 0.05		0.5 10 50	
Antimony ^U				< 0.005		< 0.05		0.06 0.7 5	
Selenium ^U				< 0.005		< 0.05		0.1 0.5 7	
Zinc ^U				0.051		0.51		4 50 200	
Chloride ^U				< 1		< 10		800 15000 25000	
Fluoride ^U				< 0.5		< 5		10 150 500	
Sulphate ^U				< 1		< 10		1000 20000 50000	
TDS				32		320		4000 60000 100000	
Phenol Index				< 0.01		< 0.1		1 - -	
DOC				8		80.4		500 800 1000	
Leach Test Information									
Sample Mass (kg)				0.11					
Dry Matter (%)				84.8					
Moisture (%)				18					
Stage 1									
Volume Eluate L10 (litres)				0.88					
Results are expressed on a dry weight basis, after correction for moisture content where applicable Stated limits are for guidance only and QTS Environmental cannot be held responsible for any discrepancies with current legislation M Denotes MCERTS accredited test U Denotes ISO17025 accredited test									



QTS Environmental Ltd
Unit 1, Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate - Sample Descriptions

QTS Environmental Report No: 16-46026

TerraConsult Ltd

Site Reference: Manchester Enterprise Academy

Project / Job Ref: 2859

Order No: 15517

Reporting Date: 06/07/2016

QTSE Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
214291	WS101	None Supplied	0.50	13.3	Brown clay with vegetation
214292	WS105	None Supplied	0.30	13	Brown sandy clay with concrete and brick
214293	TP123	None Supplied	None Supplied	17.1	Brown clay
214294	WS109	None Supplied	0.40	15.3	Brown clay with vegetation
214295	TP117	None Supplied	0.35	15.2	Brown clay with vegetation
214296	TP116	None Supplied	0.60	15.7	Green clay
214297	WS103	None Supplied	1.00	10.6	Brown clay
214299	TP121	None Supplied	0.80	16	Brown clay with stones
214300	TP118	None Supplied	0.40	12.3	Brown clay
214301	WS108	None Supplied	0.50	13.7	Brown clay
214302	WS110	None Supplied	0.25	23.4	Brown clay with brick and plastic
214303	TP120	None Supplied	1.00	16.6	Light brown clay
214304	TP122	None Supplied	0.50	18.5	Brown clay
214305	WS112	None Supplied	0.15	23.3	Brown clay
214306	WS111	None Supplied	0.80	12.9	Light brown clay
214307	TP126	None Supplied	0.25	21.1	Brown clay with vegetation
214308	TP127	None Supplied	0.70	11.7	Brown clay
214309	WS115	None Supplied	0.20	20.9	Brown clay with vegetation
214310	WS102	None Supplied	0.60	11.8	Brown clay with stones
214311	WS104	None Supplied	0.40	12.8	Brown clay with vegetation
214312	WS107	None Supplied	0.30	3.4	Brown sandy clay with stones and concrete
214313	WS111	None Supplied	0.30	20.1	Brown clay
214314	WS114	None Supplied	0.25	15.9	Brown clay with vegetation
214315	WS115	None Supplied	0.75	14.1	Brown clay

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample ^{I/S}

Unsuitable Sample ^{U/S}



QTS Environmental Ltd
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Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
Tel : 01622 850410



Soil Analysis Certificate - Methodology & Miscellaneous Information

QTS Environmental Report No: 16-46026

TerraConsult Ltd

Site Reference: Manchester Enterprise Academy

Project / Job Ref: 2859

Order No: 15517

Reporting Date: 06/07/2016

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 dphenylcarbazine followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 - C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCS	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received

Scientific Analysis Laboratories Ltd

Certificate of Analysis

Report Number: Supplemental to 582737-1

Date of Report: 18-Jul-2016

Customer: TerraConsult Limited
Unit 34
Bold Business Centre
Bold Lane
Sutton
St Helens
WA9 4TX

Customer Contact: Mr Liam McMahon

Customer Job Reference: 2859

Customer Purchase Order: 15531

Customer Site Reference: MEA Wythenshawe

Date Job Received at SAL: 04-Jul-2016

Date Analysis Started: 06-Jul-2016

Date Analysis Completed: 14-Jul-2016

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

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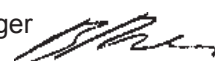
Tests covered by this certificate were conducted in accordance with SAL SOPs

All results have been reviewed in accordance with Section 25 of the SAL Quality Manual



Report checked
and authorised by :
Bianca Prince
Customer Service Manager

Issued by :
Bianca Prince
Customer Service Manager



SAL Reference: 582737 Project Site: MEA Wythenshawe Customer Reference: 2859 Water Analysed as Water Heavy Metals(9)						
SAL Reference				582737 001	582737 002	
Customer Sample Reference				WS101	WS115	
Date Sampled				04-JUL-2016	04-JUL-2016	
Determinand	Method	Test Sample	LOD	Units		
As (Dissolved)	T281	AR	0.2	µg/l	4.7	4.5
Cd (Dissolved)	T281	AR	0.02	µg/l	<0.02	<0.02
Cr (Dissolved)	T281	AR	1	µg/l	4	<1
Cu (Dissolved)	T281	AR	0.5	µg/l	5.1	9.2
Pb (Dissolved)	T281	AR	0.3	µg/l	<0.3	<0.3
Hg (Dissolved)	T281	AR	0.05	µg/l	<0.05	<0.05
Ni (Dissolved)	T281	AR	1	µg/l	4	10
Se (Dissolved)	T281	AR	0.5	µg/l	1.1	4.9
Zn (Dissolved)	T281	AR	2	µg/l	<2	3

SAL Reference: 582737								
Project Site: MEA Wythenshawe								
Customer Reference: 2859								
Water		Analysed as Water						
Suite D								
SAL Reference					582737 001	582737 002	582737 003	582737 004
Customer Sample Reference					WS101	WS115	WS111	WS114
Date Sampled					04-JUL-2016	04-JUL-2016	04-JUL-2016	04-JUL-2016
Determinand	Method	Test Sample	LOD	Units				
Ammonia expressed as NH4	T686	AR	0.05	mg/l	-	-	0.19	0.76
Chloride	T686	AR	1	mg/l	28	8	10	13
Magnesium	T6	AR	0.1	mg/l	-	-	15	30
Nitrate	T686	AR	0.5	mg/l	<0.5	<0.5	<0.5	<0.5
pH	T7	AR			8.6	7.9	7.4	7.1
Sulphate	T686	AR	0.5	mg/l	1200	25	120	130
Sulphur (total)	T65	AR	0.01	mg/l	-	-	300	300

SAL Reference: 582737 Project Site: MEA Wythenshawe Customer Reference: 2859 Water Analysed as Water TerraConsult 3						
SAL Reference			582737 001	582737 002		
Customer Sample Reference			WS101	WS115		
Date Sampled			04-JUL-2016	04-JUL-2016		
Determinand	Method	Test Sample	LOD	Units		
Alkalinity expressed as CaCO ₃	T22	AR	10	mg/l	100	370
Ammoniacal nitrogen	T686	AR	0.05	mg/l	0.11	0.11
Boron	T6	AR	0.01	mg/l	0.37	0.09
Chloride	T686	AR	1	mg/l	28	8
Cyanide(Total)	T4	AR	0.05	mg/l	<0.05	<0.05
Electrical Conductivity	T7	AR	10	µS/cm	1900	750
Hardness expressed as CaCO ₃	T6	AR	10	mg/l	1700	310
Nitrate	T686	AR	0.5	mg/l	<0.5	<0.5
pH	T7	AR			8.6	7.9
Sulphate	T686	AR	0.5	mg/l	1200	25
Total Phenols	T16	AR	0.5	µg/l	⁽¹³⁾ 20	⁽¹³⁾ 1.1
TPH (Aliphatic+Aromatic) C10-C40 (Sum)	T85	AR	0.01	mg/l	⁽¹³⁾ 0.41	⁽¹³⁾ 0.21
TPH (C35-C40 aliphatic)	T81	AR	0.01	mg/l	^(13,100) <0.03	^(100,13) <0.03
TPH (C35-C40 aromatic)	T81	AR	0.01	mg/l	^(100,13) <0.03	^(100,13) <0.03

U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Notes

Supplemental report to report amended Sulphur results

Method Index

Value	Description
T85	Calc
T54	GC/MS (Headspace)
T215	GC/MS (Headspace)(LV)
T81	GC/FID (LV)
T16	GC/MS
T7	Probe
T686	Discrete Analyser
T281	ICP/MS (Filtered)
T22	Titration
T6	ICP/OES
T65	ICP/OES (Preconc.)
T149	GC/MS (SIR)
T4	Colorimetry

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
As (Dissolved)	T281	AR	0.2	µg/l	U	001-002
Cd (Dissolved)	T281	AR	0.02	µg/l	U	001-002
Cr (Dissolved)	T281	AR	1	µg/l	U	001-002
Cu (Dissolved)	T281	AR	0.5	µg/l	U	001-002
Pb (Dissolved)	T281	AR	0.3	µg/l	U	001-002
Hg (Dissolved)	T281	AR	0.05	µg/l	U	001-002
Ni (Dissolved)	T281	AR	1	µg/l	U	001-002
Se (Dissolved)	T281	AR	0.5	µg/l	U	001-002
Zn (Dissolved)	T281	AR	2	µg/l	U	001-002
Ammonia expressed as NH ₄	T686	AR	0.05	mg/l	U	003-004
Chloride	T686	AR	1	mg/l	U	001-004
Magnesium	T6	AR	0.1	mg/l	N	003-004
Sulphate	T686	AR	0.5	mg/l	U	001-004
Sulphur (total)	T65	AR	0.01	mg/l	N	003-004
Alkalinity expressed as CaCO ₃	T22	AR	10	mg/l	N	001-002
Ammoniacal nitrogen	T686	AR	0.05	mg/l	U	001-002
Boron	T6	AR	0.01	mg/l	N	001-002
Cyanide(Total)	T4	AR	0.05	mg/l	U	001-002
Electrical Conductivity	T7	AR	10	µS/cm	N	001-002
Hardness expressed as CaCO ₃	T6	AR	10	mg/l	N	001-002
Nitrate	T686	AR	0.5	mg/l	U	001-004
pH	T7	AR			U	001-004
Total Phenols	T16	AR	0.5	µg/l	U	001-002
TPH (Aliphatic+Aromatic) C10-C40 (Sum)	T85	AR	0.01	mg/l	N	001-002
TPH (C35-C40 aliphatic)	T81	AR	0.01	mg/l	N	001-002
TPH (C35-C40 aromatic)	T81	AR	0.01	mg/l	N	001-002
Benzene	T54	AR	1	µg/l	U	001-002
EthylBenzene	T54	AR	1	µg/l	U	001-002
M/P Xylene	T54	AR	1	µg/l	U	001-002
Methyl tert-Butyl Ether	T54	AR	1	µg/l	U	001-002
O Xylene	T54	AR	1	µg/l	U	001-002
Toluene	T54	AR	1	µg/l	U	001-002
TPH (C5-C6 aliphatic)	T215	AR	0.010	mg/l	N	001-002
TPH (C6-C8 aliphatic)	T215	AR	0.010	mg/l	N	001-002
TPH (C8-C10 aliphatic)	T215	AR	0.010	mg/l	N	001-002
TPH DW(C10-C12 aliphatic)	T81	AR	0.01	mg/l	N	001-002
TPH DW(C12-C16 aliphatic)	T81	AR	0.01	mg/l	N	001-002
TPH DW(C16-C21 aliphatic)	T81	AR	0.01	mg/l	N	001-002
TPH DW(C21-C35 aliphatic)	T81	AR	0.01	mg/l	N	001-002
TPH (C6-C7 aromatic)	T215	AR	0.010	mg/l	N	001-002
TPH (C7-C8 aromatic)	T215	AR	0.010	mg/l	N	001-002

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
TPH (C8-C10 aromatic)	T215	AR	0.010	mg/l	N	001-002
TPH DW(C10-C12 aromatic)	T81	AR	0.01	mg/l	N	001-002
TPH DW(C12-C16 aromatic)	T81	AR	0.01	mg/l	N	001-002
TPH DW(C16-C21 aromatic)	T81	AR	0.01	mg/l	N	001-002
TPH DW(C21-C35 aromatic)	T81	AR	0.01	mg/l	N	001-002
Naphthalene	T149	AR	0.01	µg/l	U	001-002
Acenaphthylene	T149	AR	0.01	µg/l	U	001-002
Acenaphthene	T149	AR	0.01	µg/l	U	001-002
Fluorene	T149	AR	0.01	µg/l	U	001-002
Phenanthrene	T149	AR	0.01	µg/l	U	001-002
Anthracene	T149	AR	0.01	µg/l	U	001-002
Fluoranthene	T149	AR	0.01	µg/l	U	001-002
Pyrene	T149	AR	0.01	µg/l	U	001-002
Benzo(a)Anthracene	T149	AR	0.01	µg/l	U	001-002
Chrysene	T149	AR	0.01	µg/l	U	001-002
Benzo(b)fluoranthene	T149	AR	0.01	µg/l	U	001-002
Benzo(k)fluoranthene	T149	AR	0.01	µg/l	U	001-002
Benzo(a)Pyrene	T149	AR	0.01	µg/l	U	001-002
Indeno(123-cd)Pyrene	T149	AR	0.01	µg/l	U	001-002
Dibenzo(ah)Anthracene	T149	AR	0.01	µg/l	U	001-002
Benzo(ghi)Perylene	T149	AR	0.01	µg/l	U	001-002
PAH(total)	T149	AR	0.01	µg/l	U	001-002



Scientific Analysis Laboratories Ltd

Certificate of Analysis

Report Number: 584193-1

Date of Report: 20-Jul-2016

Customer: TerraConsult Limited
Unit 34
Bold Business Centre
Bold Lane
Sutton
St Helens
WA9 4TX

Customer Contact: Mr Chris Eccles

Customer Job Reference: 2859

Customer Purchase Order: 15531

Customer Site Reference: MEA Wythenshawe

Date Job Received at SAL: 11-Jul-2016

Date Analysis Started: 11-Jul-2016

Date Analysis Completed: 18-Jul-2016

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

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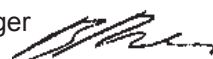
Tests covered by this certificate were conducted in accordance with SAL SOPs

All results have been reviewed in accordance with Section 25 of the SAL Quality Manual



Report checked
and authorised by :
Bianca Prince
Customer Service Manager

Issued by :
Bianca Prince
Customer Service Manager



SAL Reference: 584193 Project Site: MEA Wythenshawe Customer Reference: 2859 Water Suite D					
Analysed as Water					
SAL Reference					584193 001
Customer Sample Reference					WS101
Date Sampled					11-JUL-2016
Determinand	Method	Test Sample	LOD	Units	
Ammonia expressed as NH ₄	T686	AR	0.05	mg/l	0.26
Chloride	T686	AR	1	mg/l	34
Magnesium	T6	AR	0.1	mg/l	20
Nitrate	T686	AR	0.5	mg/l	18
pH	T7	AR			6.9
Sulphate	T686	AR	0.5	mg/l	1200
Sulphur (total)	T65	AR	0.01	mg/l	7200

Index to symbols used in 584193-1

Value	Description
AR	As Received
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Method Index

Value	Description
T7	Probe
T6	ICP/OES
T65	ICP/OES (Preconc.)
T686	Discrete Analyser

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Ammonia expressed as NH ₄	T686	AR	0.05	mg/l	U	001
Chloride	T686	AR	1	mg/l	U	001
Magnesium	T6	AR	0.1	mg/l	N	001
Nitrate	T686	AR	0.5	mg/l	U	001
pH	T7	AR			U	001
Sulphate	T686	AR	0.5	mg/l	U	001
Sulphur (total)	T65	AR	0.01	mg/l	N	001

APPENDIX G

Laboratory Geotechnical Test Results

**Nick Frost**

TerraConsult Ltd
Bold Business Centre
Bold Lane
Sutton
St Helens
Merseyside
WA9 4TX

t: 01925 291111
f: 01925 291191
e: nickfrost@terraconsult.co.uk

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 16-21074

Project / Site name:	Manchester Academy	Samples received on:	27/06/2016
Your job number:	2859	Samples instructed on:	27/06/2016
Your order number:	PO15507	Analysis completed by:	08/07/2016
Report Issue Number:	1	Report issued on:	08/07/2016
Samples Analysed:	3 soil samples		

Signed:

Dr Irma Doyle
Senior Account Manager
For & on behalf of i2 Analytical Ltd.

Signed:

Emma Winter
Assistant Reporting Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Analytical Report Number: 16-21074

Project / Site name: Manchester Academy

Your Order No: PO15507

Lab Sample Number				593021	593022	593023		
Sample Reference				WS1	WS2	WS3		
Sample Number				None Supplied	None Supplied	None Supplied		
Depth (m)				2.00	1.60	2.00-1.45		
Date Sampled				21/06/2016	21/06/2016	21/06/2016		
Time Taken				None Supplied	None Supplied	None Supplied		
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		

Geotechnical

Geotechnical Testing - Various		N/A	NONE	See attached	See attached	See attached		
--------------------------------	--	-----	------	--------------	--------------	--------------	--	--



Analytical Report Number : 16-21074

Project / Site name: Manchester Academy

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Geotechnical Testing in Soil	See attached geotechnical report	See attached geotechnical report		W	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.



TEST CERTIFICATE

Determination of Moisture Content

Tested in Accordance with BS 1377-2:1990: Clause 3.2

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Client: TerraConsult Ltd
Client Address: Bold Business Centre
Bold Lane, Sutton
St Helens, Merseyside
WA9 4TX
Contact: Nick Frost
Site Name: Manchester Academy
Site Address: Not Given

Client Reference: 2859
Job Number: 16-21074
Date Sampled: 21/06/2016
Date Received: 27/06/2016
Date Tested: 05/07/2016
Sampled By: NHF

Test results

Laboratory Reference	Sample Reference	Location	Depth Top [m]	Depth Base [m]	Sample Type	Description	Moisture Content [%]
593021	Not Given	WS1	2	Not Given	D	Yellowish brown slightly sandy silty CLAY	23
593022	Not Given	WS2	1.6	Not Given	D	Brownish grey slightly sandy silty CLAY	20
593023	Not Given	WS3	2	Not Given	D	Brownish grey slightly sandy silty CLAY	15

Comments:

Approved:

Mirosława Pytlik
PL Head of Geotechnical section
Date Reported: 08/07/2016

Signed:

Terry Stafford
Geotechnical Manager

for and on behalf of i2 Analytical Ltd

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The results included within the report are representative of the samples submitted for analysis.
The analysis was carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Śląska, Poland."



TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in Accordance with BS1377-2: 1990: Clause 4.4 & 5: One Point Method

Client: TerraConsult Ltd
Client Address: Bold Business Centre
Bold Lane, Sutton
St Helens, Merseyside
WA9 4TX
Contact: Nick Frost
Site Name: Manchester Academy
Site Address: Not Given

Client Reference: 2859
Job Number: 16-21074
Date Sampled: 21/06/2016
Date Received: 27/06/2016
Date Tested: 07/05/2016
Sampled By: NHF

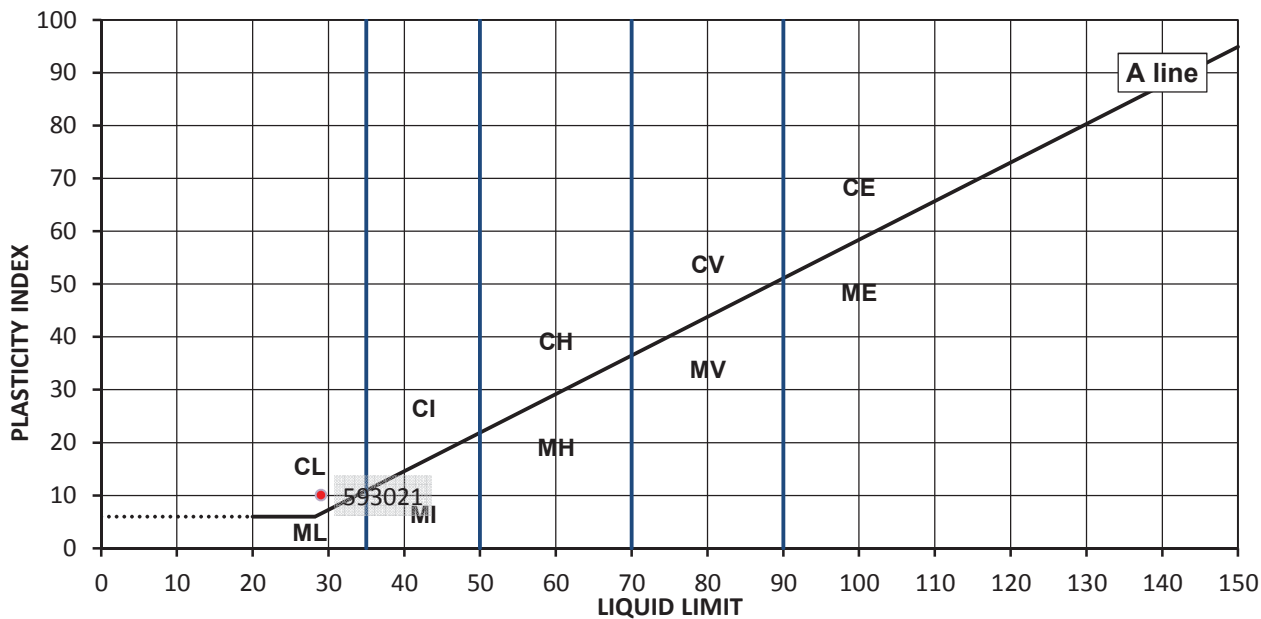
TEST RESULTS

Laboratory Reference: 593021
Sample Reference: Not Given

Description: Yellowish brown slightly sandy silty CLAY
Location: WS1
Sample Preparation: Tested in natural condition

Sample Type: ES
Depth Top [m]: 2
Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
23	29	19	10	100



Comments:

Approved:

Mirosława Pytlík
PL Head of Geotechnical section
Date Reported: 08/07/2016

Signed:

Terry Stafford
Geotechnical Manager

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in Accordance with BS1377-2: 1990: Clause 4.4 & 5: One Point Method

Client: TerraConsult Ltd
Client Address: Bold Business Centre
Bold Lane, Sutton
St Helens, Merseyside
WA9 4TX
Contact: Nick Frost
Site Name: Manchester Academy
Site Address: Not Given

Client Reference: 2859
Job Number: 16-21074
Date Sampled: 21/06/2016
Date Received: 27/06/2016
Date Tested: 07/05/2016
Sampled By: NHF

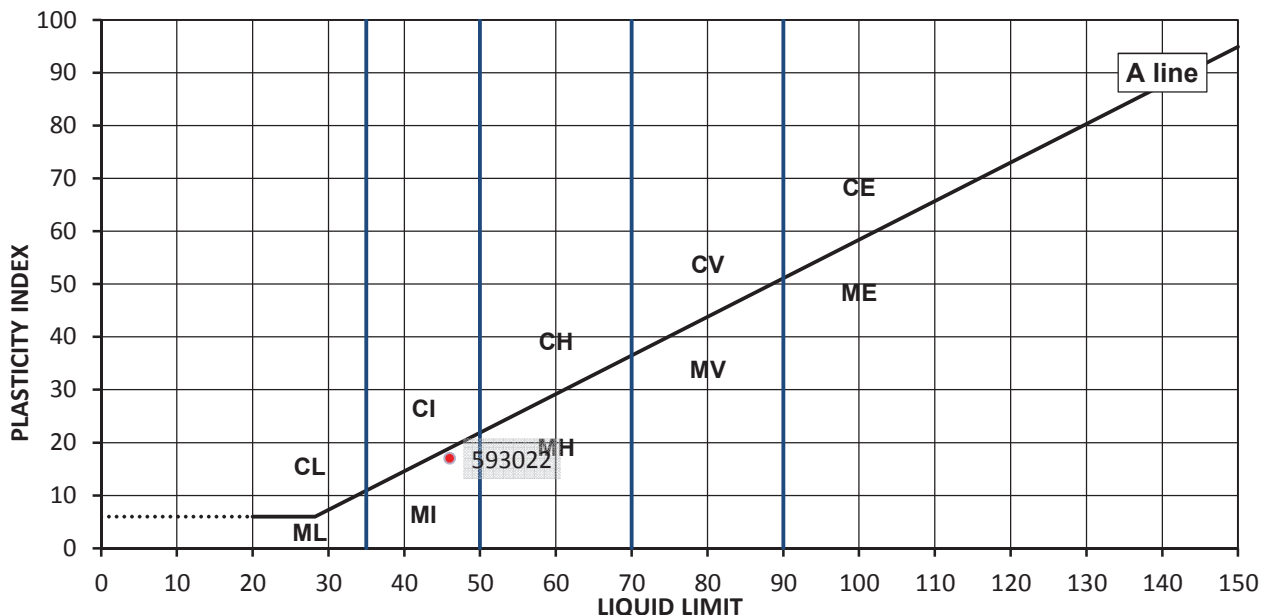
TEST RESULTS

Laboratory Reference: 593022
Sample Reference: Not Given

Description: Brownish grey slightly sandy silty CLAY
Location: WS2
Sample Preparation: Tested in natural condition

Sample Type: ES
Depth Top [m]: 1.6
Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
20	46	29	17	100



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

	Plasticity	Liquid Limit
C	Clay	
M	Silt	
L	Low	below 35
I	Medium	35 to 50
H	High	50 to 70
V	Very high	70 to 90
E	Extremely high	exceeding 90
O	Organic	append to classification for organic material (eg CHO)

Comments:

Approved:

Mirosława Pytlík
PL Head of Geotechnical section
Date Reported: 08/07/2016

Signed:

Terry Stafford
Geotechnical Manager

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in Accordance with BS1377-2: 1990: Clause 4.4 & 5: One Point Method

Client: TerraConsult Ltd
Client Address: Bold Business Centre
Bold Lane, Sutton
St Helens, Merseyside
WA9 4TX
Contact: Nick Frost
Site Name: Manchester Academy
Site Address: Not Given

Client Reference: 2859
Job Number: 16-21074
Date Sampled: 21/06/2016
Date Received: 27/06/2016
Date Tested: 07/05/2016
Sampled By: NHF

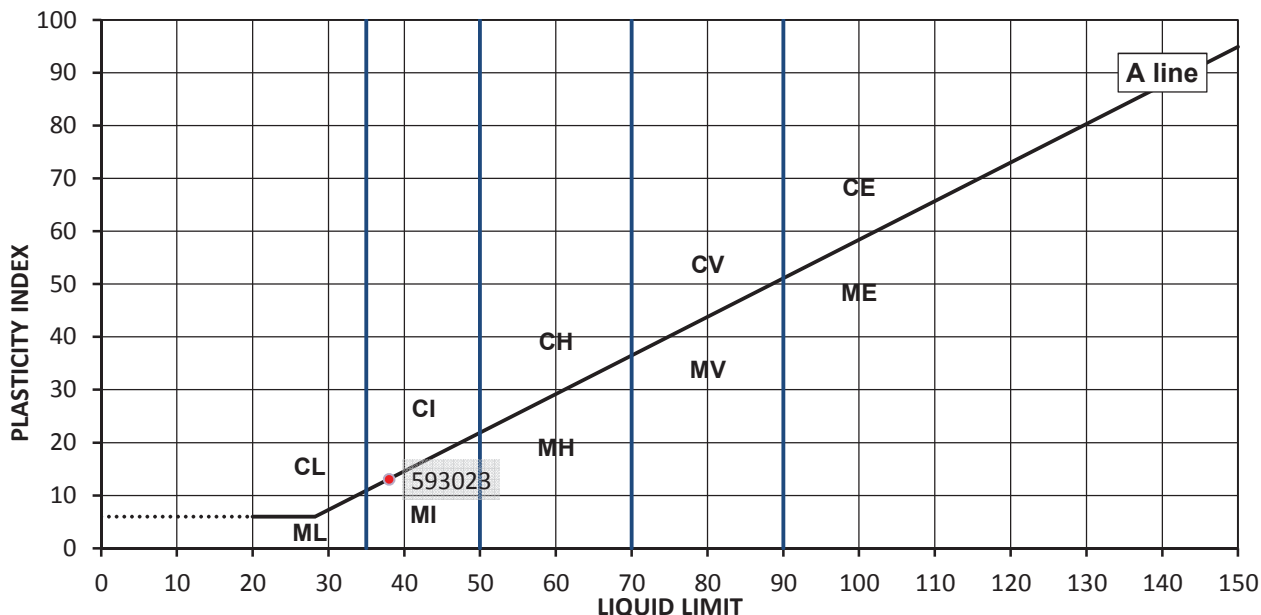
TEST RESULTS

Laboratory Reference: 593023
Sample Reference: Not Given

Description: Brownish grey slightly sandy silty CLAY
Location: WS3
Sample Preparation: Tested in natural condition

Sample Type: ES
Depth Top [m]: 2
Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
15	38	25	13	100



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

	Plasticity	Liquid Limit
C	Clay	
M	Silt	
L	Low	below 35
I	Medium	35 to 50
H	High	50 to 70
V	Very high	70 to 90
E	Extremely high	exceeding 90
O	Organic	append to classification for organic material (eg CHO)

Comments:

Approved:

Mirosława Pytlík
PL Head of Geotechnical section
Date Reported: 08/07/2016

Signed:

Terry Stafford
Geotechnical Manager

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Summary of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



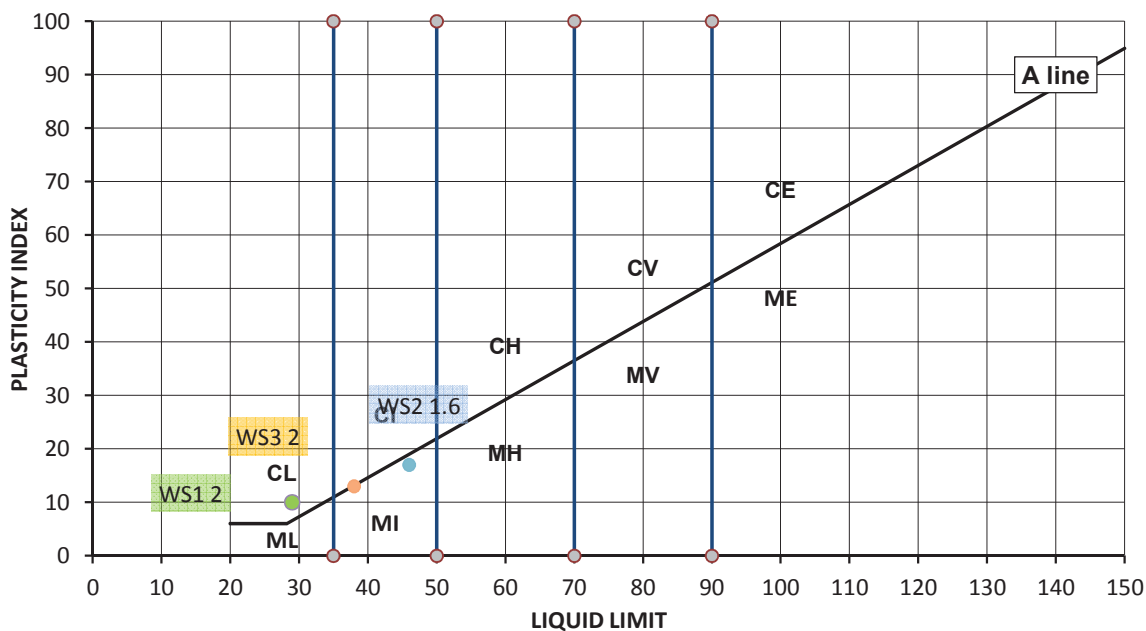
Tested in Accordance with BS1377-2: 1990: Clauses 4.4 & 5: One Point Method

Client: TerraConsult Ltd
Client Address: Bold Business Centre
Bold Lane, Sutton
St Helens, Merseyside
WA9 4TX
Contact: Not Given
Site Name: Manchester Academy
Site Address: Not Given

Client Reference: 2859
Job Number: 16-21074
Date Sampled: 21/06/2016
Date Received: 27/06/2016
Date Tested: 05/07/2016
Sampled By: NHF

TEST RESULTS

Location	Depth [m]	As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
WS1	2	23	29	19	10	100
WS2	1.6	20	46	29	17	100
WS3	2	15	38	25	13	100



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

	Plasticity	Liquid Limit
C	Clay	below 35
M	Silt	35 to 50
		50 to 70
		70 to 90
		exceeding 90
	Organic	
	O	append to classification for organic material (eg CHO)

Comments:

Approved: Mirosława Pytlík
PL Head of Geotechnical section

Mirosława Pytlík

Signed: Terry Stafford
Geotechnical Manager

Terry Stafford

Date Reported: 08/07/2016

for and on behalf of i2 Analytical Ltd

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4041

TEST CERTIFICATE**Determination of Particle Size Distribution**

Tested in Accordance with BS1377:Part 2:1990, clauses 9.2 and 9.5

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS

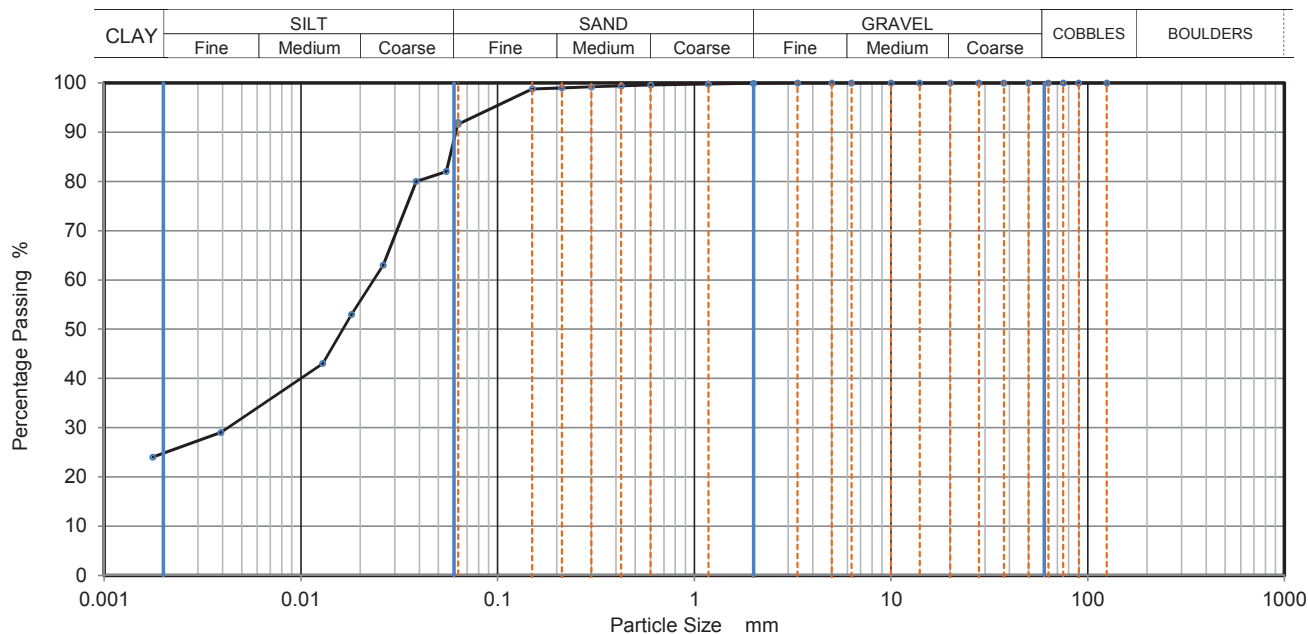


Client: TerraConsult Ltd
Client Address: Bold Business Centre
Bold Lane, Sutton
St Helens, Merseyside
WA9 4TX
Contact: Nick Frost
Site Name: Manchester Academy
Site Address: Not Given

Client Reference: 2859
Job Number: 16-21074
Date Sampled: 21/06/2016
Date Received: 27/06/2016
Date Tested: 07/05/2016
Sampled By: NHF

TEST RESULTS
Sample description: Yellowish brown slightly sandy silty CLAY
Location: WS1
Supplier: Not Given

Laboratory Reference: 593021
Sample Reference: Not Given
Sample Type: ES
Depth Top [m]: 2
Depth Base [m]: Not Given



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	92
90	100	0.0549	82
75	100	0.0386	80
63	100	0.0262	63
50	100	0.0181	53
37.5	100	0.0129	43
28	100	0.0039	29
20	100	0.0018	24
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100	Particle density (assumed)	
0.425	99	2.65	Mg/m3
0.3	99		
0.212	99		
0.15	99		
0.063	92		

Dry Mass of sample [g]: 320

Sample Proportions	% dry mass
Very coarse	0.00
Gravel	0.10
Sand	8.30
Silt	66.70
Clay	24.90

Grading Analysis		
D100	mm	3.35
D60	mm	0.0237
D30	mm	0.00428
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks
Preparation and testing in accordance with BS1377 unless noted below

Approved: *M. Pytlík*
Miroslawa Pytlík
PL Head of Geotechnical section
Date Reported: 08/07/2016

Signed: *T. Stafford*
Terry Stafford
Geotechnical Manager

for and on behalf of i2 Analytical Ltd

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The results included within the report are representative of the samples submitted for analysis.
The analysis was carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland.

**Nick Frost**

TerraConsult Ltd
Bold Business Centre
Bold Lane
Sutton
St Helens
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WA9 4TX

t: 01925 291111
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e: nickfrost@terraconsult.co.uk

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
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Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

Analytical Report Number : 16-21998

Project / Site name:	Manchester Academy	Samples received on:	29/06/2016
Your job number:	2859	Samples instructed on:	30/06/2016
Your order number:	PO15507	Analysis completed by:	14/07/2016
Report Issue Number:	1	Report issued on:	14/07/2016
Samples Analysed:	11 soil samples		

Signed:

Dr Irma Doyle
Senior Account Manager
For & on behalf of i2 Analytical Ltd.

Signed:

Emma Winter
Assistant Reporting Manager
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Analytical Report Number: 16-21998

Project / Site name: Manchester Academy

Your Order No: PO15507

Lab Sample Number				597893	597894	597895	597896	597897
Sample Reference				WS105	WS107	WS107	WS108	WS108
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				2.50-2.95	1.00	2.00	1.50	2.00
Date Sampled				22/06/2016	24/06/2016	24/06/2016	24/06/2016	24/06/2016
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		

Geotechnical

Geotechnical Testing - Various		N/A	NONE	See attached	See attached	See attached	See attached	See attached
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Analytical Report Number: 16-21998

Project / Site name: Manchester Academy

Your Order No: PO15507

Lab Sample Number				597898	597899	597900	597901	597902
Sample Reference				WS111	WS112	WS114	WS114	WS114
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.90	1.75	0.50	1.00	2.00
Date Sampled				24/06/2016	24/06/2016	24/06/2016	24/06/2016	24/06/2016
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		

Geotechnical

Geotechnical Testing - Various		N/A	NONE	See attached	See attached	See attached	See attached	See attached
--------------------------------	--	-----	------	--------------	--------------	--------------	--------------	--------------



Analytical Report Number: 16-21998

Project / Site name: Manchester Academy

Your Order No: PO15507

Lab Sample Number				597903				
Sample Reference				WS115				
Sample Number				None Supplied				
Depth (m)				2.00				
Date Sampled				24/06/2016				
Time Taken				None Supplied				
Analytical Parameter (Soil Analysis)				Units	Limit of detection	Accreditation Status		

Geotechnical

Geotechnical Testing - Various		N/A	NONE	See attached				
--------------------------------	--	-----	------	--------------	--	--	--	--



Analytical Report Number : 16-21998

Project / Site name: Manchester Academy

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Geotechnical Testing in Soil	See attached geotechnical report	See attached geotechnical report		W	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.



TEST CERTIFICATE

Determination of Moisture Content

Tested in Accordance with BS 1377-2:1990: Clause 3.2

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Client: TerraConsult Ltd
Client Address: Bold Business Centre
Bold Lane, Sutton
St Helens, Merseyside
WA9 4TX
Contact: Nick Frost
Site Name: Manchester Academy
Site Address: Not Given

Client Reference: 2859
Job Number: 16-21998
Date Sampled: 22/24/06/2016
Date Received: 30/06/2016
Date Tested: 11/07/2016
Sampled By: LM

Test results

Laboratory Reference	Sample Reference	Location	Depth Top [m]	Depth Base [m]	Sample Type	Description	Moisture Content [%]
597893	Not Given	WS105	2.5	2.95	D	Orangish brown silty CLAY	12
597894	Not Given	WS107	1	Not Given	D	Light grey to orangish brown silty CLAY with rootlets	14
597895	Not Given	WS107	2	Not Given	D	Orangish brown silty CLAY	13
597896	Not Given	WS108	1.5	Not Given	D	Light grey silty CLAY with thin laminae of pink silty clay	16
597897	Not Given	WS108	2	Not Given	D	Light grey silty CLAY with thin laminae of greenish grey clay	13
597898	Not Given	WS111	0.9	Not Given	D	Orangish brown slightly gravelly silty CLAY	15
597899	Not Given	WS112	1.75	Not Given	D	Light grey to greenish grey silty CLAY	16
597900	Not Given	WS114	0.5	Not Given	D	Yellowish brown silty CLAY with pocket of light brown sandy clay	22
597901	Not Given	WS114	1	Not Given	D	Orangish brown silty CLAY	22
597902	Not Given	WS114	2	Not Given	D	Orangish brown silty CLAY	11

Comments:

Approved:

Mirosława Pytlik
PL Head of Geotechnical section
Date Reported: 14/07/2016

Signed:

Terry Stafford
Geotechnical Manager

for and on behalf of i2 Analytical Ltd

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The analysis was carried out at i2 Analytical Limited, ul. Pionierow 39, 41-711 Ruda Slaska, Poland."



TEST CERTIFICATE

Determination of Moisture Content

Tested in Accordance with BS 1377-2:1990: Clause 3.2

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Client: TerraConsult Ltd
Client Address: Bold Business Centre
Bold Lane, Sutton
St Helens, Merseyside
WA9 4TX
Contact: Nick Frost
Site Name: Manchester Academy
Site Address: Not Given

Client Reference: 2859
Job Number: 16-21998
Date Sampled: 24/06/2016
Date Received: 30/06/2016
Date Tested: 11/07/2016
Sampled By: LM

Test results

Laboratory Reference	Sample Reference	Location	Depth Top [m]	Depth Base [m]	Sample Type	Description	Moisture Content [%]
597903	Not Given	WS115	2	Not Given	D	Orangish brown silty CLAY	8.4

Comments:

Approved:

Mirosława Pytlik
PL Head of Geotechnical section
Date Reported: 14/07/2016

Signed:

Terry Stafford
Geotechnical Manager

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in Accordance with BS1377-2: 1990: Clause 4.4 & 5: One Point Method

Client: TerraConsult Ltd
Client Address: Bold Business Centre
Bold Lane, Sutton
St Helens, Merseyside
WA9 4TX
Contact: Nick Frost
Site Name: Manchester Academy
Site Address: Not Given

Client Reference: 2859
Job Number: 16-21998
Date Sampled: 22/06/2016
Date Received: 30/06/2016
Date Tested: 11/07/2016
Sampled By: LM

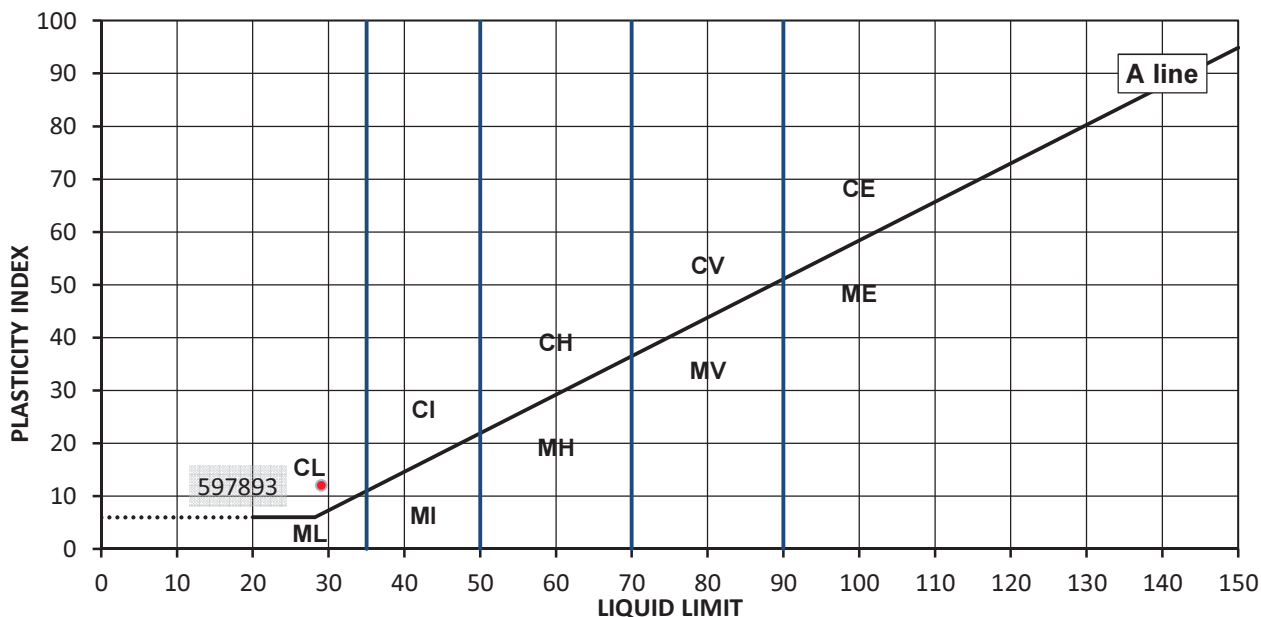
TEST RESULTS

Laboratory Reference: 597893
Sample Reference: Not Given

Description: Orangish brown silty CLAY
Location: WS105
Sample Preparation: Tested after >425um removed by hand

Sample Type: D
Depth Top [m]: 2.5
Depth Base [m]: 2.95

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
12	29	17	12	92



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

	Plasticity	Liquid Limit
C	Clay	
M	Silt	
L	Low	below 35
I	Medium	35 to 50
H	High	50 to 70
V	Very high	70 to 90
E	Extremely high	exceeding 90
O	Organic	append to classification for organic material (eg CHO)

Comments:

Approved:

Mirosława Pytlik
PL Head of Geotechnical section
Date Reported: 14/07/2016

Signed:

Terry Stafford
Geotechnical Manager

for and on behalf of i2 Analytical Ltd

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TEST CERTIFICATE

Determination of Liquid and Plastic Limits

i2 Analytical Ltd
7 Woodshots Meadow
Croxley Green Business Park
Watford Herts WD18 8YS



Tested in Accordance with BS1377-2: 1990: Clause 4.4 & 5: One Point Method

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Contact: Nick Frost
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Site Address: Not Given

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Sampled By: LM

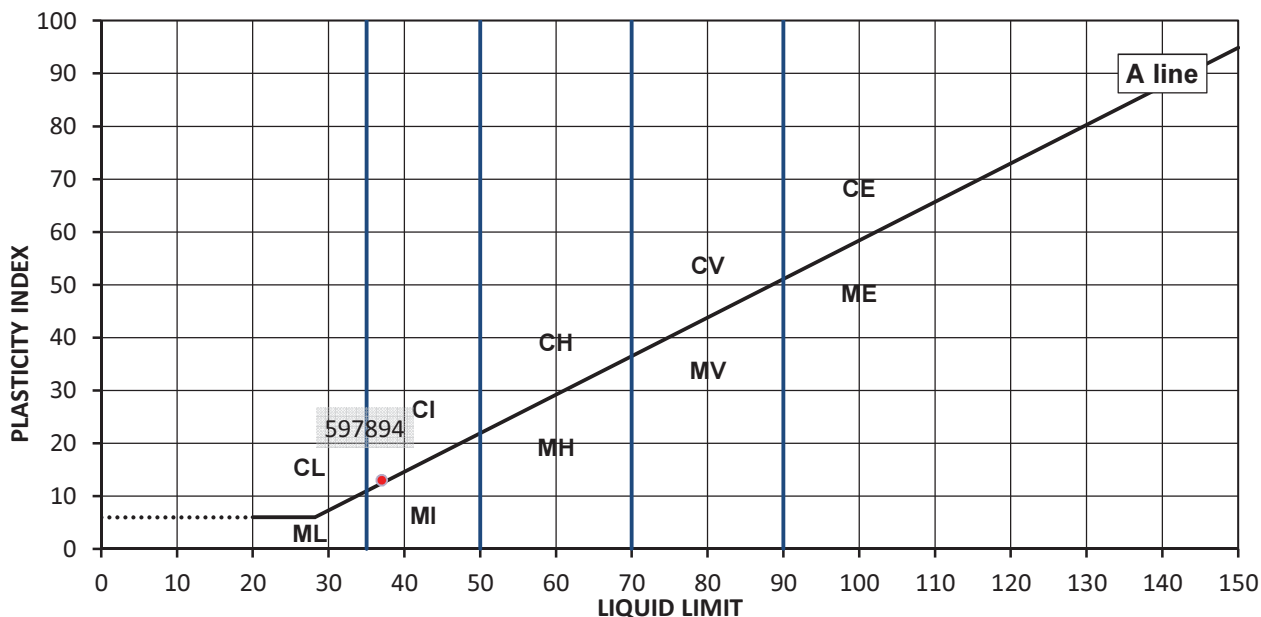
TEST RESULTS

Laboratory Reference: 597894
Sample Reference: Not Given

Description: Light grey to orangish brown silty CLAY with rootlets
Location: WS107
Sample Preparation: Tested in natural condition

Sample Type: D
Depth Top [m]: 1
Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
14	37	24	13	100



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

	Plasticity	Liquid Limit
C	Clay	below 35
M	Silt	35 to 50
	L	Low
	I	Medium
	H	High
	V	Very high
	E	Extremely high
Organic	O	append to classification for organic material (eg CHO)

Comments:

Approved:

Mirosława Pytlík
PL Head of Geotechnical section
Date Reported: 14/07/2016

Signed:

Terry Stafford
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Sampled By: LM

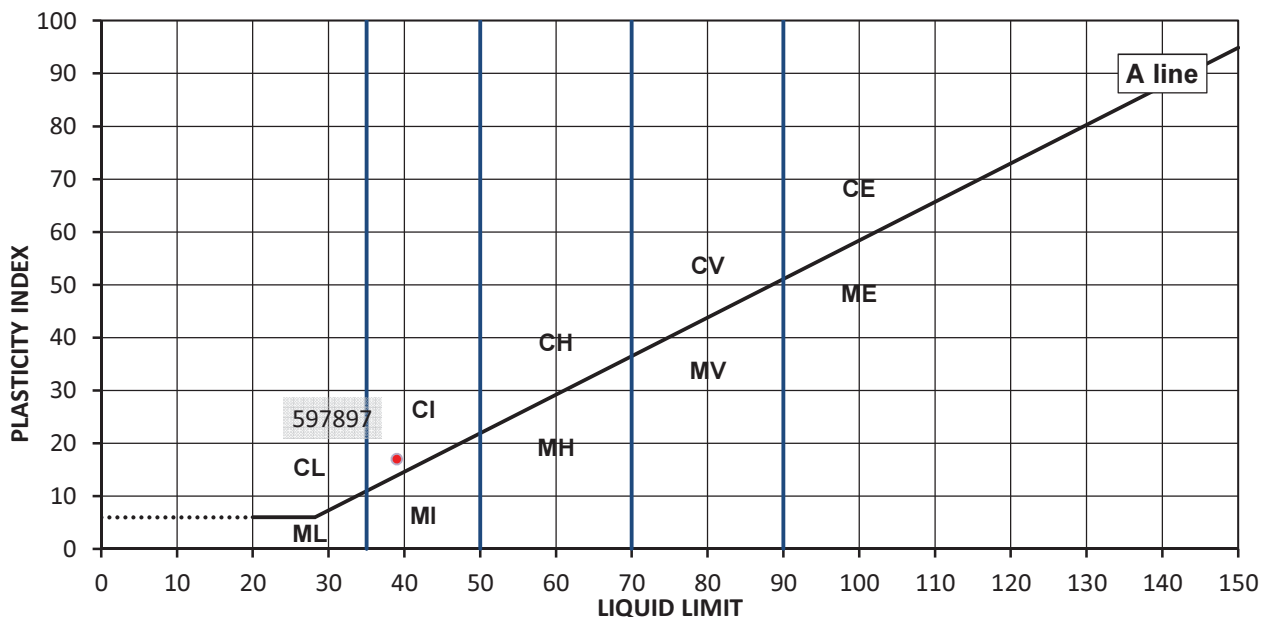
TEST RESULTS

Laboratory Reference: 597897
Sample Reference: Not Given

Description: Light grey silty CLAY with thin laminae of greenish grey clay
Location: WS108
Sample Preparation: Tested in natural condition

Sample Type: D
Depth Top [m]: 2
Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
13	39	22	17	100



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

	Plasticity	Liquid Limit
C	Clay	
M	Silt	
L	Low	below 35
I	Medium	35 to 50
H	High	50 to 70
V	Very high	70 to 90
E	Extremely high	exceeding 90
O	Organic	append to classification for organic material (eg CHO)

Comments:

Approved:

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TEST CERTIFICATE

Determination of Liquid and Plastic Limits

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Contact: Nick Frost
Site Name: Manchester Academy
Site Address: Not Given

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Sampled By: LM

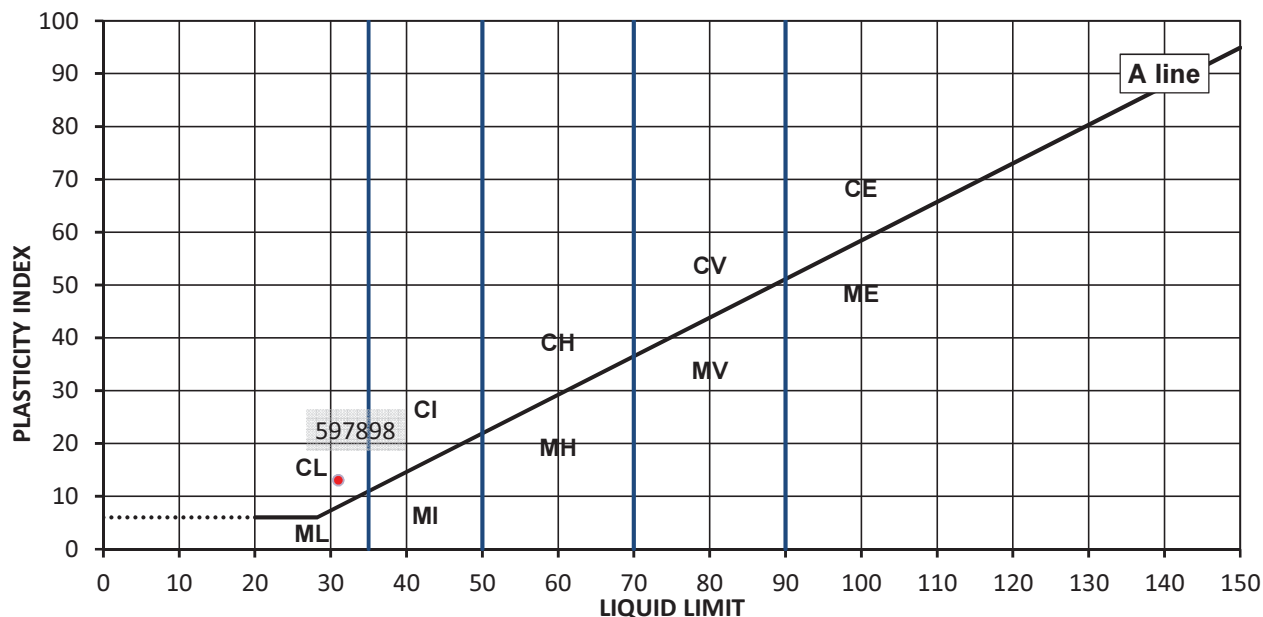
TEST RESULTS

Laboratory Reference: 597898
Sample Reference: Not Given

Description: Orangish brown slightly gravelly silty CLAY
Location: WS111
Sample Preparation: Tested after >425um removed by hand

Sample Type: D
Depth Top [m]: 0.9
Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
15	31	18	13	94



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

	Plasticity	Liquid Limit
C	Clay	
M	Silt	
L	Low	below 35
I	Medium	35 to 50
H	High	50 to 70
V	Very high	70 to 90
E	Extremely high	exceeding 90
O	Organic	append to classification for organic material (eg CHO)

Comments:

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Site Name: Manchester Academy
Site Address: Not Given

Client Reference: 2859
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Sampled By: LM

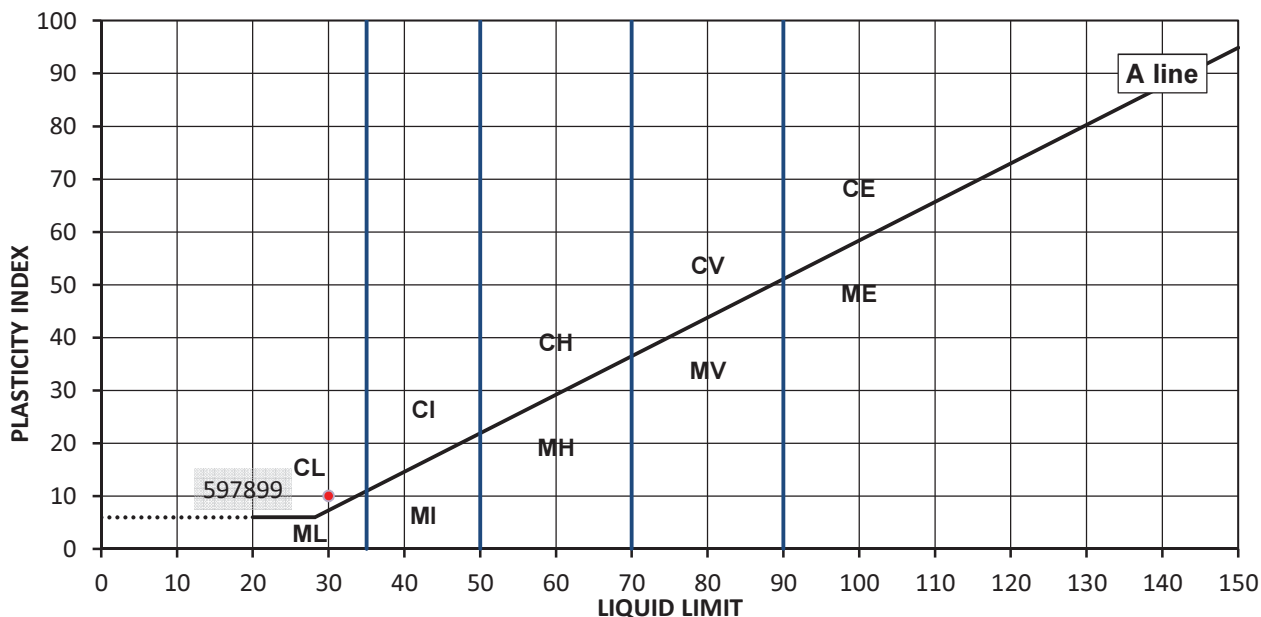
TEST RESULTS

Laboratory Reference: 597899
Sample Reference: Not Given

Description: Light grey to greenish grey silty CLAY
Location: WS112
Sample Preparation: Tested in natural condition

Sample Type: D
Depth Top [m]: 1.75
Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
16	30	20	10	100



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

	Plasticity	Liquid Limit
C	Clay	
M	Silt	
L	Low	below 35
I	Medium	35 to 50
H	High	50 to 70
V	Very high	70 to 90
E	Extremely high	exceeding 90
O	Organic	append to classification for organic material (eg CHO)

Comments:

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Sampled By: LM

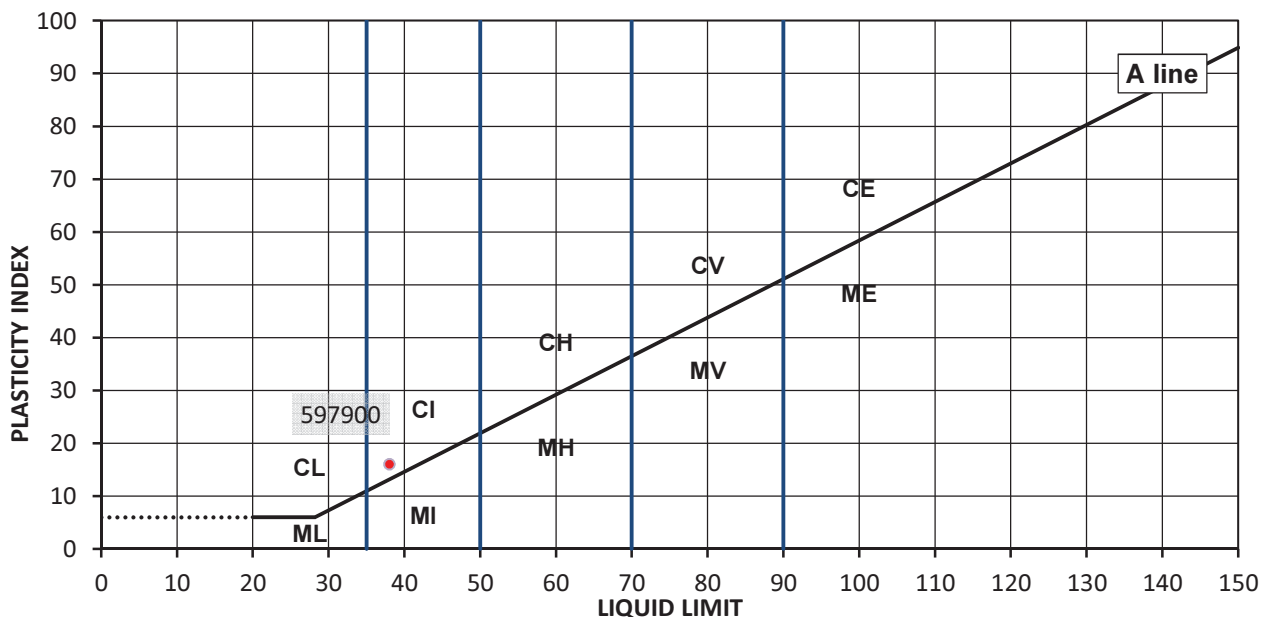
TEST RESULTS

Laboratory Reference: 597900
Sample Reference: Not Given

Description: Yellowish brown silty CLAY with pocket of light brown sandy clay
Location: WS114
Sample Preparation: Tested in natural condition

Sample Type: D
Depth Top [m]: 0.5
Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
22	38	22	16	100



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

	Plasticity	Liquid Limit
C	Clay	below 35
M	Silt	35 to 50
	L	Low
	I	Medium
	H	High
	V	Very high
	E	Exceeding 90
Organic	O	append to classification for organic material (eg CHO)

Comments:

Approved:

Mirosława Pytlik
PL Head of Geotechnical section
Date Reported: 14/07/2016

Signed:

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Site Address: Not Given

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Sampled By: LM

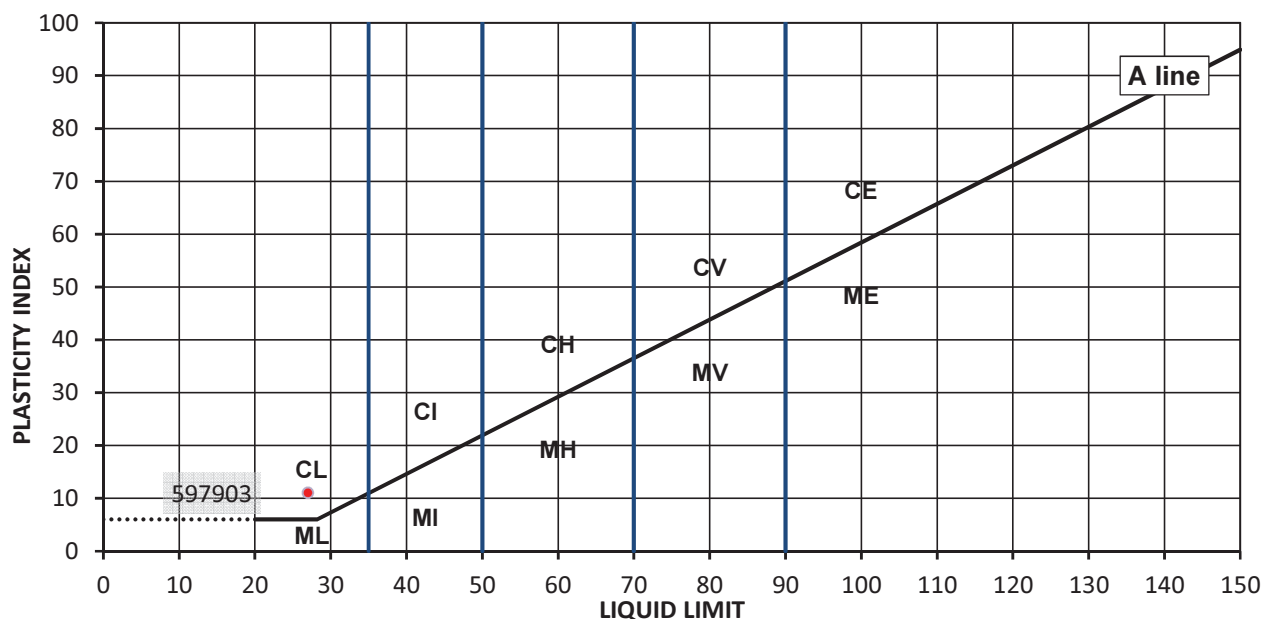
TEST RESULTS

Laboratory Reference: 597903
Sample Reference: Not Given

Description: Orangish brown silty CLAY
Location: WS115
Sample Preparation: Tested in natural condition

Sample Type: D
Depth Top [m]: 2
Depth Base [m]: Not Given

As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
8.4	27	16	11	100



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

	Plasticity	Liquid Limit
C	Clay	
M	Silt	
L	Low	below 35
I	Medium	35 to 50
H	High	50 to 70
V	Very high	70 to 90
E	Extremely high	exceeding 90
O	Organic	append to classification for organic material (eg CHO)

Comments:

Approved:

Mirosława Pytlík
PL Head of Geotechnical section
Date Reported: 14/07/2016

Signed:

Terry Stafford
Geotechnical Manager

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TEST CERTIFICATE

Summary of Liquid and Plastic Limits

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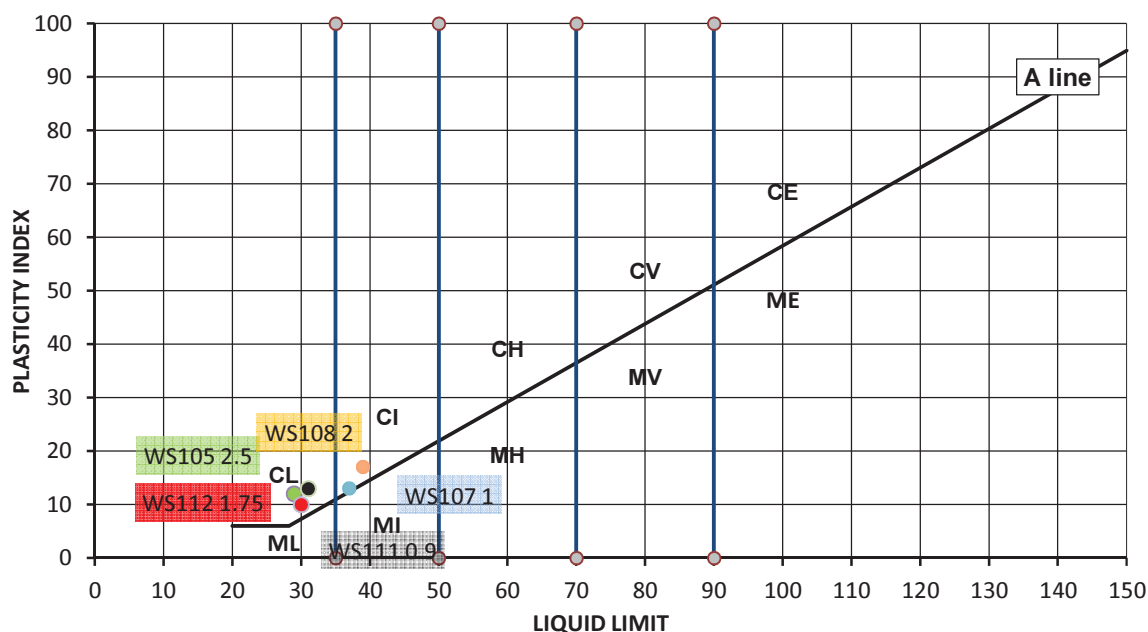
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Site Name: Manchester Academy
Site Address: Not Given

Client Reference: 2859
Job Number: 16-21998
Date Sampled: 22/24/06/2016
Date Received: 30/06/2016
Date Tested: 11/07/2016
Sampled By: LM

TEST RESULTS

Location	Depth [m]	As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
WS105	2.5	12	29	17	12	92
WS107	1	14	37	24	13	100
WS108	2	13	39	22	17	100
WS111	0.9	15	31	18	13	94
WS112	1.75	16	30	20	10	100



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

Plasticity		Liquid Limit
C	Clay	below 35
M	Silt	35 to 50
L	Low	50 to 70
I	Medium	70 to 90
H	High	exceeding 90
V	Very high	
E	Extremely high	
Organic		O append to classification for organic material (eg CHO)

Comments:

Approved: Mirosława Pytlík
PL Head of Geotechnical section

Signed: Terry Stafford
Geotechnical Manager

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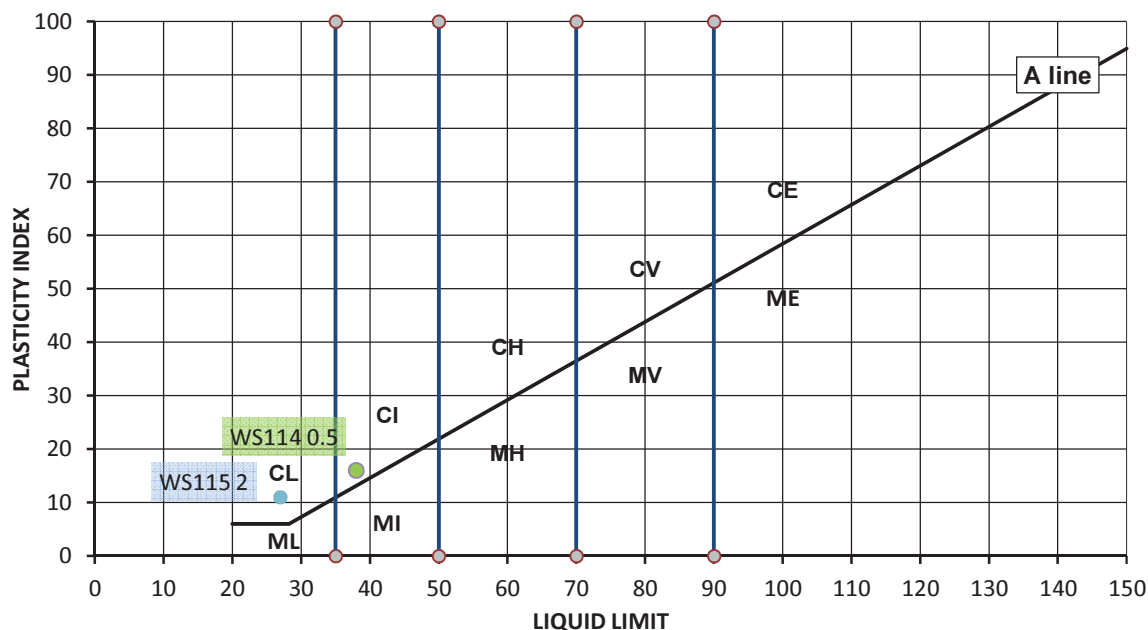
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Sampled By: LM

TEST RESULTS

Location	Depth [m]	As Received Moisture Content [%]	Liquid Limit [%]	Plastic Limit [%]	Plasticity Index [%]	% Passing 425µm BS Test Sieve
WS114	0.5	22	38	22	16	100
WS115	2	8.4	27	16	11	100



Legend, based on BS 5930:1999 +A2: 2010 Code of practice for site investigations

	Plasticity	Liquid Limit
C	Clay	below 35
M	Silt	35 to 50
	L	Low
	I	Medium
	H	High
	V	Very high
	E	Extremely high
Organic	O	append to classification for organic material (eg CHO)

Comments:

Approved: Mirosława Pytlík
PL Head of Geotechnical section

Mirosława Pytlík

Signed: Terry Stafford
Geotechnical Manager

Terry Stafford

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APPENDIX H

Summary of Chemical Test Results of Soil Samples

Results lower than detection limit are shaded in grey

APPENDIX I

Summary of Chemical Test Results of Water Samples

Job No: 2859

Site: Manchester Academy

TerraConsult

Summary of Groundwater Data - Tier I Screening

Sample Location	Units	UK Drinking Water Standard	EQS Freshwater	WHO Drinking Water Standard	TerraConsult Site Investigation Data				
					04/07/16	11/07/16	04/07/16	04/07/16	04/07/16
					Groundwater	Grndwater	Groundwater	Groundwater	Groundwater
					WS101	WS101	WS115	WS111	WS114
Water Quality - Laboratory									
pH	pH units	-	-	-	8.6	-	7.9	7.4	7.1
Electrical Conductivity	uS/cm	-	-	-	1900	-	750	-	-
Alkalinity (as CaCO ₃)	mg/l	-	-	-	100	-	370	-	-
Hardness (as CaCO ₃)	mg/l	-	-	-	1700	-	310	-	-
Metals - Minor Cations									
Arsenic	µg/l	10	50	-	4.7	-	4.5	-	-
Boron	µg/l	1000	2000	300	370	-	90	-	-
Cadmium	µg/l	5	5	3	0.02	-	0.02	-	-
Chromium (Total)	µg/l	50	200*	-	4	-	1	-	-
Copper	µg/l	2000	10*	-	5.1	-	9.2	-	-
Lead	µg/l	25	125*	-	0.3	-	0.3	-	-
Mercury	µg/l	1	1	-	0.05	-	0.05	-	-
Nickel	µg/l	20	150*	20	4	-	10	-	-
Selenium	µg/l	10	-	10	1.1	-	4.9	-	-
Zinc	µg/l	3000	1000*	3000	2	-	3	-	-
Metals - Major Cations									
Magnesium	µg/l	-	-	-	-	20	-	15	30
Anions									
Chloride	mg/l	250	250	250	28	34	8	10	13
Nitrate as N	mg/l	50	-	50	0.5	18	0.5	0.5	0.5
Sulphate (as SO ₄)	mg/l	250	400	250	1200	1200	25	120	130
Ammoniacal Nitrogen as N	mg/l	-	-	-	0.11	0.26	0.11	0.19	0.76
Unionized Ammonia as N**	mg/l	-	0.015	0.025	0.006	0.015	0.003	0.00076	0.0015
Total Cyanide	µg/l	50	5	70	0.05	-	0.05	-	-
Organics									
Phenol	µg/l	50	300	-	20	-	1.1	-	-
PAH									
Naphthalene	µg/l	10 ²¹	2.4	10	0.27	-	0.07	-	-
Acenaphthylene	µg/l	-	-	-	0.03	-	0.01	-	-
Acenaphthene	µg/l	-	-	-	0.24	-	0.01	-	-
Fluorene	µg/l	-	-	-	0.1	-	0.01	-	-
Phenanthrene	µg/l	-	-	-	0.51	-	0.08	-	-
Anthracene	µg/l	-	0.40	-	0.12	-	0.01	-	-
Fluoranthene	µg/l	-	0.10	-	0.48	-	0.05	-	-
Pyrene	µg/l	-	-	-	0.44	-	0.09	-	-
Benzo[a]anthracene	µg/l	-	-	-	0.13	-	0.02	-	-
Chrysene	µg/l	-	-	-	0.11	-	0.01	-	-
Benzo[b]fluoranthene	µg/l	-	0.03	-	0.17	-	0.01	-	-
Benzo[k]fluoranthene	µg/l	-	0.03	-	0.05	-	0.01	-	-
Benzo[a]pyrene	µg/l	0.01	0.1	-	0.12	-	0.01	-	-
indeno[1,2,3-cd]pyrene	µg/l	-	0.002	-	0.07	-	0.01	-	-
dibenzo[a,h]anthracene	µg/l	-	-	-	0.02	-	0.01	-	-
Benzo[ghi]perylene	µg/l	-	0.002	-	0.08	-	0.01	-	-
Total EPA-16 PAHs	µg/l	-	-	-	2.9	-	0.33	-	-
TPH									
Aliphatic >C5 - C6	µg/l	10	-	-	10	-	10	-	-
Aliphatic >C6 - C8	µg/l	10	-	-	10	-	10	-	-
Aliphatic >C8 - C10	µg/l	10	-	-	10	-	10	-	-
Aliphatic >C10 - C12	µg/l	10	-	-	30	-	30	-	-
Aliphatic >C12 - C16	µg/l	10	-	-	30	-	30	-	-
Aliphatic >C16 - C21	µg/l	10	-	-	30	-	30	-	-
Aliphatic >C21 - C34	µg/l	10	-	-	120	-	40	-	-
Aromatic									
Aromatic >C5 - C7	µg/l	10	-	-	10	-	10	-	-
Aromatic >C7 - C8	µg/l	10	-	-	10	-	10	-	-
Aromatic >C8 - C10	µg/l	10	-	-	10	-	10	-	-
Aromatic >C10 - C12	µg/l	10	-	-	30	-	30	-	-
Aromatic >C12 - C16	µg/l	10	-	-	60	-	60	-	-
Aromatic >C16 - C21	µg/l	10	-	-	100	-	70	-	-
Aromatic >C21 - C35	µg/l	10	-	-	70	-	40	-	-
BTEX									
Benzene	µg/l	1	30	10	1	-	1	-	-
Toluene	µg/l	-	50	700	1	-	1	-	-
Ethylbenzene	µg/l	-	200	300	1	-	1	-	-
p & m-xylene	µg/l	-	30	500	1	-	1	-	-
o-xylene	µg/l	-	30	500	1	-	1	-	-

Note:

Fail: Above UK EQS

Fail: Above UK DWS

Pass: Detection limit higher than screening criteria

Result below Detection Limit

* EQS for substances based on >100-150 mg/l CaCO₃ Hardness band and Cyprinid designation for receiving water

** Calculated from ammoniacal nitrogen and pH results using an assumed water temperature of 8 degrees.

Total of 4 Drinking Water Standard PAHs: Benzo[b]fluoranthene, Benzo[k]fluoranthene, Indeno[1,2,3-cd]pyrene, Benzo[ghi]perylene

APPENDIX J

Current Guidance for Ground Gas Risk Assessment

Current Guidance for Ground Gas Risk Assessment

Origin of Ground and Landfill Gases

When carrying out a ground gas risk assessment for permanent ground gases (e.g. methane and carbon dioxide), the origin or source of the gases is important as potential risks will vary depending on the source. This Appendix relates to the risk of the two main ground gases of concern: methane and carbon dioxide, and does not apply to other ground gases (e.g. radon or vapours from hydrocarbon spills). Methane and carbon dioxide are major constituents of landfill gas but can also occur from a variety of anthropogenic and natural sources, as summarised in Table G1 below:

Table G1. Potential Sources of Ground Gases		
Gas	Source	Comments
Landfill Gas	Anaerobic decomposition of degradable waste within landfill sites. Typically 60% methane and 40% carbon dioxide during methanogenic phase.	Composition varies over time, particularly in early stages. Contains a range of minor constituents (particularly carbon monoxide and hydrogen sulphide).
Landfill Associated Gases	- Anaerobic degradation of leachate external to the site; - Degassing of dissolved gases in groundwater; - Evolution of gases following interaction between leachate and groundwater	Can result in secondary (external) production of methane or carbon dioxide.
Made Ground	Anaerobic degradation of organic components	Very variable depending on source
Sewer Gas, Cess Pits	Anaerobic degradation of organic components of sewage producing methane and carbon dioxide.	Often characterised by hydrogen sulphide odour.
Mains Gas	Leakage from underground pipework or storage tanks. Mainly methane but often contains higher alkanes.	An odouriser is added to permit detection of leaks. Typically 90% CH ₄ , but 1 to 27% C ₂ -C ₄ alkanes, May also contain other trace gases e.g. CO, helium and CO ₂ (from degradation of CH ₄ in the ground).
Other Anthropogenic Sources	- Degradation of leaked or spilled hydrocarbons or other industrial chemicals; - Anaerobic degradation of organic contaminants in groundwaters (e.g. silage liquor); - Reactions between monitoring well construction components and environment; - Burial grounds/cemeteries.	Hydrocarbon spillages often have an 'oily' odour. Fuel spillages common – Petrol or Diesel and can contain a wide range of VOC's. Can degrade to produce methane / carbon dioxide.
Alluvium / Marsh / Peat Gas	Anaerobic microbial degradation of organic material (usually waterlogged vegetation / peat). Often associated with the presence of alluvial deposits or dredgings.	
Geogenic Gas	Natural seepages of carbon dioxide and hydrocarbon gases derived from geologic sources such as coal seams and deep oil / gas source formations. Can be present in solution in groundwaters.	Methane most common but can contain carbon dioxide and higher alkanes.
Mine Gases	Various types. Most common is "fire damp" with high methane, produced by the desorption of gas trapped in coal. "Black damp" (Stythe gas) with high carbon dioxide and denser than air. "White damp" is high in carbon monoxide.	Methane most common. Can contain higher alkanes, carbon dioxide and carbon monoxide. Often low in oxygen.
Natural Shallow Ground Gas	Various types - high carbon dioxide formed by subsurface aerobic activity leading to depleted oxygen and elevated carbon dioxide; - chemical degradation of rocks (e.g. carbonates) producing carbon dioxide; - carbon dioxide production in root zone of soils by plants.	Gases can be emitted from ground under falling barometric pressure conditions.

This Appendix concentrates on the assessment of risk from methane and carbon dioxide. This Appendix does not provide guidance for the assessment of risk when other gases are present due to 'Other Sources' from the above table (particularly organic compounds such as BTEX and VOC's or for the risk from radon or hydrogen sulphide).

To determine the origin of the gas a range of factors must be considered together, including;

1. Proximity of likely sources;
2. Ground conditions (geology, hydrogeology, anthropogenic pathways etc);
3. Properties of gases present including:
 - Chemical composition;
 - Physical properties;
 - Ratios of components e.g. methane : carbon dioxide.
4. Timeframe of activities such as infilling periods, capping works, installation of gas control systems etc.

Identification of the originating source may be problematic given that there may be more than one source present and trace gas analysis may be required. Identification of the sources of the gases encountered during monitoring is usually carried out through a process of eliminating the most unlikely potential sources (given the site setting) and selecting those which are the more likely candidates.

Hazards Associated with Presence of Ground Gases

Methane gas is combustible and potentially explosive. When the concentration of methane in air is between the limits of 5.0%v/v and 15.0%v/v an explosive mixture is formed. The Lower Explosive Limit (LEL) of methane is 5.0%v/v, which is equivalent to 100% LEL. The 15.0%v/v limit is known as the Upper Explosive Limit (UEL), but concentrations above this level cannot be assumed to represent safe concentrations. Further, the LEL and UEL will vary (up and down) depending upon the proportion of other gases (including oxygen). However, the fact that methane is a colourless, odourless gas means that there is no simple indicator of the presence of the gas until such a time as explosive limits are reached and an incident occurs. Methane is lighter than air and has a low toxicity. However, at high concentrations it can result in asphyxiation due to oxygen displacement.

Carbon dioxide is a colourless, odourless gas, which, although non-flammable, is both toxic and an asphyxiant. As carbon dioxide is denser than air, it will collect in low points and depressions. The UK Health & Safety Executive (HSE) has published information relating to concentrations of carbon dioxide that humans may be exposed to, which uses concentrations contained in the Control of Substances Hazardous to Health Regulations 2002 (as amended). These are the Long Term Occupational Exposure Limit (LTOEL, 8 hour period) and the Short Term Occupational Exposure Limit (STOEL, 15 minute period), which are 0.5% and 1.5% carbon dioxide, respectively.

Parameters Influencing the Rate of Ground Gas Production

Figure G2 is taken from EA guidance document LFTGN 03 illustrates typical ground gas generation curves from biodegradable materials:

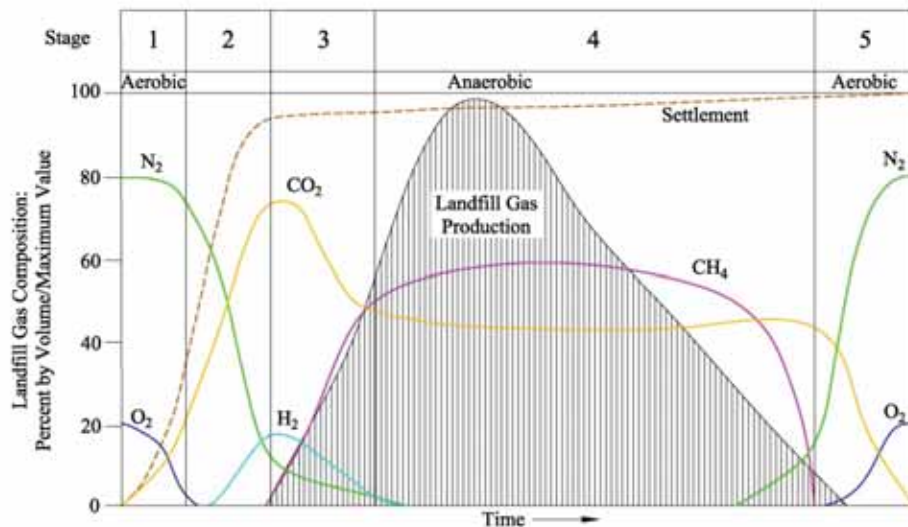


Figure G2. Idealised Representation of Landfill Gas Generation.

The production of methane and carbon dioxide at a landfill site may be expected to be considerable and ongoing. Concentrations of methane will eventually decrease, followed by concentrations of carbon dioxide, but the duration and rate of gas production can vary markedly between sites. Five distinct phases of gas production occur during the process which are, in order of event (as marked on Figure G2), as follows:

1. An aerobic phase involving oxygen depletion and temperature increase through aerobic respiration;
2. The establishment of anaerobic conditions and the evolution of carbon dioxide and hydrogen through acidogenic activity;
3. Commencement of methanogenic activity; the establishment of populations of methanogenic bacteria;
4. A phase of stable methanogenic activity, which may go on for many tens of years;
5. A phase of decreasing methanogenic activity, representing depletion of the organic material and a return to aerobic conditions.

The time scale for the return to the normal ground gas concentrations will be highly variable, depending upon the types and quantities of materials present. In addition, the optimum parameters influencing the rate of decomposition and ground gas production within the ground at a site are as follows:

- High water content with adequate rainfall and water infiltration to provide moisture content between approximately 20 to 26%;
- Conditions that either are or are very close to anaerobic;
- High proportion of biodegradable materials;
- A pH between 6.5 and 8.5, ideally verging slightly on the acidic between pH 6 to 7;
- Temperature between 25°C and 55°C;
- The ratio of the biochemical and chemical oxygen demands (BOD:COD);
- High permeability;
- Small particle size, as finer subsurface materials possess a greater surface area to provide a growing 'face' for the micro-organisms but high fines levels reduces permeability and reduces decomposition rate.

For this reason, it is vital that sources of methane and carbon dioxide are identified prior to the commencement of any work on a construction site, and that the ground gas regime is characterised at the worst temporal conditions a site may experience. From this, a risk assessment is carried out to identify the risk at the site from ground gases so that suitable protection measures can be designed and incorporated into a development to prevent a dangerous build-up of gas occurring.

Factors Influencing the Migration and Behaviour of Ground Gases

There are many factors that influence the migration of ground gases which can affect the risk from a gassing source:

- driving force – pressure differential along a pathway, diffusion and dissolved in solution;
- meteorological conditions – short term and seasonal conditions including atmospheric pressure changes (e.g. rapidly falling pressure causes gas to expand increasing emission rates), rainfall, frozen ground and thawing, temperature;
- geological and groundwater conditions – these can have the over-riding influence on the direction/pathways and quantity of migrating gas;
- anthropogenic influences – man-made pathways include mine shafts, service runs/drains, foundation piles, underground voids/pits/basements, foundation/building design/construction

Guidance Documents

Currently in the UK, there are no statutory threshold limits for hazardous gases in the ground as site specific variables mean that standard threshold values cannot be applied. The published guidance relating to development of sites where methane and carbon dioxide are present has been produced in response to building projects on or close to landfill sites, as both gases are principal constituents of landfill gas. Much of the historic guidance that has been produced on gas risk assessment focused on landfill sites and as a result there has previously been a lack of clarity when relating the process to gas conditions on non-landfill sites.

Statutory guidance regarding methane in the ground has previously taken a limiting concentration of 1.0 % by volume methane (equal to 20% of the lower explosive limit of methane in air) above which necessary actions will be appropriate. For carbon dioxide the limiting recommended trigger was 1.5 % by volume (the Long Term Exposure Limit for carbon dioxide). Above these concentrations the Building Regulations Approved Document C (1992) stated that consideration should be given to whether actions may be appropriate, whilst more specific solutions would be likely to be necessary at concentrations greater than 5% by volume of carbon dioxide (Building Regulations Approved Document C, 1992). However, the latest fully revised version of Approved Document C (DoE, 2004) no longer endorses this approach and instead requires the use of a risk-based approach in interpreting the findings of a gas monitoring survey. Further, the latest EA documentation on landfill gas (LFTGN 03, 2004) continues to sanction the use of a risk-based approach through a structured approach to the assessment of ground gases and links with the risk assessment process outlined within CLR 11 for soil contaminants.

With the above in mind, recent guidance has been produced in 2006 and 2007 with the aim of providing up to date advice in relation to residential and commercial development. The guidance does not address issues associated with gas derived from landfills, for this refer to “*Guidance on the Management of Landfill Gas*” (Environment Agency 2004) for an overview.

Recent guidance relevant to gas assessments for residential and commercial development includes;

- **Wilson *et al.* (CIRIA C665, December 2007) “Assessing Risks Posed by Hazardous Ground Gases for Buildings.”**

This document provides up to date advice on all aspects of ground gas risk assessment such as investigation, monitoring programmes, data collection and interpretation. The guidance presents separate methodologies for the characterisation of:

- **All development types except low rise housing with gardens and for Low Rise Buildings without a 150mm void** (Situation A) (Table 8.5 CIRIA C665)
and;
- **Low rise housing with gardens with a 150mm ventilated sub-floor void** (Situation B) (Table 8.7 CIRIA C665)
(See below for further explanation of the methods of characterisation)

- **Boyle and Witherington (NHBC / RSK Group, Report 10627-R01(04) January 2007) “Guidance on the Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are Present.”**

This document presents the “Traffic Lights System” detailed below and is relevant only for low rise properties (e.g. bungalows and town houses) that have a ventilated sub-floor void (i.e. Situation B as described in CIRIA C665).

- **Wilson and Card (CIEH, expected 2011) “Ground Gas Handbook for Designers and Regulators”**

This document is expected to provide practical guidance on ground gas assessments and the design and evaluation of protection measures.

- **British Standard (BS 8485, June 2015) “Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings”**

This document provides an overview of gas characterisation and assessment. The Standard is intended to be used by designers of gas protection measures and regulators involved in the assessment of design solutions. The Standard provides a framework in line with CLR11 allowing designers to judge the adequacy of ground gas and related site investigation data. The document provides an approach to determine appropriate ground gas parameters that can be used to identify a range of possible construction solutions mitigating against the presence of ground gas on a development site.

Each of these documents continues to highlight the importance of, and give further guidance towards, carrying out a tiered risk-based decision-making process in accord with government policy on dealing with contamination from historic or natural sources and highlight the importance of the Conceptual Model in site characterisation. These documents also stress the importance that the assessor should be confident that the ground gas monitoring results are representative of the likely worse case ground gas regime on a site and that the data collected from the site is sufficient. With this in mind, CIRIA C665 sets out ideal monitoring periods as below.

Idealised Frequency and Period of Monitoring (after Table 5.5a and 5.5b, CIRIA C665)						
		Generation Potential of Source				
		Very Low	Low	Moderate	High	Very High
Sensitivity of Development	Low (Commercial)	4/1	6/2	6/3	12/6	12/12
	Moderate (Flats)	6/2	6/3	9/6	12/12	24/24
	High (Residential with Gardens)	6/3	9/6	12/6	24/12	24/24
Notes 1. First number is the number of readings and the second is the minimum period in months (e.g. 6/2 – six sets of readings over two months). 2. At least two sets of readings must be at low (preferably under 1,000 mb) and falling pressure. 3. High sensitivity end use on high or very high hazard site will not normally be acceptable unless the source is treated to reduce gassing potential.						

Before the latest guidance, good practice for site characterisation had been based upon the method proposed by Wilson and Card (1999). CIRIA C665 (2007) effectively supersedes Wilson and Card (1999) and includes a modified version of the Wilson and Card method (Tables 8.5, 8.6 and Box 8.1). Gas concentrations and flow rates for either methane and/or carbon dioxide measured at a site to ‘Characteristic Situations.’ Appropriate protection measures are selected from Table 8.6 (if using modified Wilson & Card method) and from Box 8.4 from CIRIA C665 (if using the NHBC traffic lights method). Throughout the risk assessment process, strong regard must be given to the nature of the gassing source, the flow rates and the estimated surface emissions. Note that certain protection measures are stated in CIRIA Report 149 that are now considered wholly inappropriate to certain developments and consequently should not be used without modification. Throughout the process, it is important to remember that these tables are not intended to be used as a definitive design tool and have been prepared to show the typical scope of measures for gas control.

Both the NHBC (2007) and CIRIA (2007) guidance documents and BS 8485 (2015) propose that both ground gas concentrations and flow rates are used to calculate the limiting gas well gas volume flow rates for methane and carbon dioxide, based on the ground gas conditions monitored for during the worse-case temporal conditions. This limiting gas well volume flow rate is termed the Gas Screening Value (GSV, note that this was termed borehole gas volume flow), and is calculated as follows:

$$\text{GSV (l/hr)} = \frac{[\text{gas well gas concentration (\%v/v)}] \times [\text{gas well flow rate (l/hr)}]}{100}$$

These GSVs are then compared to generic ‘Traffic Lights’ contained within the NHBC guidance, which present typical maximum gas concentrations and limiting GSV’s, for ‘Situation B Development’ (Low rise housing with gardens).

Table 8.7 NHBC Traffic light system for 150 mm void				
Traffic Light	Methane ¹		Carbon Dioxide ²	
	Typical max concentration ³ (% by volume)	Gas Screening Value ^{2,4} (litres/hour)	Typical max concentration ³ (% by volume)	Gas Screening Value ^{2,4} (litres/hour)
Green	1	0.13	5	0.78
Amber 1	5	0.63	10	1.6
Amber 2	20	1.60	30	3.10
Red				
Notes: 1. The worst-case ground gas regime identified on the site, either methane or carbon dioxide, at the worst-case temporal conditions that the site may be expected to encounter will be the decider as to what Traffic Light is allocated; 2. Borehole Gas Volume Flow Rate, in litres per hour as defined in Wilson and Card (1999), is the borehole flow rate multiplied by the concentration in the air stream of the particular gas being considered; 3. The Typical Maximum Concentrations can be exceeded in certain circumstances should the Conceptual Site Model indicate it is safe to do so; 4. The Gas Screening Value thresholds should not generally be exceeded without the completion of a detailed ground gas risk assessment taking into account site-specific conditions.				

Box 8.4 of CIRIA C665 Gas protection measures for low-rise housing development based upon allocated NHBC Traffic light (Boyle and Witherington, 2007)	
Traffic Light Classification	Protection Measures Required
Green	Negligible gas regime identified and gas protection measures are not considered necessary.
Amber 1	Low to intermediate gas regime identified, which requires low-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to limit the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414. Ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours.
Amber 2	Intermediate to high gas regime identified, which requires high-level gas protection measures, comprising a membrane and ventilated sub-floor void to create a permeability contrast to prevent the ingress of gas into buildings. Gas protection measures should be as prescribed in BRE Report 414. Membranes should always be fitted by a specialist Contractor. As with Amber 1, ventilation of the sub-floor void should facilitate a minimum of one complete volume change per 24 hours. Certification that these passive protection measures have been installed correctly should be provided.
Red	High gas regime identified. It is considered that standard residential housing would not normally be acceptable without a further Gas Risk Assessment and/or possible remedial mitigation measures to reduce and/or remove the source of gas.

For a 'Situation A Development' (All development except low rise housing with gardens), the GSV value is used to derive the appropriate Characteristic Situation from Table 8.5 of CIRIA C665 (below):

Table 8.5 from CIRIA C665 Modified Wilson and Card Classification					
Characteristic Situation (CIRIA R149)	Comparable Partners in Technology gas Regime (see Box 8.2)	Risk Classification	Gas Screening Value (CH₄ or CO₂) (l/hr)¹	Additional Factors	Typical Source of Generation
1	A	Very low risk	<0.07	Typically methane ≤ 1% and/or carbon dioxide ≤ 5%. Otherwise consider increase to Situation 2	Natural soils with low organic content "Typical" made ground
2	B	Low risk	<0.7	Borehole air flow rate not to exceed 70l/hr. Otherwise consider increase to characteristic Situation 3	Natural soil, high peat/organic content. "Typical" made ground
3	C	Moderate risk	<3.5		Old landfill, inert waste, mine working flooded
4	D	Moderate to high risk	<15	Quantitative risk assessment required to evaluate scope of protective measures.	Mine working susceptible to flooding, completed landfill (WMP 26B criteria)
5	E	High risk	<70		Mine working unflooded inactive with shallow workings near surface
6	F	Very high risk	>70		Recent landfill site

It was intended in CIRIA C665 that the characteristic situation allocated to the development from the table above would then be used in Table 8.6 of CIRIA C665 in order to determine the level of gas protection the development requires. However, BS8485:2015 superseded this document and a different set of mitigation standards were put forward.

The recommended minimum gas protection score (points) be selected based on the building type (Table 3 which defines four building types) and the ground gas Characteristic Situation as detailed in Table 4 of BS8485:2015 (see below).

The first step in the decision making process is to obtain the level of gas protection necessary in the range 0 to 7.5 from Table 4. Then a combination of structural barriers (Table 5) ventilation protection measures (Table 6) and/or gas resistant membranes (Table 8) should be chosen to meet that requirement. The level of gas protection necessary should take into account the characteristic gas situation and a number of other factors. The whole decision making process should be made transparent, where all parties can see the approach being taken, can understand the various steps and decisions made and be confident that a risk-assessed solution has been designed and installed commensurate with the construction and site constraints.

Where the gas Characteristic Situation is 4 or more (and for NHBC Red situations according to CIRIA C665), the site requires a comprehensive risk assessment to confirm the scope of protection measures. These are higher risk sites and reliance on Table 4 alone is not sufficient.

BS8485:2015 Table 3 Building Types				
	Type A	Type B	Type C	Type D
Ownership	Private	Private or commercial/ public, possible multiple	Commercial / public	Commercial / industrial
Control (change of use, structural alterations, ventilation)	None	Some but not all	Full	Full
Room sizes	Small	Small / medium	Small to large	Large industrial / retail park style

BS8485:2015 Table 4 Gas Protection Score by CS and Type of Building				
CS	Required Gas Protection			
	High risk	Medium risk	Low risk	
	Type A	Type B	Type C	Type D
1	0	0	0	0
2	3.5	3.5	2.5	1.5
3	4.5	4	3	2.5
4	6 ^(A)	5.5 ^(A)	4.5	3.5
5	(B)	6.5 ^(A)	5.5	4.5
6	(B)		7.5	6.5
a) Residential building should not be built on CS4 or higher sites unless the type of construction or site circumstances allow additional levels of protection to be incorporated, e.g. high-performance ventilation or pathway intervention measures, and an associated sustainable system of management of maintenance of the gas control system, e.g. in institutional and/or fully serviced contractual situations. b) The gas hazard is too high for this empirical method to be used to define the gas protection measures				
NOTE³ The NHBC has published guidance for use on residential developments, which utilise an alternative classification (“traffic light”) system. This guidance typically applies to Type A buildings utilising beam and block floor constructions with clear void ventilation. The design choice variables are limited to decisions relating to the membrane specification and verification recommendations (see Table 7). Designers utilising this system would therefore need to refer to NHBC to assess compliance for specific recommendations [see 8485:2015 for further on this note] NOTE⁴ The method of selecting the combination of these types of protection is given in section 7.2 of BS8485:2015. Once type of measures has been decided, the detailed design and specification of the measures should be undertaken (section 7.3)				

Section 7.2 defines the order of selecting protective measures. The first choice is provided by structural barriers as defined in Table 5.

BS8485:2015 Table 5 Gas protection scores for structural barriers		
PROTECTION ELEMENT/SYSTEM	SCORE	COMMENTS
Floor and substructure design		
Floor slabs		<i>General – score conditional that breaches of slab are sealed</i>
Block and beam floor slab	0	
Cast in situ ground-bearing floor slab (with only nominal mesh reinforcement)	0.5	
Cast in situ monolithic reinforced ground-bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations (with only nominal mesh reinforcement)	1 or 1.5	<i>To achieve 1.5, raft or suspended slab to be well reinforced to prevent cracking and minimal penetrations</i>
Basement floor and walls to BS 8102:2009, Grade 2 waterproofing	2	
Basement floor and walls to BS 8102:2009, Grade 3 waterproofing	2.5	<i>Conditional that waterproofing is not based on geosynthetic clay liner</i>

Ventilation methods are detailed in Table 6, and points can only be gained from using one of the five types

BS8485:2015 Table 6 Gas Protection Scores for Ventilation Protection Measures		
PROTECTION ELEMENT/SYSTEM	SCORE	COMMENTS
a) Pressure relief pathway (usually formed by low fines gravel or with a thin geocomposite blanket with strips terminating in a gravel trench external to the building)	0.5	<i>Whenever possible, a pressure pathway relief pathway (as a minimum) should be installed in all gas protection measures systems. If a layer has a low permeability and/or is not terminating in a venting trench (or similar), then the score is zero.</i>
b) Passive sub floor dispersal layer		
Very good performance	2.5	
Good performance	1.5	<i>Performance criteria shown in Fig B.6 and B.7 of BS 8484:2015. [See Annex B]</i>
Media used to provide the dispersal layer are:		
• Clear void		
• Polystyrene void forming blanket		
• Geocomposite void former blanket		
• No-fines gravel layer with gas drains		
• No-fines gravel layer		
c) Active dispersal layer, usually comprising fans with active abstraction (suction) from a subfloor dilution layer, with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers	1.5 to 2.5	<i>This system relies on continued serviceability of the pumps, therefore alarm and response systems should be in place. [See Annex B].</i>
d) Active positive pressurisation by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket	1.5 to 2.5	<i>This system relies on continued operation of the pumps, therefore alarm and response systems should be in place. [See Annex B].</i>
e) Ventilated car park (floor slab of occupied part of the building under consideration is underlain by a basement or undercroft)	4	<i>Assumes car park is vented, designed to Building Regulations 2000, Approved Document F.</i>

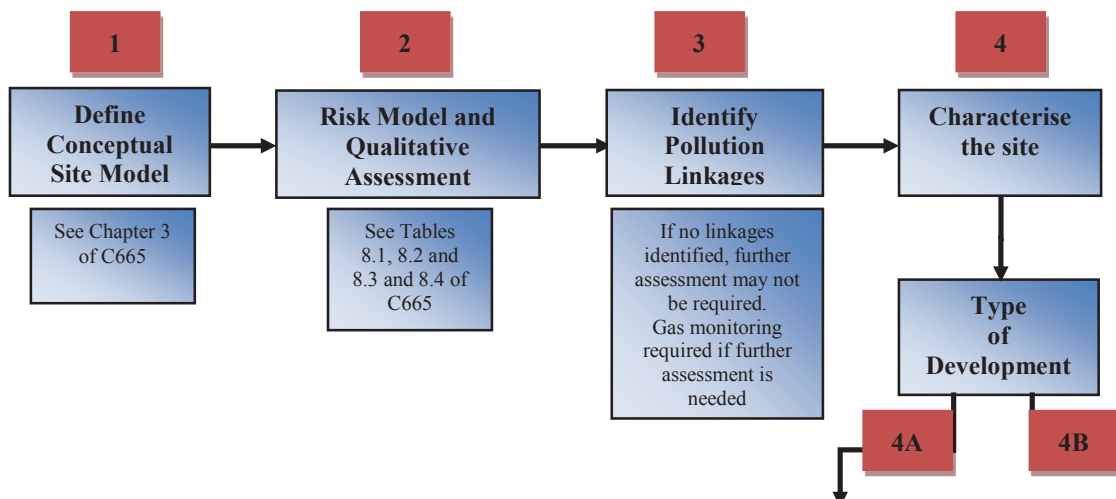
Membrane methods are detailed in Table 7.

BS8485:2015 Table 7 Gas protection score for gas resistant membrane		
PROTECTION ELEMENT/SYSTEM	SCORE	COMMENTS
Gas resistant membrane meeting all of the following criteria: • Sufficiently impervious to gases with a methane gas transmission rate <40.0 ml/day/m²/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method) • Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; • Sufficiently strong to withstand in-service stresses (eg settlement if placed below a floor slab); • Sufficiently strong to withstand the installation process and following trades until covered (eg penetration from steel fibres in fibre reinforced concrete, dropping tools etc); • capable, after installation, of providing a complete barrier to the entry of the relevant gas; and • verified in accordance with CIRIA C735	2	<i>The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation, and the integrity of joints.</i> <i>If a membrane is installed that does not meet the criteria, then the score is zero.</i>

For a site which is impacted by migratory gases from an off-source, the development may be protected by imposing pathway intervention methods, which if successfully validated, could also remove the need for further analysis. It is essential that the gas regime in these circumstances has been fully characterised and that the only source impacting the site is located off site and that the pathway is clearly defined and its interception equally proven before construction commences. Pathway intervention methods may include vertical membrane installations, venting trenches, rows of stone columns, activated trenches and various proprietary systems. These systems are particularly relevant to domestic housing where there is limited scope for foundation type solutions.

Following the choice of protection measures, detailed design should be entered into [section 8 of BS 8485:2015].

s:

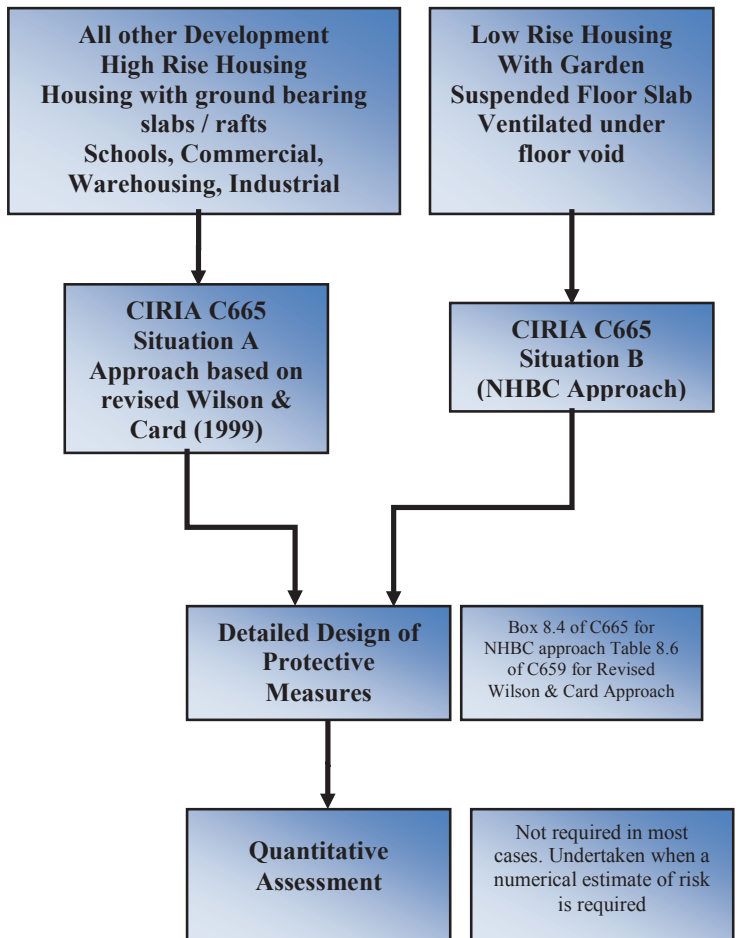


Flowchart showing the general Risk Assessment process, as defined in CIRIA C665 “Assessing Risks posed by Hazardous Ground Gases to Buildings”

Each stage is numbered and corresponds to the relevant Risk Assessment stage in the document.

Reference should be made to Section 8 of the document which goes into further detail on the Risk Assessment processes defined here.

Reference should also be made to NHBC / RSK Group Report No. 10627-R01(04) “Guidance on Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are present”



APPENDIX K

Summary of Guidance for Classification of Soil as a Waste Material

Guidance for Classification of Soil for Off Site Disposal at a Landfill Site

Many site developments create a portion of excess soils and Made Ground which if not re-usable, are required to be disposed off-site at a suitably licensed landfill site. The regulations and associated guidance published by the Environment Agency is relatively complex and lengthy. This guidance provides a summary of the following documents which should be referred to when assessing soil (and common constituents found within Made Ground on remediation sites) for off-site disposal:

- Guidance for Waste destined for disposal in landfills: Interpretation of the Waste Acceptance Requirements of the Landfill (England and Wales) Regulations 2002 (as amended) (EA, 2004);
- Guidance on Sampling and Testing of Wastes to Meet Landfill Waste Acceptance Procedures (EA, April 2005);
- WM3 - Hazardous Waste: Interpretation of the Definition and Classification of Hazardous Wastes (EA, May 2015);
- European Regulation No 1272/2008 on Classification, Labelling and Packaging of substances 2015 (CLP 2015);
- Guidance on Waste Destined for Disposal in Landfill (EA, June 2006);
- Treatment of Non-hazardous wastes for Landfill (EA, February 2007).

It is important to distinguish between the waste classification system and the designation of materials as “suitable for use” on site. A material may be retained on site for an appropriate end use if that end-use is clearly designated and that a site-specific risk assessment ensures that it does not pose a risk to human health or controlled waters. However, if this material is excavated and sent for disposal, the material is then subject to waste management regulations and the two systems cannot be directly correlated. It is therefore important to note that classifying a material as hazardous (should it be excavated and become a waste) does not necessarily indicate that it might not be suitable to be kept on site for re-use. Separate guidance in the form of a Code of Practice (CL:AIRE Version 2, 2011) has been developed jointly between the development industry and the Environment Agency to provide best practice when assessing whether materials are wastes or not, and for determining when waste can cease to be waste for a particular use.

In accordance with the current waste regulations (or Landfill Directive, as they are more commonly known), from 30th October 2007 all waste materials produced from construction sites have to be pre-treated prior to disposal. Pre-treatment includes waste minimisation, recovery (e.g. separation of demolition waste to be used as hardcore) and separation of materials into different waste categories (e.g. separate inert waste from hazardous waste etc). Mixing of different waste types shall be avoided and intentional mixing of inert materials with hazardous waste to ‘dilute it’ and hence change its waste classification, is illegal.

The current waste regulations (based on the EU landfill directive) introduced a two tier classification system for waste materials, defining them as either being hazardous or non-hazardous. Landfills are licensed to take wastes based on a three tier classification system with the non-hazardous waste divided into two sub-categories:

- Non-Hazardous - inert;
- Non-Hazardous - non-hazardous;
- Hazardous.

Waste materials are categorised with a six figure numeric code in the European Waste Catalogue. Commonly found construction and demolition wastes including excavated soil from contaminated sites and Made Ground with their waste codes are summarised below (this is not a comprehensive list):

Waste Code	What is it?	Likely Waste Category–		
		Inert Waste	Non-Hazardous	Hazardous Waste
17 01 01 Concrete	Concrete, possibly with reinforcement (from Construction & Demolition)	✓		
17 01 02 Bricks		✓		
17 01 06* Mixtures of concrete, bricks, tiles & ceramics containing dangerous substances	These are not normally considered hazardous but if they are contaminated (e.g. by asbestos) then could be hazardous – see comment above			✓
17 01 07 Mixtures of concrete, bricks, tiles & ceramics other than those in 17 01 06	This is mixed inerts c.f. 17 09 04	✓		
17 05 03* soils and stones containing dangerous substances				✓
17 05 04 soils and stones other than those mentioned in 17 05 03	Soil and stones only (excluding top soil, peat, soil and stones from contaminated sites)	✓		
17 06 05* Construction materials containing asbestos	e.g. corrugated asbestos sheeting			✓
17 08 02 Gypsum-based construction materials other than those mentioned in 17 08 01	Plaster & plasterboard (although specific disposal requirements are required for high sulphate waste – see EA guidance ‘Understanding the Landfill Directive’ version 1.0 March 2010.		✓	
17 09 01* Construction & demolition wastes containing mercury				✓
17 09 02* Construction & demolition wastes containing PCBs	Waste with more than 50 mg/kg of PCB’s are hazardous			✓
17 09 03* Other mixed construction & demolition wastes containing dangerous substances	Broad range of potentially (see notes below – if asterix the waste is hazardous) hazardous wastes			✓
17 09 04 Mixed construction & demolition wastes other than those mentioned in 17 09 01, 17 09 02 & 17 09 03	Mixed inerts with soil, tarmac, cables, vegetation, plaster, etc. (this waste can only be considered inert if it passes the waste acceptance criteria identified in the regulations).	✓	✓	

Note: all wastes with an asterix code are hazardous regardless of whether they are mirror or absolute entries in the EWC list the decision to with regard to composition must come before applying the code for mirror entries.

Some materials are classified as Inert Waste based in its origin (e.g. 17 01 01 Concrete, or glass) without any requirement for laboratory chemical analysis.

However, most soils will require laboratory testing to confirm whether they are classified as Hazardous Waste. The protocol for assessing these materials and the appropriate threshold values is complicated and are set out in the Environment Agency's "Technical Guidance WM3 Hazardous Waste – Interpretation of the Definition and Classification of Hazardous Waste" (2015). If the test results for the waste indicates that it is not hazardous then further analysis of the waste is required to determine whether it is Inert Waste. If the waste does not meet the criteria for either Hazardous or Inert, then it is by default classified as Non-hazardous Waste.

As an alternative location to landfills for off-site disposal of inert and non-hazardous waste, there are a number of sites which have Waste Permit Exemptions that can accept certain categories of inert and non-hazardous wastes. Additionally some quarries can accept certain types of wastes to be used for quarry restoration material. For both alternatives to disposal at landfill sites the material still requires chemical testing as these sites have site specific acceptance criteria for wastes. It should also be noted that these types of site do not incur landfill tax which in the 2016/17 tax year is £2.65/Tonne for inactive waste (inert and some types of non-hazardous waste) and £84.40/Tonne for active waste (some types of non-hazardous waste and hazardous waste. Note that the Inland Revenue uses a different classification scheme for waste for tax purposes to the European Waste Classification scheme.

Waste Categorisation

The process of determining the category of wastes is a three stage process:

- Stage 1 – is the waste either Hazardous or Inert by definition without the requirement for chemical analysis (if it is then Stages 2 and 3 are not required);
- Stage 2 - Waste characterisation;
- Stage 3 - WAC classification.

Waste characterisation determines if a waste is hazardous or not. Excavated soil is characterised using a system based on the contaminants present and their hazardous properties. The system uses total concentrations of the contaminants. Thresholds (as a percentage of the waste) have been set for the various hazardous properties.

Fourteen hazardous properties together with other scenarios where material could cause a hazard have been defined:

- Hazardous properties: explosive, oxidising, highly flammable/flammable, irritant, harmful, toxic, carcinogenic, corrosive, infectious, toxic for reproduction, mutagenic and ecotoxic;
- Substances which can release toxic/very toxic gases in contact with water, acid or air;
- Substances which, after disposal, can yield another substance, e.g. a leachate, which possesses any of the above hazardous properties.

Some of the hazardous properties are sub-divided e.g. there are three categories of carcinogenic, mutagenic and toxic for reproduction substances. The hazardous properties were originally defined in the European Hazardous Waste Directive 91/689/EC. Should a waste contain a contaminant with one or more of the listed hazardous properties at a concentration equal to or above the threshold value for the particular

property, then the waste is hazardous. The hazardous properties of a wide range of chemicals are sourced from CLP 2015.

There are many reasons why waste soil is classified as being hazardous but the majority of reasons can be divided into the following four groups:

- Hydrocarbons – this is probably the most common reason for the hazardous classification of soils. For most soils hydrocarbon analysis will be required for both Polycyclic Aromatic Hydrocarbons (PAH) and speciated Petroleum Hydrocarbons (PHCs) but depending on the site's history other groups of organic contaminants may also be included in any analysis suite for soil samples;
- Metals – Particularly sites from former metal processing or mining sites and also some types of ash have metal concentrations that are sufficiently high to characterise materials requiring disposal as hazardous waste.
- Asbestos;
- Anions – e.g. sulphate in plasterboard (there are special disposal requirements for high sulphate waste and specific WAC requirements); it is possible that sulphate salts of metals and semi-metals could make the waste hazardous – the sulphate concentration could possibly be significant under H12, H13 and H14.

The characterisation of wastes with significant metal concentrations involves some processing of the analysis data. The chemical analysis results for inorganic substances are generally reported as total concentrations e.g. total lead, total arsenic, total sulphate etc. However, CLP 2015 deals with the hazardous properties of actual compounds e.g. lead sulphate, arsenic pentoxide, nickel carbonate. Therefore, the total metal results have to be converted into assessed chemical analysis results for the compound most likely to be present in the soil samples. For example, if the sample contains high total lead concentrations and high sulphate concentrations, then the lead is likely to be present in the soil as lead sulphate. The most likely compounds can often be determined from a desk study or previous site uses. If the site has been derelict for a number of years, consideration should be given as to whether water soluble compounds should or should not be chosen, as rainfall could have removed them from the soil (this does not apply if the soil has been taken from below under a concrete slab etc). Chemical knowledge and common sense needs to be used in choosing a suitable compound.

If no data is available, then a worst case scenario has to be assumed and the most hazardous compound likely to be present has to be chosen. For example, metal chromates (lead chromate, nickel chromate) are often the most hazardous compounds formed by many metals, but if the chromium concentrations in the soil are low, chromates are unlikely to be present. It should also be noted that for many of the hazard categories, the cumulative hazard from different compounds is added (e.g. add the concentrations of the copper, lead and zinc compounds together to assess the Hazard Category H14 Ecotoxicity).

If the results of the above assessment determine that the waste is hazardous, it must then be analysed for the Waste Acceptance Criteria (WAC) analysis contained within appropriate Environmental Permitting Regulations (this comprises mainly leachate but also analysis for TOC and Loss on ignition). WAC limit values have been set for the listed determinands. If any of the determinands exceed their limit value, the waste must be pre-treated to reduce concentrations to below the limit values before the waste may be disposed of at a landfill site licensed to take hazardous waste.

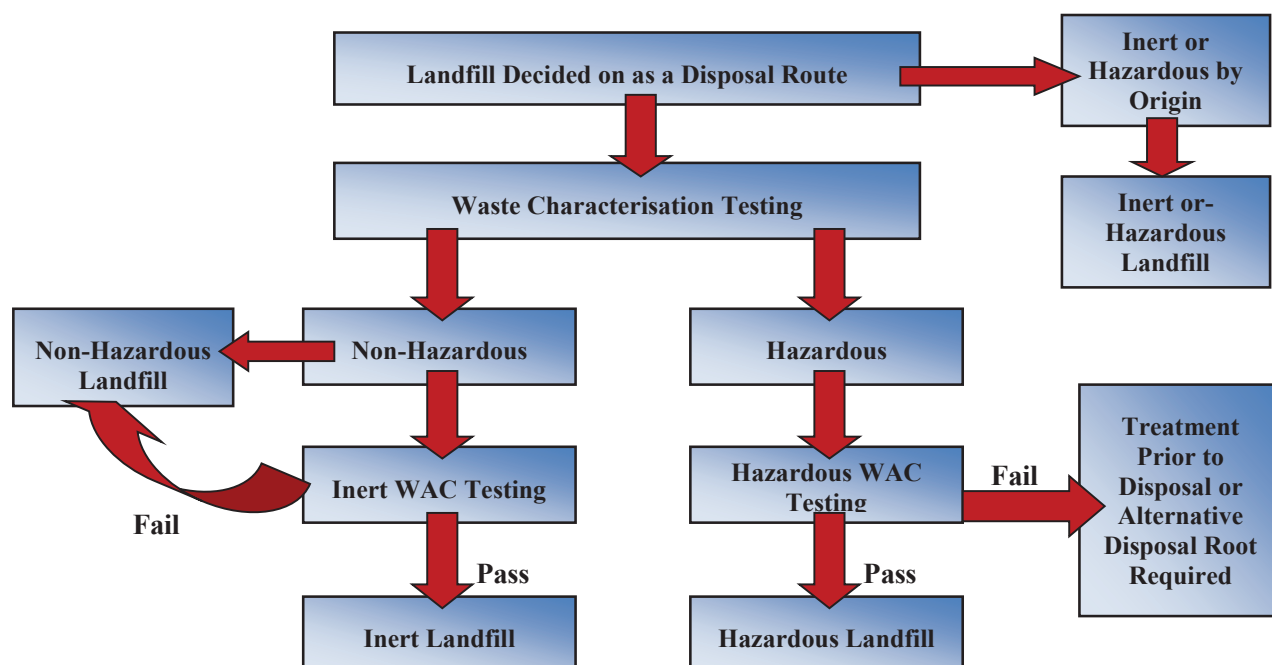
For waste classified as not being hazardous, then there are two options available. Currently, waste correctly characterised as not being hazardous may be disposed of without WAC testing to a non-hazardous landfill. Alternatively WAC testing for Inert Waste can be carried out (this is similar to the list for hazardous waste

with the addition of PAH's, BTEX and Mineral Oil). If the results pass the Inert WAC criteria it can be disposed of at an Inert Waste Landfill. If any of the WAC test results exceed the Inert WAC criteria the waste has to be disposed at a non-hazardous landfill. There are WAC limits for non-hazardous waste set for pH and TOC. If these two criteria are not met then the waste must be pre-treated so that it meets the criteria before it can be disposed.

If materials fail the WAC criteria they can be pre-treated on site or taken to a soil treatment centre for pre-treatment (such as at the facility run by Biffa at Risley near Warrington). Here the soil's hazardous properties may be reduced (e.g. by bioremediation of hydrocarbons).

It should be noted that in order to dispose of Hazardous Waste, the site must register as a producer of Hazardous Waste with the Environment Agency. When disposing of waste materials to landfill sites the appropriate Duty of Care Waste Transfer procedures must be followed.

Landfilled Waste Decision Tree



Landfill Tax

It should be noted that HM Revenue and Customs (HMRC) classify wastes for tax purposes using a different scheme to the three fold landfill EU Landfill Directive scheme (i.e. the hazardous, non-hazardous and inert). HMRC have a two-fold system for landfill tax. The Standard Landfill Tax is currently £84.40/T and applies to all wastes unless they qualify for the reduced rate of landfill tax of £2.65/T. The wastes that qualify for the reduced rate of Landfill Tax are set out in The Landfill Tax (Qualifying Material) Order 2011 with supplementary information on the interpretation of these regulations in HMRS "Notice LFT1 – A General Guide to Landfill Tax" (May 2012) and HMRC Briefing Notes 15/12 and 18/12.



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