Redrow Homes (Lancashire)

Ground Investigation Report

For

Watergate School, Speke Road,

Woolton, Liverpool

December 2014

REPORT NO: 14RED080/GI

- *Desk Studies and Site Walkovers*
- *Intrusive Contaminated Land Investigations*
- *Geotechnical Appraisals and Ground Investigations*
- *Landfill Gas Assessments and Remedial Design*
- *Remediation Design and Implementation*
- *Remediation Project Management and Supervision*
- *Site Abnormal Assessments (Foundations and Contaminated Land)*
- *Ecological Surveys (Bats, Badgers, Newts, Japanese Knotweed etc)*

GEOTECHNICAL - CONTAMINATED LAND - ECOLOGY - FLOOD RISK

DOCUMENT ISSUE RECORD

Contract No:	14RED080/GI
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REVISION RECORD

Revision	Date	Description	Prepared by
0	Oct 2014	Draft for comment with partial gas results	PH / SM
1	Dec 2014	Full gas monitoring results	SM

CONTENTS

1 EXECUTIVE SUMMARY

1. Site Location

The site is located east of Speke Road, Liverpool, Merseyside, L25 8QA. The coordinates on National Grid are 342710, 386650. The proposed site area is approximately 1.75 hectares in total.

2. Site Description

On Site

Site is derelict since the closure as a community resource within the last few years or so and as a special needs school in 2005. The site is accessed via Speke Road to the west of the site boundary. The site slopes from the west (circa 60m AOD) to the east (circa 48m AOD).There are a series of small retaining walls around the car park area, due to slopes from the boundaries towards the car park. The site is on a series of levelled terraces, with car park to the west, steps down to the main school buildings with grassed areas. To the east of the school buildings is a concrete/tarmac playing area with a slope down to a metal palisade fence, gate on to the large grassed field (green edge on plan above) with an access along Watergate Lane.

There is a boiler house located to the north of the site and has a chimney and extensive hard standing. It is unknown as to what the source of fuel was for the boiler house.

The site boundaries are as follows;

- West – Stone wall adjacent to Speke Road and main site access.
- North – (West) A mixture of stonewalls, hedgerows and trees, bordering Marie Curie Hospice. (East) Tree, hedges and fences bordering residential dwellings, which are approximately 2.00m lower than site with main school building on.
- East – Hedgerows, trees and garden fences bordering residential dwellings.
- South – Trees, hedges and fences bordering residential dwellings. Access to field from Watergate Lane.

Surrounding Area

Surrounding land uses for the site are as follows:

- North – Immediately adjacent is Marie Curie Hospice and residential dwellings, with King's Drive and the High Street (B5171) 80m beyond. Approximately 200m beyond is Woolton High Street with a mixture of commercial and residential dwellings.
- West – Immediately adjacent is Speke Road with residential dwellings immediately beyond (higher elevation) with school playing fields beyond.
- West/Southwest – Approximately 100m beyond is St Julie's Catholic High School.
- South – Immediately adjacent are residential dwellings with Watergate Lane (40m beyond) and further residential dwellings.
- Southeast – Immediately adjacent residential dwellings and Watergate Lane. Approximately 25m beyond is Much Woolton Catholic Primary School and further residential dwellings beyond.
- East – Immediately adjacent are residential dwellings that continue beyond.

3. Proposed Development

The proposed construction of sixteen (16 No) residential dwellings with associated infrastructure, gardens and public open space. At the time of writing this report, no proposed layout was available.

4. Site History

On Site

The earliest map is the 1849 1:10,560 and shows the site as parts of several differing fields, Speke Road (west) and Watergate Lane (south) are present. There seems to be a residential dwelling along the western boundary with Speke Road (no longer shown by 1893).

The site is shown as approximately as its current border, shows trees along the borders and several sporadically scattered through the site. The site seems to be part of a larger estate, possibly part of the Priory

that was located to south of the site. The 1907 map shows the site as two separate fields which remained the situation when part of the site was converted to allotment gardens.

The entire site is denoted as allotments in the 1953 map and remains the situation until the mid-1970's when the Watergate School is constructed with car parking, play area and fields. There have been no major significant changes since.

Surrounding Area

1849 - 5m E – Buildings and orchard known as The Orchard (reduced in size 1927, replaced by residential dwellings circa 1980). 10m W – Residential dwellings (still present). 25m S – Priory complex with Chapel (replaced by residential dwellings circa 1986). 115m SW – Woolton Hall (built 1704, extended 1772, still present with reduced grounds). 120m N – Woolton Village Centre (still present). 120m NE – Pond (replaced by Halewood Drive and residential dwellings circa 1938). 130m N – Woolton Heyes House and grounds (no longer shown by 1936, replaced by King's Drive and residential dwellings by 1952, still present). 140m N – Pond (replaced by residential dwellings 1938). 140m SE – Pond (replaced by primary school/residential dwellings circa 1980).
1893-1894 - No Significant Changes.
1907-1908 - 50m N – Liverpool & Bootle Police Orphanage (extended by 1927, nursing home by 1967, Marie Curie Hospice by 1993, still present).
1927-1928 - 0m S – Residential dwellings appear on land between site and Watergate Lane (still present).
1936-1938 - 0m N, 0m NE, 0m E, 50m S – Residential dwellings (still present).
1952-1956 - 115m SW – Woolton Hall convent school, (extended by 1967, St Julies Secondary School by 1974, still present).
1957-1974 - No Significant Changes.
1974 - 35m SE – Primary School (still present).
1994 - 0m N – Marie Curie Hospice constructed (still present).
1994-2014 - No Significant Changes.

5. Published Geology

The BGS map shows the geology (1:10,000 Maps SJ67SE, 1962) beneath the following:

- Drift – Glacial Till – Diamicton CLAY (Eastern half of site only). No Superficial Deposits Recorded (Western half of site only).
- Bedrock – Chester Pebble Beds Formation – Sandstone (Western half of site only). Wilmslow Sandstone Formation – Sandstone (Eastern half of site only).

6. Hydrogeology and Hydrology

- The superficial deposits of Glacial Till are classed as an Unproductive Strata (Negligible Permeability).
- The bedrock deposits of the Chester Pebble Beds and Wilmslow Sandstone Formations are classed as a Principal Aquifer (High Permeability).
- The site does not lie within a Groundwater Source Protection Zone as defined by the Environment Agency.
- The nearest water feature a covered reservoir 667m S of site.
- There is one (1 No) water abstraction within 1000m of site.

Flood Risk Assessment

The site lies within Flood Zone 1 as defined by the Environment Agency and due to the site being greater than one (1 No) hectare in size, a standalone Flood Risk Assessment should be undertaken with consideration to surface water drainage strategy.

7. Summary of Environmental Data

Possible Contamination Sources and risk levels are shown below;

- Current Land Use On Site - Used as a special needs school, possible made ground from construction. Due to age of construction, asbestos and fuel contamination, TPH's and PAH's (former boiler house). Targeted ground investigation and ground gas monitoring. Yes
- Historical Land Use – Allotments On Site - Used as open lands before being turned into Allotments post

WW1, extended across site post 1936, used as allotments till late 1960's when the school was built. Possible heavy metal, TPH and PAH contamination. Ground investigation and ground gas monitoring. Yes

- Historical Ponds 120m NE 140mN 140mSE - Historical ponds backfilled >50 yrs ago, residential dwellings/roads. Cohesive strata anticipated and significantly lower elevation than site. Low risk of ground gas migration. No
- Landfill 480m W - Landfill 480m W, extensive cohesive strata, and infrastructure between sites is anticipated. Low risk. No

In this qualitative risk assessment, a Low-Moderate risk implies that remedial action may be necessary at the site in particularly around the boiler house, former buildings and possibly in area of former allotments, the scope of which cannot be confirmed until the intrusive investigation has been completed.

8. Scope of Investigation

The fieldwork was carried out on the 23rd September 2014;

- Six (6 No) Trial Pits dug to between 2.00mbgl (TP4) and 3.10mbgl (TP1).
- Eight (8 No) window sampling small diameter boreholes drilled to between 0.40mbgl (WS7) to 3.00mbgl.
- Five (5 No) of the eight window sampling boreholes were installed with gas monitoring wells – which are to be monitored over 6 ground gas monitoring visits over a period of at least 3 months with varying barometric pressures.
- Chemical analysis (Metals, PAH's, TPH's) of fifteen (15 No) samples.
- Analysis of fifteen (10 No) samples for asbestos screening.
- Analysis of seventeen (17 No) samples for pH and water soluble sulphates.

9. Ground Conditions Encountered

- TOPSOIL - Grass over dark brownish slightly gravelly sandy SILT.
- TOPSOIL (2) - Grass over dark brown with light orangish brown mottling slightly gravelly, sandy CLAY.
- MADE GROUND - Blackish brown slightly gravelly sandy CLAY. Occasionally very silty. Occasional sand and gravel of brick.
- MADE GROUND (2) - Tarmac.
- MADE GROUND (3) - Orange Fine SAND.
- MADE GROUND (4) - Brown and black slightly clayey cobbly SAND & GRAVEL.
- MADE GROUND (5) - Brown/ dark brown clayey SILT/ Silty CLAY.
- MADE GROUND (6) - Blackish brown slightly gravelly clayey silty SAND.
- MADE GROUND (7) - Flagstone/ Grey Gravel of Tarmac. Concrete Spots.
- MADE GROUND (8) - Greyish brown fine to coarse sub-rounded to sub-angular GRAVEL.
- MADE GROUND (9) - Greyish Purple silty gravelly fine to coarse SAND. Strong hydrocarbon Odour. Oily Looking.
- Possible MADE GROUND - Dark Orangish brown slightly gravelly fine to coarse SAND.
- CLAY - Firm locally soft orangish brown silty very sandy CLAY.
- CLAY (2) - Firm to stiff reddish brown / orangish brown very silty very sandy CLAY.
- CLAY (3) - Firm to stiff dark reddish brown slightly gravelly silty sandy CLAY.
- SAND - Loose to Medium dense orangish becoming reddish brown slightly clayey gravelly silty SAND.
- SAND (2) - Loose reddish brown silty fine SAND.
- SILT - Brown slightly gravelly sandy SILT.
- SAND & GRAVEL - Medium dense locally loose reddish brown SAND & GRAVEL.
- SAND / SILT - Loose to medium dense orangish brown/ reddish brown silty SAND / sandy SILT.
- SANDSTONE - Weak to very weak reddish brown fine grained SANDSTONE.

Olfactory and Visual Contamination

There was a strong olfactory and slight visual contamination in WS6 near the boiler house. There was no other significant visual or olfactory contamination on site other than the Made Ground stated within the exploratory

borehole logs and the following details below:

Exploratory Hole	Depth (mbgl)	Strata	Remark
TP1	0.30 – 1.60	MADE GROUND	Slight organic odour.
TP2	0.25 – 0.90	MADE GROUND	Slight hydrocarbon odour.
WS5	0.25 – 0.60	MADE GROUND	Slight hydrocarbon odour.
WS6	0.55 – 0.85	SAND	Greyish Purple silty gravelly fine to coarse SAND. Strong hydrocarbon Odour. Oily Looking.

Groundwater Fieldwork and Post Fieldwork

TP2 0.25-0.50m Made Ground, slight seepage during the fieldwork. During the two visits post fieldwork all holes have been recorded as dry.

10. Contamination Encountered

Topsoil

All determinants for TPH's, PAH's and Metals fall below the residential home grown produce guidance levels within the Topsoil.

Made Ground

All determinants for TPH's, PAH's and Metals fall below the residential home grown produce guidance levels within the Made Ground, with the exception of the TPH Ali C12-C16, WS6 0.60m 358mg/kg v SGV 24mg/kg (1% SOM).

11. Remedial Actions

There was one elevated level that exceeded the guidance of 'Residential with Homegrown Produce' (ATrisk 2009) for Ali C12-C16 WS6 0.60m, therefore additional risk assessment is required.

There are no superficial deposits recorded to the west and Glacial Till to the east (east of WS5) and the sandstone bedrock is classed a Principal Aquifer (high permeability). Therefore the site's environmental setting is considered to be a moderate to high environmental sensitivity. With respect to human health, the proposed end use (residential use with home-grown produce) is of high sensitivity. Transient risks to construction workers can be addressed by the adoption of appropriate health and safety measures (see Section 14.2).

The area around WS6 is in the vicinity of the current boiler house, it is likely at some point in the past there was a fuel tank in the area, as there was a strong odour of hydrocarbons and there was visual evidence. The level of Ali C12-C16 was 358mg/kg v SGV of 24mg/kg (1% SOM). The maximum value is an outlier, therefore is classed as a hotspot. All other holes apart from WS3 showed no evidence of TPH's, however TP2 noted hydrocarbon odour. WS3 showed Ali C12-C16 of 55.1mg/kg v SGV of 142mg/kg (6% SOM). This is provisional evidence of a possible small hydrocarbon plume in this area, further TPH testing in the vicinity of WS6 and WS3 post demolition is required to delineate extent of TPH contamination.

The boilers will need removing and validating by an appropriate engineer, post demolition delineation and testing.

12. Groundwater Risk Assessment

The site has limited to no superficial deposits to the west and Glacial Till to the east and in most cases is straight on to sandstone bedrock. The fieldwork and two visits post fieldwork have shown all holes to be dry.

The lack of groundwater indicates low migration potential risk, with precipitation being the principal driver of any contamination into the bedrock and aquifer within vicinity of WS3 and WS6. As it is proposed that this source will be removed as part of the demolition/remediation, the risk to the aquifer is deemed low.

13. Off-Site Disposal of Surplus Soil

It is recommended that the results of the contamination testing (including the history of the site) be presented to the proposed landfills, to obtain their acceptance of the information to date and to determine the actual WAC limits used by them.

14. Specialist Ground Gas Measures

Green – Rest of Site – No specialist gas protection is required.

It is anticipated that hydrocarbon contamination encountered in the boiler house area is removed and validated, however if this is to remain in place then a hydrocarbon resistant membrane may be required within plots proposed in this area. Further investigation post demolition is required to confirm.

BRE211 (2007) Radon: Guidance on protective measures for new buildings that <1% of the properties are affected by Radon and therefore no radon protection measures are necessary.

15. Site End Users

There is TPH contamination Ali C12-C16 in WS6, with evidence of migration in WS3, post demolition delineation and testing required.

Given that the hydrocarbon contamination is anticipated to be small and localised to this former boiler house area, it is anticipated that is area is delineated, excavated, and removed from beneath plots and garden areas. Depending on finished floor levels, roads, public open space, it may be possible to use the contaminated Made Ground beneath, roads and public open space to reduce the need for disposal, subject to geotechnical viability and further chemical testing and risk assessment.
Following removal of contamination within the affected garden areas in the vicinity, no additional cover systems will be required. A nominal 300mm growing medium will be required (made up from at least 150mm topsoil and 150mm subsoil) as per NHBC guidance. It is likely that this is made up from a combination of on site and off site sources.

Further investigation is required post demolition of the existing buildings to clarify and confirm the findings of this investigation and the remedial actions proposed. It is anticipated that at this stage proposed layouts and site levels will be confirm and will be able to be factored in to remedial actions proposed

16. Foundations

The site slopes 60m AOD from the west to 48m AOD to the east, the current building has been benched in and constructed on relatively flat terraces. Careful consideration to the existing slope levels is required
Plots 7 and 8 may be complicated due to the transition from shallow bedrock (circa 1.00m) and to firm to stiff clay (circa 2.00-2.50m). Post demolition investigation is required in vicinity of WS5 and within the building footprint to confirm.
Bearing capacities anticipated on natural strata encountered are as follows:

- Firm to stiff brown CLAY strata with an allowable bearing pressure of 125kN/m^2
- Weathered SANDSTONE strata an allowable bearing pressure of 175kN/m^2
- Weak SANDSTONE strata an allowable bearing pressure of 250kN/m^2

Localised deepening of foundations and/or piled foundations are likely to be required in the vicinity of trees, existing and historical buildings. A foundation zoning plan should be undertaken post demolition to determine areas that are not affected by shallow rock.

Foundations should be excavated wholly on one stratum. Should proposed foundations span different strata, trenching and stepping of foundations and/or nominal reinforcement will be required. A foundation zoning plan should be undertaken when proposed levels are made available. Calculations on the allowable bearing capacity indicate settlements of less than 25mm for a square pad using the above allowable bearing capacity.

17. Concrete Design
It is considered for concrete design purposes that brownfield site and mobile groundwater conditions are applicable and the results indicate a Design Sulphate Class of DS-1, ACEC class of AC-1E and Design Chemical Class of DC-1 as defined by BS8500-1:2006. This is subject to review upon import of fill to site.

18. Heave / Shrinkage Potential
The plasticity limit/moisture content of clay strata encountered and tested were classed as LOW plasticity, tree heave protection should be designed accordingly following discussion with NHBC.

19. Ground Floor Construction
Suspended floor construction e.g. either in situ RC slabs or block and beam flooring is recommended as per NHBC guidance.

20. Control of Groundwater
No significant groundwater was encountered, post fieldwork monitoring shows all holes to be dry. It is likely that provision of pumping/shuttering will be necessary during excavation of foundation trenches during wet weather, close to existing ditches and to deeper excavations for sewers etc. It is good practice to have such equipment on standby in case of seasonal / abnormal weather conditions.

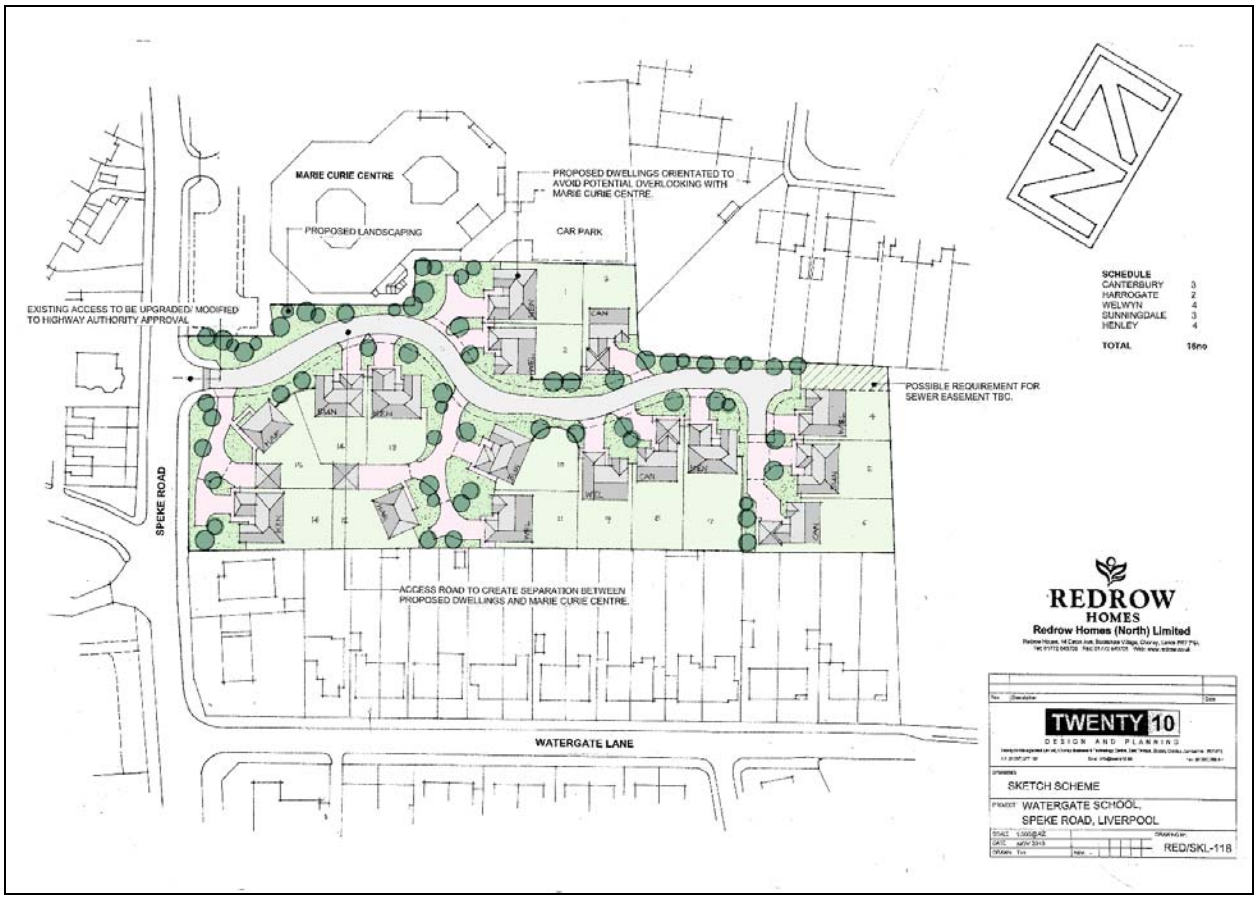
21. Highway
According to the criteria of Highways Agency HD 25/95 Volume 7 Section 2 Part 2 HD 25/94, a CBR value of 3-5% on the firm to stiff clay/weathered sandstone is anticipated, however confirming in-situ CBR's should be undertaken. Placement of geotextiles within the areas of roads / parking could also be designed to minimise the subgrade thickness.

22. Further Investigation
The following additional site investigation is advisable post demolition:
- Delineate the extent of and testing of soils within vicinity of WS6 and WS3 for TPH and contamination from the boiler house. This is not possible until after demolition due to the restriction from existing buildings, walls, trees and services.
- Investigate areas previously inaccessible due to existing buildings, services, vegetation and services, post demolition.
- Delineation the shallow bedrock/Glacial Till boundary to the east of WS5.
- Determine depth of sandstone bedrock beneath the existing buildings post demolition.

2 SITE DESCRIPTION

2.1 Introduction

This investigation was carried out on the instruction of Redrow Homes (Lancashire). The purpose of the work was to carry out a desk study and ground investigation to provide geotechnical and contamination risk information for the proposed construction of sixteen (16 No) residential dwellings with associated gardens, public open spaces and other infrastructure.



Sketch Scheme of Proposed Layout at proposed development; Wategate School, Speke Rd, Liverpool.

2.2 Site Location

The site is located east of Speke Road, Woolton, Liverpool, Merseyside, L25 8QA. The coordinates on National Grid are 342710, 386650. The proposed site area is approximately 1.75 hectares. See Site Location Plan in Appendix A.

2.3 Site Description

2.3.1 On Site

Site is derelict since the closure as a community resource within the last few years or so and as a special needs school in 2005. The site is accessed via Speke Road to the west of the site boundary. The site slopes from the west (circa 60m AOD) to the east (circa 48m AOD).There are a series of small retaining walls around the car park area, due to slopes from the boundaries towards the car park. The site is on a series of levelled terraces, with car park to the west, steps down to the main school buildings with grassed areas. To the east of the school buildings is a concrete/tarmac playing area with a slope down to a metal palisade fence, gate on to the large grassed field (green edge on plan above) with an access along Watergate Lane.

Red edged plan showing site boundaries for Watergate School, green edge is a possible option for drainage exit

There is a boiler house located to the north of the site and has a chimney and extensive hard standing. It is unknown as to what the source of fuel was for the boiler house.

The site boundaries are as follows;

- West – Stone wall adjacent to Speke Road and main site access.
- North – (West) A mixture of stonewalls, hedgerows and trees, bordering Marie Curie Hospice. (East) Tree, hedges and fences bordering residential dwellings, which are approximately 2.00m lower than site with main school building on.
- East – Hedgerows, trees and garden fences bordering residential dwellings.
- South – Trees, hedges and fences bordering residential dwellings. Access to field from Watergate Lane.

2.3.2 Surrounding Area

Surrounding land uses for the site are as follows:

- North – Immediately adjacent is Marie Curie Hospice and residential dwellings, with King's Drive and the High Street (B5171) 80m beyond. Approximately 200m beyond is Woolton High Street with a mixture of commercial and residential dwellings.
- West – Immediately adjacent is Speke Road with residential dwellings immediately beyond (higher elevation) with school playing fields beyond.
- West/Southwest – approximately 100m beyond is St Julie's Catholic High School.
- South – Immediately adjacent are residential dwellings with Watergate Lane (40m beyond) and further residential dwellings.
- Southeast – Immediately adjacent residential dwellings and Watergate Lane. Approximately 25m beyond is Much Woolton Catholic Primary School and further residential dwellings beyond.
- East – Immediately adjacent are residential dwellings that continue beyond.

3 ENVIRONMENTAL SETTING AND DATA

3.1 Site History from Ordnance Survey Maps

A search of available historic maps was undertaken to establish the land use history of the site. All maps are Ordinance Survey unless otherwise stated. All distances quoted on OS maps are taken from the site boundary, which is marked on the map.

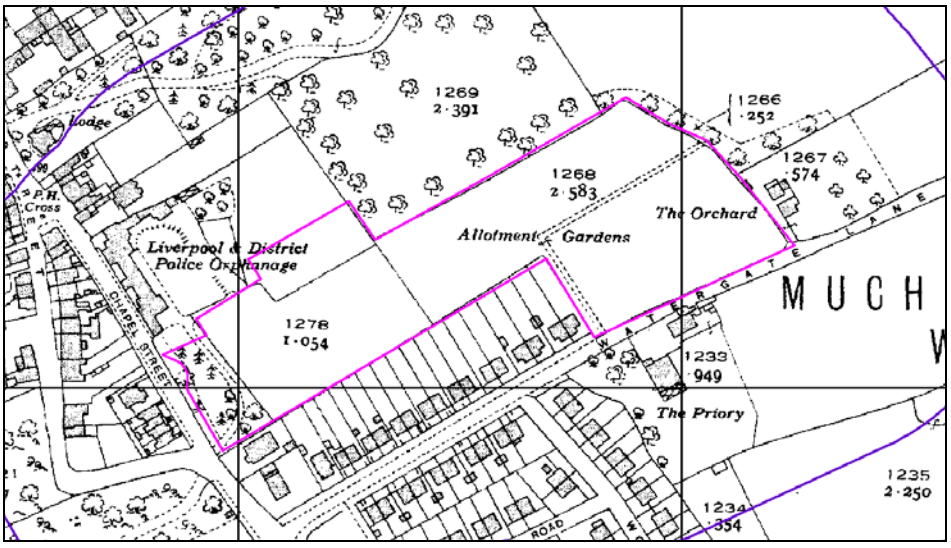
3.2 Summary of Site History

3.2.1 On Site

The earliest map is the 1849 1:10,560 and shows the site as parts of several differing fields, Speke Road (west) and Watergate Lane (south) are present. There seems to be a residential dwelling along the western boundary with Speke Road (no longer shown by 1893).

The site is shown as approximately as its current border, shows trees along the borders and several sporadically scattered through the site. The site seems to be part of a larger estate, possibly part of the Priory that was located to south of the site.

The 1907 map shows the site as two separate fields which remained the situation when part of the site was converted to allotment gardens, an extract from the 1936 1:2,500 map is shown below;



Draft red edged plan showing site boundaries for Watergate School (1936 map).

The entire site is denoted as allotments in the 1953 map and remains the situation until the mid-1970's when the Watergate School is constructed with car parking, play area and fields. There have been no major significant changes since.

3.2.2 Surrounding Area

The following table below summarises the significant changes in historical use surrounding the site:

Date First Shown	Land Uses
1849	5m E – Buildings and orchard known as The Orchard (reduced in size 1927, replaced by residential dwellings circa 1980). 10m W – Residential dwellings (still present). 25m S – Priory complex with Chapel (replaced by residential dwellings circa 1986). 115m SW – Woolton Hall (built 1704, extended 1772, still present with reduced grounds). 120m N – Woolton Village Centre (still present). 120m NE – Pond (replaced by Halewood Drive and residential dwellings circa 1938). 130m N – Woolton Heyes House and grounds (no longer shown by 1936, replaced by King's Drive and residential dwellings by 1952, still present). 140m N – Pond (replaced by residential dwellings 1938). 140m SE – Pond (replaced by primary school/residential dwellings circa 1980).
1893-1894	No Significant Changes.
1907-1908	50m N – Liverpool & Bootle Police Orphanage (extended by 1927, nursing home by 1967, Marie Curie Hospice by 1993, still present).
1927-1928	0m S – Residential dwellings appear on land between site and Watergate Lane (still present).
1936-1938	0m N, 0m NE, 0m E, 50m S – Residential dwellings (still present).
1952-1956	115m SW – Woolton Hall convent school, (extended by 1967, St Julies Secondary School by 1974, still present).
1957-1974	No Significant Changes.
1974	35m SE – Primary School (still present).
1994	0m N – Marie Curie Hospice constructed (still present).
1994-2014	No Significant Changes.

4 ENVIRONMENTAL DATA

The following section details both geological and environmental data available for the site and the surrounding area. Full details can be found in the Envirocheck Report by Landmark located in Appendix C.

4.1 Geology

Geology	Drift	Solid
1:10,000 SJ48NW, 1946	Glacial Till – Diamicton CLAY (Eastern half of site only). No Superficial Deposits Recorded (Western half of site only).	Chester Pebble Beds Formation – Sandstone (Western half of site only). Wilmslow Sandstone Formation – Sandstone (Eastern half of site only).

Geology 1:10,000 Maps Legends

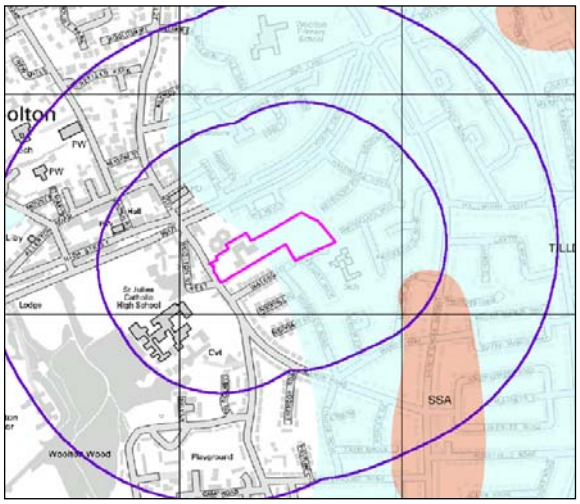
Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	ALV	Alluvium	Clay, Silt, Sand and Gravel	Flandrian - Pleistocene
	TILLD	Till, Devensian	Diamicton	Devensian - Ipswichian
	SSA	Shirdley Hill Sand Formation	Sand	Flandrian - Ipswichian

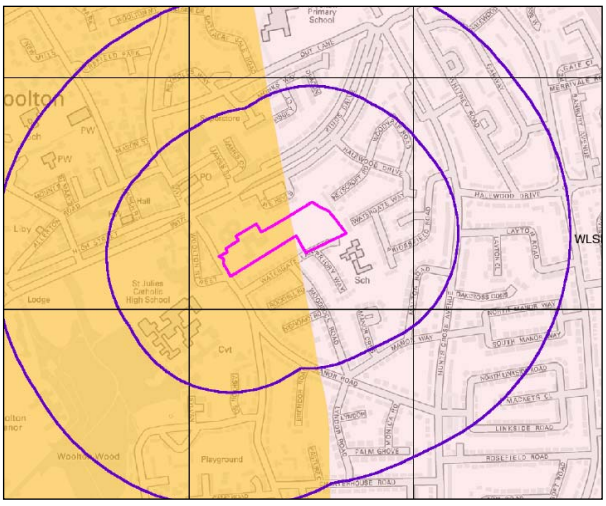
Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	WLSF	Wilmslow Sandstone Formation	Sandstone	Early Triassic - Early Triassic
	CPB	Chester Pebble Beds Formation	Sandstone	Early Triassic - Early Triassic
	KNSF	Kinnerton Sandstone Formation	Sandstone	Early Triassic - Early Triassic
	Fault			

Superficial Geology



Bedrock Geology



4.1.1 Fault Lines

There are no fault lines within 500m of site.

4.2 Mining, Extraction and Natural Cavities

4.2.1 Coal Mining

The site does not lie within an area affected by historical, current or future coal mining.

4.2.2 Natural Cavities

There are no known recorded cavities within 500m of site.

4.2.3 Mineral Extraction

There are no known recorded mineral extractions sites within 500m of site.

4.3 Environmental Permits, Incidents and Registers

4.3.1 Discharge Consents

There are no discharge consents recorded within 500m of site.

4.3.2 Local Authority Pollution Prevention and Controls

There is one (1 No) Local Authority Pollution Prevention and Controls within 500m of site, this is detailed below:

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
1	**Local Authority Pollution Prevention and Controls** Name: Johnsons Dry Cleaners, Sainsburys, Woolton Location: Unit 3 Sainsburys Centre, 16 James Road, Woolton, Liverpool, L25 5qa Authority: Liverpool City Council, Liverpool Environmental Health & Trading Standards Division Permit Reference: PPC 07/07 Dated: 12th July 2010 Process Type: Local Authority Pollution Prevention and Control Description: PG6/46 Dry cleaning **Status: Permitted** Positional Accuracy: Manually positioned to an adjacent address or location	A13NW (NW)	217	1	342519 386859

4.3.3 Pollution Incidents to Controlled Waters

There are no Pollution Incidents to Controlled Waters recorded within 500m of site.

4.3.4 Substantiated Pollution Incident Register

There are no Substantiated Pollution Incident Register recorded within 500m of site.

4.3.5 Contemporary Trade Directory Entries

There are four (4 No) Contemporary Trade Directory Entries within 250m of site, two of which are currently active, these are detailed below;

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
19	**Contemporary Trade Directory Entries** Name: Johnson Cleaners (Uk) Ltd Location: 16, Sainsburys Centre, James Road, Liverpool, Merseyside, L25 5QA Classification: Dry Cleaners **Status:** **Active** Positional Accuracy: Automatically positioned to the address	A13NW (NW)	131	-	342560 386783
20	**Contemporary Trade Directory Entries** Name: Salisbury Farm Dairy Location: Salisbury Farm Dairy, 29, Woolton Street, Liverpool, L25 5NH Classification: Dairies **Status:** **Active** Positional Accuracy: Automatically positioned to the address	A13NW (NW)	139	-	342494 386742
21	**Contemporary Trade Directory Entries** Name: M & J Lever (Ingredients) Ltd Location: 17, Woolton Street, Liverpool, Merseyside, L25 5NH Classification: Food Products - Manufacturers **Status:** **Inactive** Positional Accuracy: Automatically positioned to the address	A13NW (NW)	216	-	342455 386814
22	**Contemporary Trade Directory Entries** Name: Andrews The Cleaners Ltd Location: Kings Dr, Woolton, Liverpool, L25 8RG Classification: Dry Cleaners **Status:** **Inactive** Positional Accuracy: Manually positioned to the road within the address or location	A13NE (NE)	216	-	342872 386924

4.4 Landfills and Other Waste Management Sites

4.4.1 Historical Landfill Sites

There is one (1 No) recorded Historical Landfill Site and this is detailed below;

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
7	**Historical Landfill Sites** Licence Holder: Not Supplied Location: Liverpool, Merseyside Name: Woolton Quarry South Operator Location: Not Supplied Boundary Accuracy: As Supplied Provider Reference: EAHLD16927 First Input Date: Not Supplied Last Input Date: Not Supplied Specified Waste Type: Deposited Waste included Inert Waste EA Waste Ref: 0 Regis Ref: Not Supplied WRC Ref: Not Supplied BGS Ref: Not Supplied Other Ref: GDO M184	A12NE (W)	480	2	342147 386851

There are no other waste management sites within 500m of site.

4.5 Hydrogeology and Hydrology

- The superficial deposits of Glacial Till are classed as an Unproductive Strata (Negligible Permeability).
- The bedrock deposits of the Chester Pebble Beds and Wilmslow Sandstone Formations are classed as a Principal Aquifer (High Permeability).
- The site does not lie within a Groundwater Source Protection Zone as defined by the Environment Agency.
- The nearest water feature a covered reservoir 667m S of site.
- There is one (1 No) water abstraction within 1000m of site, this is detailed below;

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
5	**Water Abstractions** Operator: A Clegg & Sons Ltd Licence Number: 2569028005 Permit Version: Not Supplied Location: Borehole, Gateacre, LIVERPOOL Authority: Environment Agency, North West Region Abstraction: Manufacturing Abstraction Type: Not Supplied Source: Groundwater Daily Rate (m3): 227 Yearly Rate (m3): 27276 Details: Licence Status: Revoked Authorised Start: Not Supplied Authorised End: Not Supplied Permit Start Date: Not Supplied Permit End Date: Not Supplied Positional Accuracy: Located by supplier to within 100m	A23SW (N)	972	2	342700 387700

4.6 Flood Risk Assessment

The site lies within Flood Zone 1 as defined by the Environment Agency and due to the site being greater than one (1 No) hectare in size, a standalone Flood Risk Assessment should be undertaken with consideration to surface water drainage strategy.

4.7 Radon

The property is in a lower probability area, as less than 1% of homes are above the action level. Therefore no Radon protective measures are necessary in the construction of new dwellings or extensions.

5 SUMMARY OF ENVIRONMENTAL SENSITIVITY

The following section is a review of the environmentally sensitivity of the site as discussed in Sections 2-3. Significant potential risks are discussed in the following subsections and will then be evaluated as part of the Site Conceptual Model in Section 5.

Sources are defined as where pollution comes from, pathways are a route in which the pollution travels and receptors are anything affected by a pollutant. Further details on Source-Pathway-Receptor methodology can be found in Appendix F.

The table below focuses on significant site specific sources, pathways and receptors. More 'generic' pathways and receptors (such as site end uses) will be covered as part of the full Site Conceptual Model in Section 5.

5.1 Sources

Source	Distance/ Direction	Details	Significant Risk
Current Land Use	On Site	Used as a special needs school, possible made ground from construction. Due to age of construction, asbestos and fuel contamination, TPH's and PAH's (former boiler house). Targeted ground investigation and ground gas monitoring.	Yes
Historical Land Use - Allotments	On Site	Used as open lands before being turned into Allotments post WW1, extended across site post 1936, used as allotments till late 1960's when the school was built. Possible heavy metal, TPH and PAH contamination. Ground investigation and ground gas monitoring.	Yes
Historical Ponds	120m NE 140mN 140mSE	Historical ponds backfilled >50 yrs ago, residential dwellings/roads. Cohesive strata anticipated and significantly lower elevation than site. Low risk of ground gas migration.	No
Landfill	480m W	Landfill 480m W, extensive cohesive strata, and infrastructure between sites is anticipated. Low risk.	No

5.2 Pathways and Receptors

Source	Distance/ Direction	Details	Significant Risk
Aquifers	Below Site	Bedrock geology is defined as a Principal Aquifer the pathway from surface to receptor is moderate to high risk to the west, due to limited to no superficial deposits. Extensive hard standing cover, moderate risk to the east due to anticipated cohesive strata. Possible risk from boiler house. The site does not lie within a groundwater source protection zone. No water abstractions within 750m of site	Unlikely

6 INITIAL CONCEPTUAL SITE MODEL

For details on how the conceptual model is evaluated please refer to Appendix F

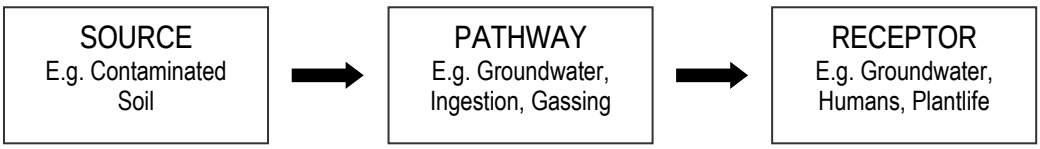
This section of the report aims to identify land which could potentially be affected by contamination, such that it could affect the value or re-use of the land, or such that mitigation would be required for certain proposed end uses of the land.

Potential contamination sources and environmentally sensitive receptors have been discussed in Section 4. Potentially significant risks are evaluated as part of the subsequent sub-sections.

6.1 Source-Pathway-Receptor Linkages

The risk assessment uses a 'Source-Pathway-Receptor' methodology for assessing whether a source of contamination could potentially lead to harmful consequences. This means that there needs to be a pollutant linkage from source to receptor for harm to be caused, this linkage consisting of: a source of pollution; a pathway for the pollutant to move along; a receptor that is affected by the pollutant.

The current potential risks to site arising from various source-pathway-receptor linkages are assessed below. A risk may be considered significant if all three of the stages are present and therefore providing a pollution linkage. The various sources, pathways and receptors are considered separately. The assessment is based on the future use, which is understood to be predominantly residential with garden areas and hard standing.



Type of Contamination	Potential Sources	Potential Pathway	Potential Receptors	Pollution Linkage	Comment	Estimated Level of Risk
Ground Gas	Made Ground Boiler House Former Allotments	Inhalation of Vapours	Construction/ Maintenance Workers	Potentially Active	Possible ground gas from boiler house and localised made ground. Possible ashy material used beneath allotment. Ground investigation and ground gas monitoring to confirm.	Moderate
		Vapours Penetrating Unprotected Buildings	Future Site Users	Potentially Active	Possible ground gas from boiler house and localised made ground. Possible ashy material used beneath allotment. Ground investigation and ground gas monitoring to confirm.	Moderate
Surface and Near Surface Contaminants Within Soils	Made Ground Boiler House Former Allotments	Ingestion, Inhalation, Dermal Contact	Current Site Users	Potentially Active	Localised potential for determinants within Made Ground, boiler house and former allotments (particularly field to east). Ground investigation to confirm.	Low/ Moderate
			Construction Workers	Potentially Active	Localised potential for determinants within Made Ground, boiler house and former allotments (particularly field to east). Ground investigation to confirm.	Low/ Moderate
			Future Site Users	Potentially Active	Localised potential for determinants within Made Ground, boiler house and former allotments (particularly field to east). Ground investigation to confirm.	Low/ Moderate
			Adjacent Land Users	Potentially Active	No significant contamination from off-site sources anticipated.	Low
		Direct Contact	Structures	Potentially Active	Possible TPH and high sulphates within the made ground from boiler house and former use as allotments.	Low/ Moderate
		Absorption in Root Zone	Plants	Potentially Active	Possible TPH, PAH, heavy metals and sulphates within the made ground from boiler house and former use as allotments.	Low/ Moderate
Mobile Contaminants, Leachables e.g. from Pollution Sources Adjacent to Site/On Site	Current Land Use	Leaching into Groundwater	Groundwater	Potentially Active	Limited migration to east of site due to anticipated cohesive strata and extensive hard standing cover to the west.	Low/Low-Moderate
		Off-site Migration in Groundwater	Abstractions	Potentially Active	No groundwater abstractions within 750m. Not in a Groundwater Source Protection Zone. No significant sources identified.	Low
			Controlled Waters	Potentially Active	Nearest controlled surface water feature >600m SW and is a cover reservoir.	Low
Organic and Inorganic Contaminants Within Soils / Groundwater	Current Land Use	Potable Water Supply Pipes	Utilities Workers	I Potentially Active	Not anticipated, possible localised TPH and PAH contamination from boiler house, unlikely to provide significant risk to pipelines. Ground investigation to confirm, then liaise with local water authority supplier.	Low/Low-Moderate

6.2 Summary

In this qualitative risk assessment, a Low-Moderate risk implies that remedial action may be necessary at the site in particularly around the boiler house, former buildings and possibly in area of former allotments, the scope of which cannot be confirmed until the intrusive investigation has been completed.

6.3 Geotechnical Constraints

- Potential Tree Heave should any cohesive stratum are encountered (east half of site only).
- Possible shallow sandstone bedrock (west and central only)
- Service restrictions.

7 FIELDWORK

7.1 Fieldwork Objectives

The objectives of the intrusive ground investigation will be to:

- Clarify the 'Initial Contamination Conceptual Model'.
- Clarify the initial risk assessment.
- Benchmark the contamination status of the site.
- Provide data for the design of any remedial works that may be required.
- Provide a geotechnical appraisal for the site

7.1.1 Site Constraints

The site still had the buildings in situ which provided access issues for the JCB excavator, with no access possible along the southern boundary region. There was also limited investigation around the building due to slopes between the terraces. Where possible, window samples were undertaken in areas inaccessible with an excavator. Details of inaccessible areas are shown on the exploratory hole location plan

7.2 Fieldwork Scope

The fieldwork was carried out on the Wednesday 23rd September 2014;

- Six (6 No) Trial Pits dug to between 2.00mbgl (TP4) and 3.10mbgl (TP1).
- Eight (8 No) window sampling small diameter boreholes drilled to between 0.40mbgl (WS7) to 3.00mbgl.
- Five (5 No) of the eight window sampling boreholes were installed with gas monitoring wells – which are to be monitored over 6 ground gas monitoring visits over a period of at least 3 months with varying barometric pressures.
- Chemical analysis (Metals, PAH's, TPH's) of fifteen (15 No) samples.
- Analysis of fifteen (10 No) samples for asbestos screening.
- Analysis of seventeen (17 No) samples for pH and water soluble sulphates.

The exploratory hole positions were selected and set out by Betts Geo Environmental Ltd (BGE) as shown on the Exploratory Hole Location Plan in Appendix B.

Prior to any intrusive works, each location was checked for services using a cable avoidance tool (CAT) and review of statutory service plans.

7.3 Targeted Ground Investigation

Several window samples were to target areas around the boiler house and former allotment.

8 GROUND CONDITIONS

8.1 General

The exploratory holes were logged by an Engineer in general accordance with the recommendations of BS5930:1999+A2:2010 Detailed descriptions, together with relevant comments, are given in the exploratory hole logs included in Appendix C. Ground conditions were very variable and as such the full logs should be consulted in conjunction with this summary.

8.2 Ground Conditions Summary

Strata	General Description	Thickness m		No of Holes Located
		Top	Base	
TOPSOIL	Grass over TOPSOIL: Dark brownish slightly gravelly sandy SILT.	0.00	1.10 (WS3)	TP4,TP6, WS2, WS3, WS4
TOPSOIL (2)	Grass over TOPSOIL: Dark brown with light orangish brown mottling slightly gravelly, sandy CLAY.	0.00	0.90 (WS7)	TP1, WS7, WS7A
MADE GROUND	MADE GROUND: Blackish brown slightly gravelly sandy CLAY. Occasionally very silty. Occasional sand and gravel of brick.	0.15	1.60 (TP1)	TP1, TP5
MADE GROUND (2)	MADE GROUND: Tarmac.	0.00	0.20 (TP2)	TP2, TP5, WS5
MADE GROUND (3)	MADE GROUND: Orange Fine SAND.	0.20	0.25	TP2, WS5
MADE GROUND (4)	MADE GROUND: Brown and black slightly clayey cobbly SAND & GRAVEL.	0.00	0.60	TP3
MADE GROUND (5)	MADE GROUND: Brown/ dark brown clayey SILT/ Silty CLAY.	0.60	1.00 (TP3)	TP3, WS1
MADE GROUND (6)	MADE GROUND: Blackish brown slightly gravelly clayey silty SAND.	0.25	0.60	WS5
MADE GROUND (7)	MADE GROUND: Flagstone/ Grey Gravel of Tarmac. Concrete Spots.	0.00	0.15	WS6
MADE GROUND (8)	MADE GROUND: Greyish brown fine to coarse sub-rounded to sub-angular GRAVEL.	0.15	0.55	WS6
MADE GROUND (9)	MADE GROUND: Greyish Purple silty gravelly fine to coarse SAND. Strong hydrocarbon Odour. Oily Looking.	0.55	0.85	WS6
Possible MADE GROUND	Dark Orangish brown slightly gravelly fine to coarse SAND.	0.40	1.20	WS2
CLAY	Firm locally soft orangish brown silty very sandy CLAY.	0.90	2.60 (TP1)	TP1, TP2

CLAY (2)	Firm to stiff reddish brown / orangish brown very silty very sandy CLAY.	0.60	1.00	WS4
CLAY (3)	Firm to stiff dark reddish brown slightly gravelly silty sandy CLAY.	1.00	3.10	TP1, TP2, WS3, WS4, WS5
SAND	Loose to Medium dense orangish becoming reddish brown slightly clayey gravelly silty SAND.	0.60	2.10 (TP5)	TP3, TP5, WS3, WS5
SAND (2)	Loose reddish brown silty fine SAND.	0.30	0.60	TP6
SILT	Brown slightly gravelly sandy SILT.	0.40	0.80	TP4
SAND & GRAVEL	Medium dense locally loose reddish brown SAND & GRAVEL.	0.60	1.90	TP3, TP6, WS7A
SAND / SILT	Loose to medium dense orangish brown/ reddish brown silty SAND / sandy SILT.	0.80	1.40	TP4
SANDSTONE	Weak to very weak reddish brown fine grained SANDSTONE.	0.80 (WS1)	2.40	TP3,TP4, TP5, TP6, WS1, WS3, WS5, WS6, WS7A

8.3 Visual and Olfactory Contamination

There was a strong olfactory and slight visual contamination in WS6 near the boiler house. There was no other significant visual or olfactory contamination on site other than the Made Ground stated within the exploratory borehole logs and the following details below:

Exploratory Hole	Depth (mbgl)	Strata	Remark
TP1	0.30 – 1.60	MADE GROUND	Slight organic odour.
TP2	0.25 – 0.90	MADE GROUND	Slight hydrocarbon odour.
WS5	0.25 – 0.60	MADE GROUND	Slight hydrocarbon odour.
WS6	0.55 – 0.85	SAND	Greyish Purple silty gravelly fine to coarse SAND. Strong hydrocarbon Odour. Oily Looking.

8.4 Obstructions

All exploratory holes terminated on sandstone bedrock with the exception of the following;

Exploratory Hole	Depth (mbgl)	Strata	Remark
WS7	0.4	MADE GROUND	Hole terminated at 0.40m on Concrete Boulder

8.5 Groundwater - Fieldwork

All exploratory holes were recorded as dry during the fieldwork with the exception of the following;

Exploratory Hole	Depth (mbgl)	Strata	Remark
TP2	0.25 – 0.50	MADE GROUND	Slight Seepage

8.6 Groundwater – Post-Field Work Monitoring

The table below indicates groundwater encountered during the monitoring post fieldwork, details are below;

Exploratory Hole	Depth to Water (mbgl)		Borehole Depth (mbgl)	
	Min	Max	Min	Max
WS1	Dry	Dry	0.73	0.74
WS4	Dry	0.61	2.98	3.00
WS5	Dry	0.91	1.40	1.63
WS6	Dry	Dry	0.64	0.65
WS7A	Dry	Dry	1.37	1.49

9 LABORATORY TESTING

9.1 General

An assessment of potential determinands associated with the former uses and previous investigations has been undertaken.

Determinands originating from the former site uses may include metals, polycyclic aromatic hydrocarbons and total petroleum hydrocarbons. No significant determinands associated with former or current surrounding land uses are anticipated. A general suite of testing should detect most potential contaminants.

9.2 Scheduled Chemical Testing: Soils

Soil was sent to a UKAS accredited laboratory, and were generally analysed in accordance with ISO 17025 and/or MCERTS accreditation. The results are summarised in tabular and/or graphical form in Appendix D.

Chemical Test	No. of Samples	Comment/Method
pH Values	17	Determination of pH (using Cyberscan pH meter).
Sulphate - Soluble 2:1 Extract	17	Dionex.
Arsenic, Cadmium, Chromium VI, Chromium III, Total Chromium, Lead, Mercury, Selenium, Copper, Nickel, Complex and Free Cyanide and Zinc.	15	Soil samples were analysed in accordance with UKAS/MCERTS standards Inductively coupled plasma atomic emission spectroscopy (ICP-OES)
Speciated Polycyclic Aromatic Hydrocarbons (PAH),	15	Determination of Polycyclic Aromatic Hydrocarbons by GC-MS. End/end extraction using DCM on as received sample. In house method modified USEPA 8270. Include coronene if required.
TPH CWG	15	TPH CWG (Aliphatics C5-6,>6-8,>8-10,>10-12,>12-16,>16-21,>2-35) (aromatics >C5-7,>7-8,>8-10,>10-12,>12-16,>16-21,>21-35) C5-8 fractions by Headspace GC-MS (003S). C8-35 fractions on as received sample extracted with hexane/acetone, aliphatic/aromatic splits run by GC-FID (005S), banded as listed above.
GRO/BTEX/MTBE by GC-FID (C5-10; C10-C12)	15	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12).
Organic Matter	15	Determination of Organic Matter by combustion.
Asbestos Screen	10	Visual Screening for Fibres.
Atterburg's	3	BS1377 Part 2. 1990, 4.3,5.3,5.4
Moisture Content	3	BS1377 Part 2. 1990, 3.2

10 CONTAMINATION ASSESSMENT

10.1 General

Contaminants of concern recorded at concentrations above relevant screening values are summarised below. For ease of description, the identification of contaminant sources and possible re-use of material, Made Ground, Natural Strata and Groundwater will be dealt with in separate sub-headings in this section of the report where required.

Our assessment is based on the following assumptions:

- The proposed site end use in of a high risk rating (residential housing with gardens). For analysis purposes, 'residential with home grown produce' is deemed most appropriate end use.
- The superficial deposits of Glacial Till Clay are classed as an Unproductive Strata (Negligible Permeability).
- The bedrock deposits of the Chester Pebble Beds and Wilmslow Sandstone Formations are classed as a Principal Aquifer (High Permeability).
- It is deemed that some statistical analysis is appropriate. Where sample data numbers are low and/or targeted, each determinant result is however reviewed further as an individual result as opposed to an average across the site.
- Site history has indicated a Low/Moderate risk of contamination.
- Statistical analysis of the chemical test results has been undertaken in general accordance with Environment Agency 2009 SGV Guidance and LQM/CIEH GAC's using the combined assessment criterion given by CLEA (Note: all SSVs for EA derivation are for a SOM of 6%, in line with Environment Agency Report SC050021/SR4 – this figure is deemed representative as an average value for a sandy loam soil). LQM/CIEH 2009 GAC's are used to the nearest SOM percentage deemed appropriate.
- No free product was noted within the exploratory holes.
- Following the withdrawal of CLR 7-10 Guidance documents by the Environment Agency, statistical analysis has been undertaken in accordance with the CIEH/CL:AIRE 'Guidance on Comparing Soil Contamination Data with a Critical Concentration' (May 2008). As such, the use of the mean value test alone is not considered.

A full risk assessment is detailed within Section 10 of this report.

10.2 Soils Contamination Summary

10.2.1 Topsoil

All determinants for TPH's, PAH's and Metals fall below the residential home grown produce guidance levels within the Topsoil.

10.2.2 Made Ground

All determinants for TPH's, PAH's and Metals fall below the residential home grown produce guidance levels within the Made Ground, with the exception of the TPH Ali C12-C16 as detailed below;

Determinant	Location	Depth (mbgl)	Concentration (mg/kg)	SGV v SOM (mg/kg)
Ali C12-C16	WS6	0.60	358	24 (1%SOM)

10.2.3 Asbestos

Ten (10 No) samples were tested across the site within the made ground and topsoil, no asbestos was detected.

10.2.4 Natural Strata

All determinants for TPH's, PAH's and Metals fall below the residential home grown produce guidance levels within the Natural Strata.

10.3 Groundwater Contamination

No significant groundwater was encountered on site.

11 ENVIRONMENTAL RISK ASSESSMENT

11.1 General

This section assesses likely risks to the identified receptors, arising from potential contamination sources. It provides a final qualitative assessment of the risks involved, indicating whether (where appropriate) any immediate action is required to mitigate certain risks.

In assessing the risk qualitatively, it is appropriate to use the methods outlined in the CIRIA document C552, "Contaminated Land Risk Assessment a Guide to Good Practice". It uses a classification of risk based on the magnitude of the potential consequence or severity of risk occurring, compared with the magnitude of the probability or likelihood of the risk occurring. These are indicated on the attached tables in Appendix H.

11.2 Assessment of Contamination Analytical Results

There was one elevated level that exceeded the guidance of 'Residential with Homegrown Produce' (ATrisk 2009) for Ali C12-C16 WS6 0.60m, therefore additional risk assessment is required.

There are no superficial deposits recorded to the west and Glacial Till to the east (east of WS5) and the sandstone bedrock is classed a Principal Aquifer (high permeability). Therefore the site's environmental setting is considered to be a moderate to high environmental sensitivity. With respect to human health, the proposed end use (residential use with home-grown produce) is of high sensitivity. Transient risks to construction workers can be addressed by the adoption of appropriate health and safety measures (see Section 14.2).

The area around WS6 is in the vicinity of the current boiler house, it is likely at some point in the past there was a fuel tank in the area, as there was a strong odour of hydrocarbons and there was visual evidence. The level of Ali C12-C16 was 358mg/kg v SGV of 24mg/kg (1% SOM). The maximum value is an outlier, therefore is classed as a hotspot. All other holes apart from WS3 showed no evidence of TPH's, however TP2 noted hydrocarbon odour. WS3 showed Ali C12-C16 of 55.1mg/kg v SGV of 142mg/kg (6% SOM). This is provisional evidence of a possible small hydrocarbon plume in this area, further TPH testing in the vicinity of WS6 and WS3 post demolition is required to delineate extent of TPH contamination.

The boilers will need removing and validating by an appropriate engineer, post demolition delineation and testing.

11.3 Groundwater Risk Assessment

The site has limited to no superficial deposits to the west and Glacial Till to the east and in most cases is straight on to sandstone bedrock. The fieldwork and two visits post fieldwork have shown all holes to be dry.

The lack of groundwater indicates low migration potential risk, with precipitation being the principal driver of any contamination into the bedrock and aquifer within vicinity of WS3 and WS6. As it is proposed that this source will be removed as part of the demolition/remediation, the risk to the aquifer is deemed low.

12 GROUND GAS ASSESSMENT

12.1 Ground Gas Requirements – Radon

BRE211 (2007) Radon: guidance on protective measures for new buildings shows it is in a lower probability area, as less than 1% of homes are above the action level. Therefore no Radon protective measures are necessary in the construction of new dwellings or extensions.

12.2 Ground Gas Assessment

12.2.1 Summary of Results

The ground gas monitoring has now been completed and is summarised below;

Borehole Number	Methane (%)	Carbon Dioxide (%)	Oxygen (%)	Atmospheric Pressure (mB)	Peak Flow (l/hr)	GSV CH_4	GSV CO_2	No. of Visits
WS1	0.0	0.1-0.7	19.9-20.4	1000-1025	0.3	0.000	0.002	6
WS4	0.0	1.2-2.9	17.7-20.3	1000-1025	14.9	0.015	0.432	6
WS5	0.0	0.3-0.7	19.7-20.9	1000-1025	0.1	0.000	0.001	6
WS6	0.0	0.1-0.3	20.4-20.9	1000-1025	0.2	0.000	0.001	6
WS7A	0.0	0.4-0.9	20.1-20.9	1000-1025	0.3	0.000	0.003	6

12.2.2 Guidance

Three recent publications are used for ground gas risk assessment:

- 'Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present', Report Edition No.04 March 2007 NHBC – designed for use with low rise residential properties
- CIRIA C665 'Assessing risks posed by hazardous ground gases for buildings' 2007 - for high rise residential / flats
- BS8485:2007 'Code of practice for the characterization and remediation from ground gas in affected developments'

12.2.3 Gas Recommendations

The ground gas monitoring has now been completed and the ground gas protection measures are summarised below;

Site Area	Site Classification	Recommended Ground Gas Protection Measures
Rest of Site	Green	No specialist ground gas protection is required.

It is anticipated that hydrocarbon contamination encountered in the boiler house area is removed and validated, however if this is to remain in place then a hydrocarbon resistant membrane may be required within plots proposed in this area. Further investigation post demolition is required to confirm.

13 REVISED CONCEPTUAL SITE MODEL

13.1 General

The Initial Conceptual Site Model has been amended in light of data obtained during the ground investigation, most notably the absence of any contaminated soil in relation to the screening criteria for the proposed end use.

13.2 Final Conceptual Site Model

This section reassesses likely risks to the identified receptors, arising from potential contamination sources. It provides a final qualitative assessment of the risks involved, indicating whether (where appropriate) any immediate action is required to mitigate certain risks. It also discusses (where appropriate) what longer term measures or remedial works may be required in the future if the site were to be developed. It is considered that the site has not been assessed by the Local Authority as a contaminated site under the terms of the Environmental Protection Act 1990 Part IIa.

Target (Receptor)	Potential Source-Pathway Linkage	Remedial Action Required (where appropriate)	Est. Degree of Risk to Target Following Remedial Action Where Necessary
Site End Users	Inhalation of soil gases, odours or dust.	No specialist ground gas measures. Potential hydrocarbon membrane within plots in vicinity of WS6	Low
Site End Users	Ingestion of, and skin contact with, contaminated soil.	Further investigation post demolition. Boiler removal and validation.	Low
Site End Users	Ingestion of contaminants in vegetables etc. or in soils adhering to vegetables, etc	Further investigation post demolition. Boiler removal and validation.	Low
Construction/ Maintenance Workers.	Inhalation of soil gases, odours or dust.	PPE	Low **
Construction/ Maintenance Workers.	Ingestion of, and skin contact with, contaminated soil	PPE	Low **
Plants	Adverse effects on growth caused by presence of contaminants in soil	Further investigation post demolition. Boiler removal and validation.	Low
Buildings and Structures	Flow of ground gas into buildings. Asphyxiation, toxicity, explosion and fire hazards	No specialist ground gas measures. Potential hydrocarbon membrane within plots in vicinity of WS6	Low
Foundations	Sulphate attack of foundations	Foundations to be designed as per section 15.4.	Low
Water Supplies	Hydrocarbons penetrating plastic water supply pipes.	United Utilities pipeline risk assessment required.	Low
Groundwater	Migration of soluble contaminants into groundwater on or off site	Removal of boilers in vicinity of WS6 and delineation post demolition.	Low
Surface Water	Migration of soluble contaminants and/or direct run-off of contaminants	No remedial action required.	Low

** assumes basic PPE is used

14 OUTLINE STRATEGY FOR RISK REDUCTION/REMEDIATION STRATEGY

14.1 General

The following section details any recommendations and to reduce risk on site and recommended remedial actions (as per the previous sections of this report). For clarity, the section is split into sub-sections as per the conceptual site model (Section 13).

14.2 Construction/Maintenance Workers

Though no significant contamination was encountered on site, the following recommendations should be adhered to during site works:

- Site workers should wear gloves, boots and overalls and wash their hands before eating, drinking and smoking. Excessive dust generation should be avoided.
- It is recommended that during all excavations adequate ventilation should be maintained. If man entry is required, gas monitoring should be carried out as a precaution.
- If areas of suspected contamination are found then a suitably qualified person should undertake appropriate sampling, testing and further risk assessment.
- Asbestos was not encountered on site, vigilance should be adhered and any suspected asbestos should be notified and a suitably qualified.

14.3 Site-End Users

There is TPH contamination Ali C12-C16 in WS6, with evidence of migration in WS3, post demolition delineation and testing required.

Given that the hydrocarbon contamination is anticipated to be small and localised to this former boiler house area, it is anticipated that is area is delineated, excavated, and removed from beneath plots and garden areas. Depending on finished floor levels, roads, public open space, it may be possible to use the contaminated Made Ground beneath, roads and public open space to reduce the need for disposal, subject to geotechnical viability and further chemical testing and risk assessment.

Following removal of contamination within the affected garden areas in the vicinity, no additional cover systems will be required. A nominal 300mm growing medium will be required (made up from at least 150mm topsoil and 150mm subsoil) as per NHBC guidance. It is likely that this is made up from a combination of on site and off site sources.

Further investigation is required post demolition of the existing buildings to clarify and confirm the findings of this investigation and the remedial actions proposed. It is anticipated that at this stage proposed layouts and site levels will be confirm and will be able to be factored in to remedial actions proposed.

14.4 Groundwater Risk Assessment and the Aquifer

Negligible risk anticipated post removal of the boiler house/hydrocarbon contamination.

14.5 Piped Drinking Water Supplies

The use of Protect-a-Line is not anticipated, if the contamination plume within WS6 and WS3 is remediated. Further risk assessment is required upon detailed site layout plans. Further liaison with the water provider is required.

14.6 Off-Site Disposal of Surplus Soil

It is recommended that the results of the contamination testing (including the history of the site) be presented to the proposed landfills, to obtain their acceptance of the information to date and to determine the actual WAC limits used by them, (see Appendix J for further guidance). Segregation of made ground and natural should be possible given the chemical analysis and very different visual identification.

15 GEOTECHNICAL ASSESSMENT

15.1 Introduction

It is understood that the proposed development will consist of construction of residential properties with associated rear gardens, associated infrastructure, public open space and new highway.

15.2 Site Preparation and Excavation

All excavations should be planned and due consideration should be given to providing temporary support or suitable battering. Excavations should be regularly inspected by a competent person to ensure continued safety. Further advice on the safety of excavations is given *in Health and Safety in Construction.* Shallow (<1.20mbgl) excavations for service trenches could be complicated by shallow bedrock.

15.3 Control of Groundwater

No significant groundwater was encountered, post fieldwork monitoring shows all holes to be dry. It is likely that provision of pumping/shuttering will be necessary during excavation of foundation trenches during wet weather, close to existing ditches and to deeper excavations for sewers etc. It is good practice to have such equipment on standby in case of seasonal / abnormal weather conditions.

15.4 Foundations

The site slopes 60m AOD from the west to 48m AOD to the east, the current building has been benched in and constructed on relatively flat terraces. Careful consideration to the existing slope levels is required

Plots 7 and 8 may be complicated due to the transition from shallow bedrock (circa 1.00m) and to firm to stiff clay (circa 2.00-2.50m). Post demolition investigation is required in vicinity of WS5 and within the building footprint to confirm.

Bearing capacities anticipated on natural strata encountered are as follows:

- Firm to stiff brown CLAY strata with an allowable bearing pressure of 125kN/m^2
- Weathered SANDSTONE strata an allowable bearing pressure of 175kN/m^2
- Weak SANDSTONE strata an allowable bearing pressure of 250kN/m^2

Localised deepening of foundations and/or piled foundations are likely to be required in the vicinity of trees, existing and historical buildings. A foundation zoning plan should be undertaken post demolition to determine areas that are not affected by shallow rock.

Foundations should be excavated wholly on one stratum. Should proposed foundations span different strata, trenching and stepping of foundations and/or nominal reinforcement will be required. A foundation zoning plan should be undertaken when proposed levels are made available.

Calculations on the allowable bearing capacity indicate settlements of less than 25mm for a square pad using the above allowable bearing capacity.

15.5 Ground Floor Construction

Suspended floor construction e.g. either in-situ RC slabs or block and beam flooring is recommended as per NHBC guidance.

15.6 Soakaways

Due to the sloping nature of the site, and underlying cohesive material/bedrock, soakaways are unlikely to be a suitable surface water drainage option, however in situ testing will be required to confirm.

15.7 Heave / Shrinkage Potential

A summary of Atterburg limit tests is shown below. Full results are located in Appendix D.

Exploratory Position ID	Depth (m)	% <425um	% Plasticity Index	Modified Plasticity Index %	NHBC Modified Plasticity Level
TP1	2.70	88	18	15.8	LOW
TP2	2.00	82	19	15.6	LOW
WS4	1.50	82	20	16.4	LOW

Low plasticity is evident; foundation design for tree heave protection could be designed accordingly following discussion with the NHBC.

15.8 Highway

According to the criteria of Highways Agency HD 25/95 Volume 7 Section 2 Part 2 HD 25/94, a CBR value of 3-5% on the firm to stiff clay/weathered sandstone is anticipated, however confirming in-situ CBR's should be undertaken. Placement of geotextiles within the areas of roads / parking could also be designed to minimise the subgrade thickness.

15.9 Protection of Buried Concrete

It is considered for concrete design purposes that brownfield site and mobile groundwater conditions are applicable, the results are summarised below:

Concrete Classification	
Design Sulphate Class	DS-1
ACEC Class	AC-1
Design Chemical Class	DC-1

15.10 Further Investigation

The following additional site investigation is advisable post demolition:

- Delineate the extent of and testing of soils within vicinity of WS6 and WS3 for TPH and contamination from the boiler house. This is not possible until after demolition due to the restriction from existing buildings, walls, trees and services.
- Investigate areas previously inaccessible due to existing buildings, services, vegetation and services, post demolition.
- Delineation the shallow bedrock/Glacial Till boundary to the east of WS5.
- Determine depth of sandstone bedrock beneath the existing buildings post demolition.

16 REFERENCES

16.1 *Betts Geoenvironmental Ltd Watergate School, Speke Road, Liverpool August 2014 Ref 14RED080/DS.*

16.2 *Flood Risk Assessment and Drainage Management Strategy – Watergate School, Woolton, Liverpool Sept 2014, Red541-FRA&DMS Rev 2.1 Final*

16.3 *BS 5930:1999+A2 Code of Practice for Site Investigation.*

16.4 *BS1377: 1990 Methods of Test for Soils for Civil Engineering Purposes.*

16.5 Assessment of risks to human health from land contamination: an overview of the development of guideline values and related research. EA, 2002

16.6 *Contaminated Land Risk Assessment; A Guide to Good Practice; CIRIA C552: 2001.*

16.7 *Health and Safety in Construction, HSG150, HSE, 1996.*

16.8 *Hazardous Waste: Interpretation of the Definition and Classification of Hazardous Waste, Environment Agency, WM2 Version 1.0, June 2003.*

16.9 *DoE (1991), The Building Regulations Approved Document C, Site Preparation and Resistance to Moisture, HMSO*

16.10 *Baker W (1987), Investigation Strategy - lecture at City of Birmingham Development Department Symposium on Methane Generating Sites, 9 December 1987, Industrial Research Laboratories, Birmingham*

16.11 *NHBC Standards, Chapter 4.2, 2003 Building Near Trees*

16.12 *Highways Agency HD 25/95 volume 7 section 2 Part 2 HD 25/94*

16.13 *Water Regulations Advisory Scheme (2002) The selection of materials for water supply pipes to be laid in contaminated land*

16.14 *Anon (1997) Dutch in Policy Retreat on Contaminated Land ENDS (Environmental Data Services), 269, 46*

16.15 *Water Regulations Advisory Scheme (2002) The selection of materials for water supply pipes to be laid in contaminated land*

16.16 *Piling In Layered Ground: Risks to Groundwater and Archaeology Science Report SC020074/SR Environment Agency October 2006*

16.17 *Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention National Groundwater & Contaminated Land Centre report NC/99/73 F J Westcott, C M B Lean & M L Cunningham May 2001*

16.18 *'Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present', Report Edition No.04 March 2007 NHBC – designed for use with low rise residential properties*

16.19 *CIRIA C665 'Assessing risks posed by hazardous ground gases for buildings' 2007 - for high rise residential / flats*

16.20 *BS8485:2007 'Code of practice for the characterization and remediation from ground gas in affected developments'*

16.21 *BRE 414 'Protective measures for housing on gas-contaminated land' Roger Johnson, Parkman Environment 2001*

16.22 *BS 8500- 1:2006 'Concrete – Complementary British Standard to BS EN 206-1 – Part 1: Method of specifying and guidance for the specifier' November 2006*

16.23 *'Planning Policy 23:Planning and Pollution Control' Office of the Deputy Prime Minister 2004*

16.24 *CLR11 'Model Procedures for the Management of Land Contamination' DEFRA 2004*

16.25 *BRE 465 'Cover Systems for Land Regeneration' 2004*

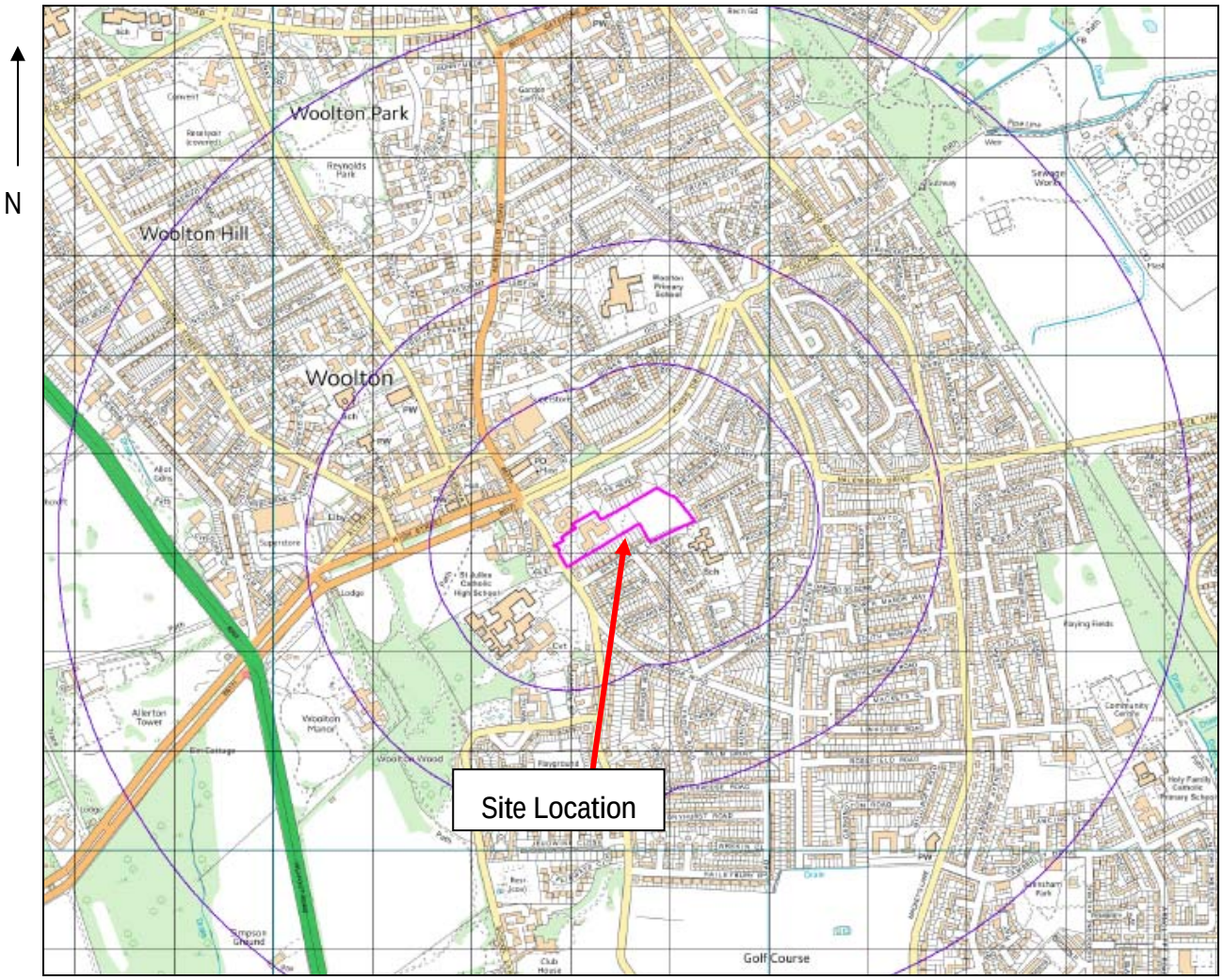
16.26 *'The UK Approach for Evaluating the Human Health Risks from Petroleum Hydrocarbons in Soils, Environment Agency Science Report P5-080/TR3', Environment Agency (May 2005)*

16.27 *TOX12- Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans. Dioxins, Furans and Dioxin-like PCBs' Environment Agency 2003*

16.28 *The LQM/CIEH GAC for Human Health Risk Assessment 2009 second edition*

APPENDIX A

(i) Site Location Plan



Site Location Plan
Watergate School, Speke Road, Liverpool, L25 8QH (coordinates for centre of site 342710, 386650).

BETTS ASSOCIATES
GEO ENVIRONMENTAL

APPENDIX B

(i) Betts Exploratory Hole Location Plan

(ii) Betts Indicative Geology Depth Map

NOTES

DO NOT SCALE

THIS DRAWING SHOWS THE INDICATIVE LOCATION OF EXPLORATORY HOLES UNDERTAKEN BY BETTS GEO-ENVIRONMENTAL LTD IN 2014.

THE PLAN OVERLAYS THE EXISTING LAYOUT.

KEY

TP1 — INDICATIVE LOCATION OF TRIAL PIT

WS1 — INDICATIVE LOCATION OF WINDOW SAMPLE

WS1 * — INDICATIVE LOCATION OF WINDOW SAMPLE INSTALLATION

RESTRICTED ACCESS FOR JCB / WS RIG

RESTRICTED ACCESS DUE TO BUILDINGS

RESTRICTED ACCESS DUE TO SERVICES

REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS: DRAFT

BETTS ASSOCIATES
GEO ENVIRONMENTAL
Unit 6, Old Marsh Farm Barns, Welsh Road, Sealand, Flintshire CH5 2LY
Tel: 01244 288178 Fax: 01244 288516 enquiries@betts-associates.co.uk

REDROW

PROJECT: WATERGATE SCHOOL, LIVERPOOL, MERSEYSIDE

TITLE: EXPLORATORY HOLE LOCATION PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
23/09/14	1:1000 @ A3	PH	SM

PROJECT No:	DRAWING No:	REV:
14RED080	002	-

N

Marie Curie Centre

TP1
0.00 - 0.30m
0.30 - 1.60m MG
1.60 - 2.60m
2.60 - 3.10m

TP2
0.00 - 0.90m MG
0.90 - 2.00m
2.00 - 3.00m

TP3
0.00 - 1.00m MG
1.00 - 2.20m
2.20 - 2.40m BNE

TP4
0.00 - 0.80m
0.80 - 1.40m
1.40 - 1.90m
1.90 - 2.00m BNE

TP5
0.00 - 0.60m MG
0.60 - 2.10m
2.10 - 2.30m BNE

TP6
0.00 - 0.30m
0.30 - 0.60m
0.60 - 1.90m
1.90 - 2.00m BNE

WS1 *
0.00 - 0.70m MG
0.70 - 0.80m BNE

WS2
0.00 - 0.40m
0.40 - 1.20m MG

WS3
0.00 - 1.10m
1.10 - 1.70m
1.70 - 2.20m
2.20 - 2.30m BNE

WS4 *
0.00 - 0.60m
0.60 - 3.00m

WS5 *
0.00 - 0.60m MG
0.60 - 1.10m
1.10 - 1.60m
1.60 - 1.70m BNE

WS6 *
0.00 - 0.85m MG
0.85 - 0.90m BNE

WS7
0.00 - 0.40m

WS7A *
0.00 - 0.90m
0.90 - 1.45m
1.45 - 1.50m BNE

WOOLTON STREET

WATERGATE LANE

WOODROCK ROAD

NOTES

DO NOT SCALE

THIS DRAWING INDICATES THE GROUND CONDITIONS ENCOUNTERED RECORDED DURING SITE INVESTIGATION IN SEPTEMBER 2014. FULL EXPLORATORY HOLE LOGS SHOULD BE REVIEWED IN CONJUNCTION WITH THIS DRAWING.

KEY

TP1	INDICATIVE LOCATION OF TRIAL PIT
WS1	INDICATIVE LOCATION OF WINDOW SAMPLE
WS1 *	INDICATIVE LOCATION OF WINDOW SAMPLE INSTALLATION
	RESTRICTED ACCESS FOR JCB / WS RIG
	RESTRICTED ACCESS DUE TO BUILDINGS
	RESTRICTED ACCESS DUE TO SERVICES
0.00 - 0.40m	TOPSOIL DEPTH mbgl
0.30 - 1.00m MG	DEPTH OF MG mbgl
0.00 - 0.40m	DEPTH OF SOFT TO FIRM CLAY
0.00 - 0.40m	DEPTH OF FIRM TO STIFF CLAY
0.00 - 0.40m	DEPTH OF LOOSE SAND
0.00 - 0.40m	DEPTH OF LOOSE TO MEDIUM DENSE SAND
0.00 - 0.40m	DEPTH OF MEDIUM DENSE SAND & GRAVEL
0.00 - 0.40m	DEPTH OF LOOSE TO MEDIUM DENSE SAND/SILT
2.90 - 3.00m	DEPTH OF SANDSTONE (BEDROCK) mbgl
BNE	BASE NOT ENCOUNTERED

REV	DATE	BY	DESCRIPTION	CHK

DRAWING STATUS: DRAFT

BETTS ASSOCIATES
GEO ENVIRONMENTAL
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Tel: 01244 288178 Fax: 01244 288516 enquiries@betts-associates.co.uk

REDROW

PROJECT: WATERGATE SCHOOL, LIVERPOOL, MERSEYSIDE

TITLE: SIMPLIFIED GROUND CONDITIONS PLAN

DATE:	SCALE @ SIZE:	DRAWN:	CHECKED:
16/10/14	1:1000 @ A3	PH	SM

PROJECT No:	DRAWING No:	REV:
14RED080	003	-

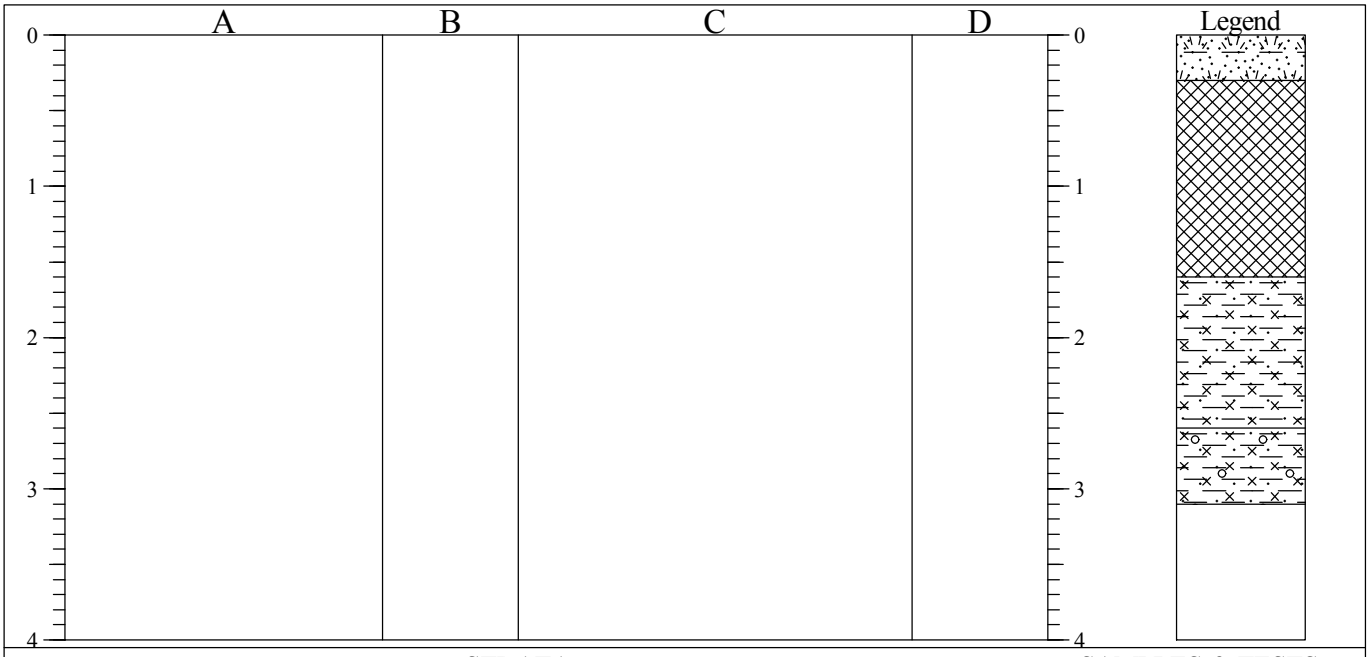
APPENDIX C

(i) Betts Exploratory Hole Logs

Betts Geoenvironmental Ltd
Old Marsh Farm Barns, Unit 6-7, Welsh Road
Flintshire, CH5 2LY
Telephone: 01244 288 179

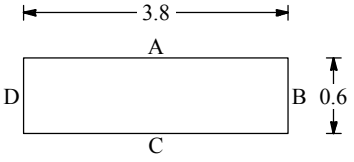
TRIAL PIT LOG

Project				TRIAL PIT No
Watergate School, Woolton, Liverpool				**TP1**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
14RED080	23-09-14	52.51		
Contractor				Sheet
BETTS GEOENVIRONMENTAL LTD				1 of 1



STRATA				SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Grass over TOPSOIL: Dark brown with occasional light brown mottling slightly gravelly silty sandy CLAY. Occasionally very silty. Occasional gravel of slate and brick. Rare cobble of brick.	0.10	ES	
0.30-1.60		Rare coal. MADE GROUND: Blackish brown slightly gravelly sandy CLAY. Occasionally very silty. Occasional sand and gravel of brick. 0.80 Brown clay drain fragments. 0.80 - 1.50 Cobbles of brick, burnt timber, dressed sandstone, metal pipe, slight organic odour. Wet.	0.80	ES	
1.60-2.60		Firm locally soft orangish brown silty very sandy CLAY. Occasional sand pockets.			
2.60-3.10		2.50 Firm locally stiff. Firm to stiff dark reddish brown slightly gravelly silty sandy CLAY. Rare sand sized coal.	2.70	D	

Shoring/Support:
Stability: Stable.



GENERAL REMARKS

Dry.
Hole terminated at on sandstone bedrock.

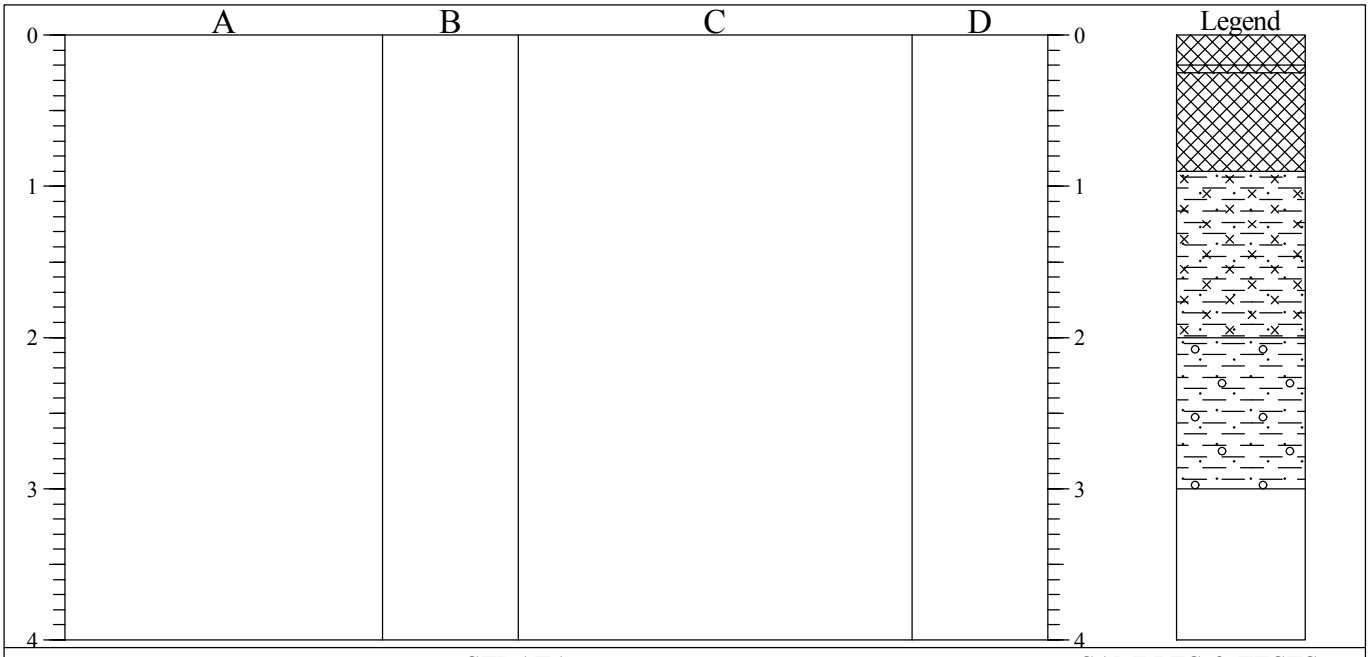
All dimensions in metres Scale 1:50	Client Redrow Homes (Lancashire)	Method/ Plant Used JCB 3CX	Logged By SM

AGS3 UK TP 14RED080 - WATERGATE SCHOOL, WOOLTON, LIVERPOOL.GPJ GINT STD AGS 3_1.GDT 24/9/14

Betts Geoenvironmental Ltd
Old Marsh Farm Barns, Unit 6-7, Welsh Road
Flintshire, CH5 2LY
Telephone: 01244 288 179

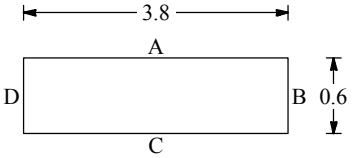
TRIAL PIT LOG

Project				TRIAL PIT No
Watergate School, Woolton, Liverpool				TP2
Job No	Date	Ground Level (m)	Co-Ordinates ()	
14RED080	23-09-14	52.75		
Contractor				Sheet
BETTS GEOENVIRONMENTAL LTD				1 of 1



STRATA				SAMPLES & TESTS		
Depth	No	DESCRIPTION		Depth	No	Remarks/Tests
0.00-0.20		MADE GROUND: Tarmac.				
0.20-0.25		MADE GROUND: Orange fine SAND.				
0.25-0.90		MADE GROUND: Blackish brown slightly gravelly clayey silty SAND. Ashy to very ashy. Slight hydrocarbon odour. Rare timber.		0.60	ES	
0.90-2.00		Firm light brown/orangish brown silty very sandy CLAY. Occasionally clayey silty SAND/sandy SILT pocket.				
2.00-3.00		Firm to stiff reddish brown slightly gravelly sandy CLAY. Rare sand of coal.		2.00	D	

Shoring/Support:
Stability: Stable.



GENERAL REMARKS

Slight seepage 0.25-0.50m. Hole terminated at on sandstone bedrock.

All dimensions in metres Scale 1:50	Client Redrow Homes (Lancashire)	Method/ Plant Used JCB 3CX	Logged By SM

AGS3 UK TP 14RED080 - WATERGATE SCHOOL, WOOLTON, LIVERPOOL.GPJ GINT STD AGS 3_1.GDT 24/9/14

Betts Geoenvironmental Ltd
Old Marsh Farm Barns, Unit 6-7, Welsh Road
Flintshire, CH5 2LY
Telephone: 01244 288 179

TRIAL PIT LOG

Project				TRIAL PIT No
Watergate School, Woolton, Liverpool				TP3
Job No	Date	Ground Level (m)	Co-Ordinates ()	
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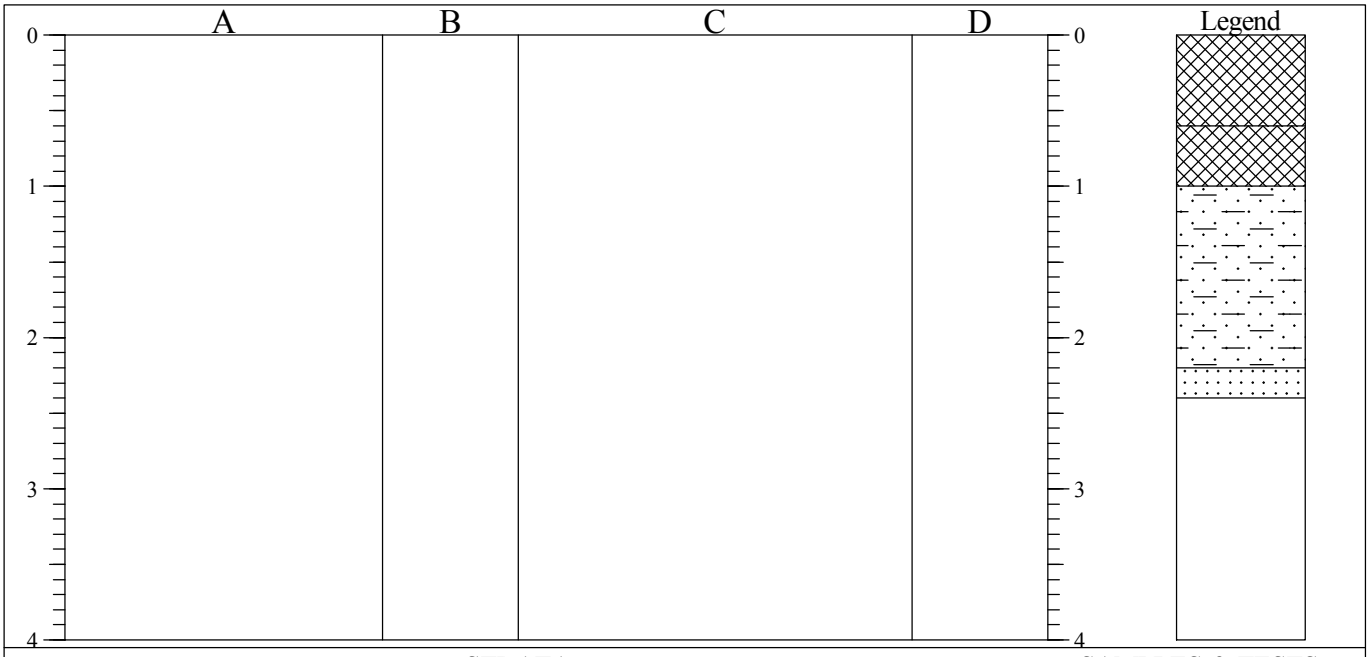
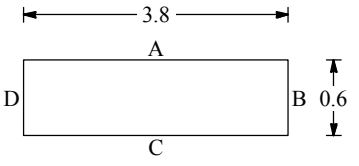
Contractor				Sheet
BETTS GEOENVIRONMENTAL LTD				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.60		Grass/vegetation over MADE GROUND: Brown and black slightly clayey cobbly SAND & GRAVEL. Occasional dressed sandstone. Gravel and cobbles of brick and concrete. Rare pocket of ash. Occasional slate. Rare pottery.	0.40	ES	
0.60-1.00		MADE GROUND: Brown/dark brown clayey SILT/silty CLAY. Occasional boulder of dressed sandstone.			
1.00-2.20		Medium dense orangish becoming reddish brown slightly clayey silty SAND. Occasional clay pocket. 1.60 - 2.20 Occasional to rare slightly gravelly sandy CLAY pocket.			
2.20-2.40		Weak to very weak reddish brown fine grained SANDSTONE.			

Shoring/Support:
Stability: Stable.



GENERAL REMARKS

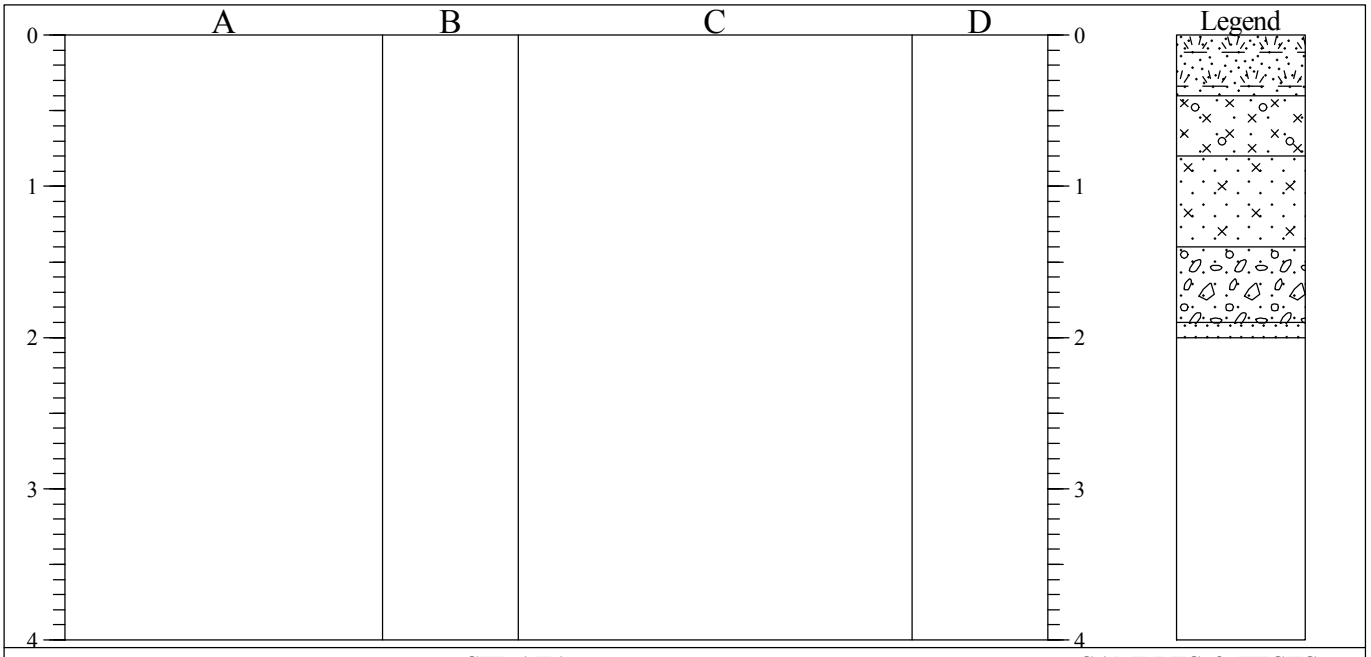
Dry.
Hole terminated at on sandstone bedrock.

All dimensions in metres Scale 1:50	Client Redrow Homes (Lancashire)	Method/ Plant Used JCB 3CX	Logged By SM

Betts Geoenvironmental Ltd
Old Marsh Farm Barns, Unit 6-7, Welsh Road
Flintshire, CH5 2LY
Telephone: 01244 288 179

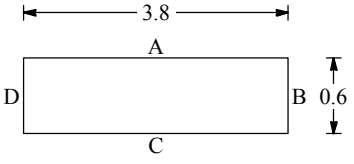
TRIAL PIT LOG

Project				TRIAL PIT No
Watergate School, Woolton, Liverpool				**TP4**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
14RED080	23-09-14	58.96		
Contractor				Sheet
BETTS GEOENVIRONMENTAL LTD				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.40		Grass over TOPSOIL: Brown slightly gravelly sandy SILT with occasional clay pocket. Frequent roots and rootlets. Occasional brick, slate cobbles. Rare dressed sandstone cobble.	0.20	ES	
0.40-0.80		Brown slightly gravelly sandy SILT.			
0.80-1.40		Loose to medium dense orangish brown/reddish brown silty SAND/sandy SILT.			
1.40-1.90		Medium dense locally loose reddish brown SAND & GRAVEL. (Weathered Sandstone).			
1.90-2.00		Weak reddish brown fine grained SANDSTONE.			

Shoring/Support:
Stability: Stable.



GENERAL REMARKS

Dry.
Hole terminated at on sandstone bedrock.

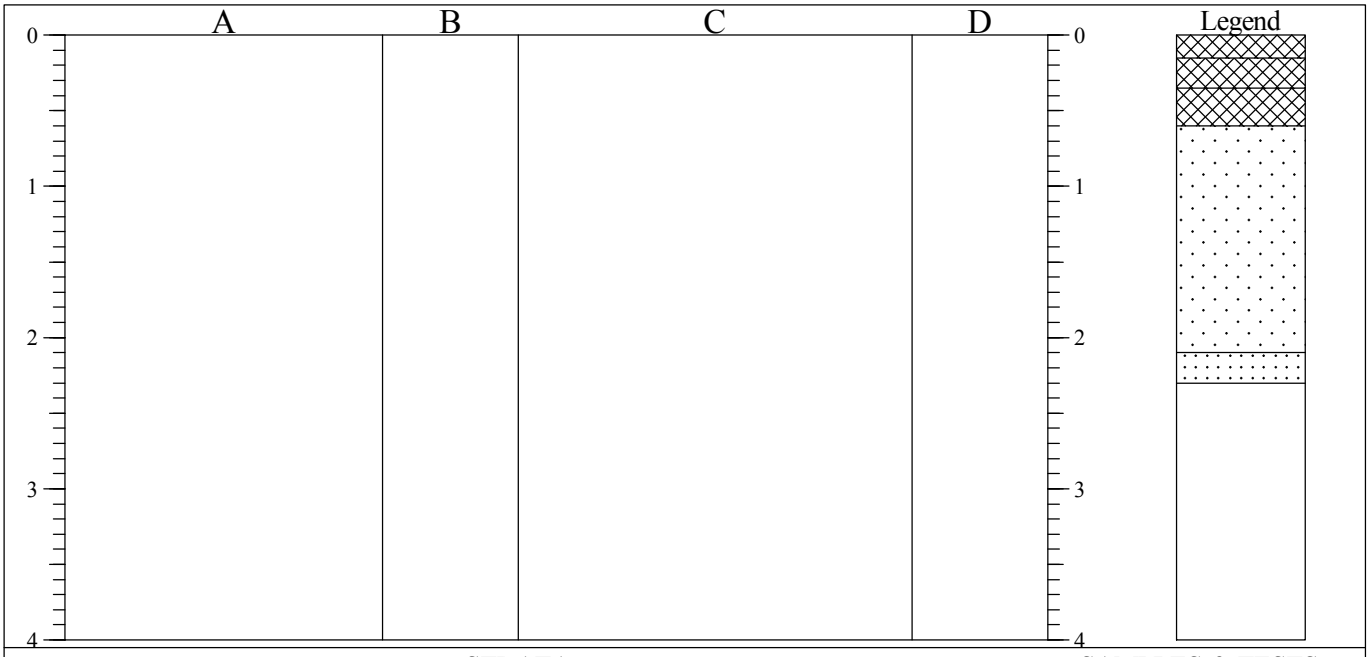
All dimensions in metres Scale 1:50	Client Redrow Homes (Lancashire)	Method/ Plant Used JCB 3CX	Logged By SM

AGS3 UK TP 14RED080 - WATERGATE SCHOOL, WOOLTON, LIVERPOOL.GPJ GINT STD AGS 3_1.GDT 24/9/14

Betts Geoenvironmental Ltd
Old Marsh Farm Barns, Unit 6-7, Welsh Road
Flintshire, CH5 2LY
Telephone: 01244 288 179

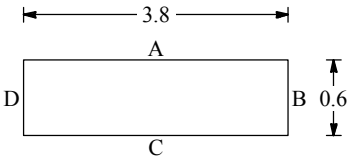
TRIAL PIT LOG

Project				TRIAL PIT No
Watergate School, Woolton, Liverpool				**TP5**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
14RED080	23-09-14	59.27		
Contractor				Sheet
BETTS GEOENVIRONMENTAL LTD				1 of 1



STRATA				SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.15		MADE GROUND: Tarmac.			
0.15-0.35		MADE GROUND: Black silty sandy gravelly CLAY. Slightly ashy. Occasional brick.	0.20	ES	
0.35-0.60		MADE GROUND: Brown with frequent black and reddish brown mottling slightly gravelly sandy to very sandy CLAY. Occasional gravel of brick. (Reworked).	0.40	ES	
0.60-2.10		Loose to medium dense reddish brown slightly gravelly slightly silty fine SAND.			
2.10-2.30		Weak to very weak reddish brown fine grained SANDSTONE.	2.00	ES	

Shoring/Support:
Stability: Stable.



GENERAL REMARKS

Dry.
Hole terminated at on sandstone bedrock.

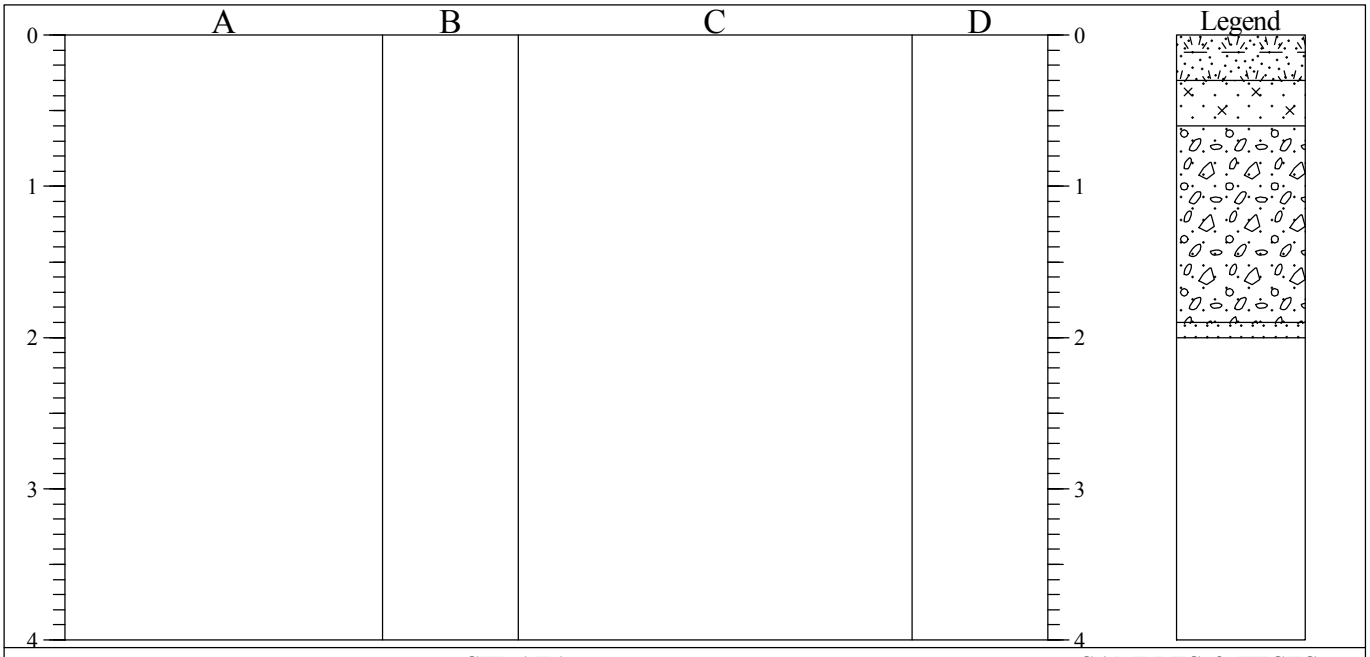
All dimensions in metres Scale 1:50	Client Redrow Homes (Lancashire)	Method/ Plant Used JCB 3CX	Logged By SM

AGS3 UK TP 14RED080 - WATERGATE SCHOOL, WOOLTON, LIVERPOOL.GPJ GINT STD AGS 3_1.GDT 24/9/14

Betts Geoenvironmental Ltd
Old Marsh Farm Barns, Unit 6-7, Welsh Road
Flintshire, CH5 2LY
Telephone: 01244 288 179

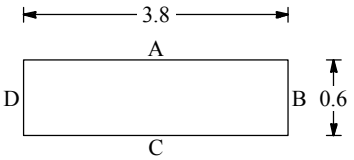
TRIAL PIT LOG

Project				TRIAL PIT No
Watergate School, Woolton, Liverpool				TP6
Job No	Date	Ground Level (m)	Co-Ordinates ()	
14RED080	23-09-14	61.05		
Contractor				Sheet
BETTS GEOENVIRONMENTAL LTD				1 of 1



STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.30		Grass over TOPSOIL: Brown slightly gravelly sandy SILT. Occasional glass and pottery.			
0.30-0.60		Loose reddish brown silty fine SAND. Occasional gravel of sandstone.			
0.60-1.90		Medium dense locally loose reddish brown SAND & GRAVEL. (Weathered Sandstone).			
		1.50 Below recovered as cobbles and gravel.			
1.90-2.00		Weak to very weak reddish brown fine grained SANDSTONE.			

Shoring/Support:
Stability: Stable.



GENERAL REMARKS

Dry.
Hole terminated at on sandstone bedrock.

All dimensions in metres Scale 1:50	Client Redrow Homes (Lancashire)	Method/ Plant Used JCB 3CX	Logged By SM

AGS3 UK TP 14RED080 - WATERGATE SCHOOL, WOOLTON, LIVERPOOL.GPJ GINT STD AGS 3_1.GDT 24/9/14

Betts Geoenvironmental Ltd
Old Marsh Farm Barns, Unit 6-7, Welsh Road
Flintshire, CH5 2LY
Telephone: 01244 288 179

BOREHOLE LOG

Project				BOREHOLE No
Watergate School, Woolton, Liverpool				WS1
Job No	Date	Ground Level (m)	Co-Ordinates ()	
14RED080	23-09-14	55.82		
Contractor				Sheet
BETTS GEOENVIRONMENTAL LTD				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.20	ES					(0.70)	Grass/vegetation over MADE GROUND: Black with grey and red mottling slightly sandy gravelly silty CLAY and clayey SILT. Occasional concrete and brick gravel. Rare sand of coal. 0.30 Brown clay drain.		
				55.12		0.70			
				55.02		0.80	Weak to very weak reddish brown fine grained SANDSTONE.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Dry. Hole terminated at on 0.80m sandstone bedrock. 0.80m plain pipe installed with no encap with gravel at base and bentonite seal. 0.30m brown clay drain encountered, hand pit widened.

All dimensions in metres Scale 1:25	Client Redrow Homes (Lancashire)	Method/ Plant Used Competitor Rig	Logged By SM

Betts Geoenvironmental Ltd
Old Marsh Farm Barns, Unit 6-7, Welsh Road
Flintshire, CH5 2LY
Telephone: 01244 288 179

BOREHOLE LOG

Project				BOREHOLE No
Watergate School, Woolton, Liverpool				WS2
Job No	Date	Ground Level (m)	Co-Ordinates ()	
14RED080	23-09-14	57.22		
Contractor				Sheet
BETTS GEOENVIRONMENTAL LTD				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.20	ES			56.82		(0.40) 0.40	Grass/vegetation over TOPSOIL: Dark brownish black slightly gravelly sandy SILT.		
				56.02		(0.80) 1.20	POSSIBLE MADE GROUND: Dark orangish brown slightly gravelly silty fine to coarse SAND. Occasional to rare sand of coal. Occasional gravel of concrete and brick.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Dry. Hole terminated at 1.20m on sandstone bedrock or concrete, no recovery possible.

All dimensions in metres Scale 1:25	Client Redrow Homes (Lancashire)	Method/ Plant Used Competitor Rig	Logged By SM

Betts Geoenvironmental Ltd
Old Marsh Farm Barns, Unit 6-7, Welsh Road
Flintshire, CH5 2LY
Telephone: 01244 288 179

BOREHOLE LOG

Project				BOREHOLE No
Watergate School, Woolton, Liverpool				WS3
Job No	Date	Ground Level (m)	Co-Ordinates ()	
14RED080	23-09-14	54.43		
Contractor				Sheet
BETTS GEOENVIRONMENTAL LTD				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.50	ES					(1.10)	Grass/vegetation over TOPSOIL: Dark brownish black slightly gravelly sandy SILT. Rare gravel.		
				53.33		1.10	1.00 - 1.20 Rare sand of coal.		
						(0.60)	Medium dense dark brown becoming orangish brown slightly gravelly silty fine SAND with occasional fine sandy silt pockets.		
				52.73		1.70			
						(0.50)	Stiff to very stiff reddish brown with light reddish brown mottling slightly gravelly sandy CLAY.		
				52.23		2.20			
				52.13		2.30	Weak to very weak reddish brown fine grained SANDSTONE.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Dry. Hole terminated at on sandstone bedrock.

All dimensions in metres Scale 1:25	Client Redrow Homes (Lancashire)	Method/ Plant Used Competitor Rig	Logged By SM

Betts Geoenvironmental Ltd
Old Marsh Farm Barns, Unit 6-7, Welsh Road
Flintshire, CH5 2LY
Telephone: 01244 288 179

BOREHOLE LOG

Project				BOREHOLE No
Watergate School, Woolton, Liverpool				WS4
Job No	Date	Ground Level (m)	Co-Ordinates ()	
14RED080	23-09-14	50.87		
Contractor				Sheet
BETTS GEOENVIRONMENTAL LTD				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
0.20	ES			50.27		(0.60) 0.60	Grass over TOPSOIL: Dark brown slightly gravelly sandy clayey SILT. Occasional gravel of brick. Rare cobble of brick.		
				49.87		(0.40) 1.00	Firm to stiff reddish brown/orangish brown very silty very sandy CLAY.		
1.50 1.50	D ES			49.07		(0.80) 1.80	Firm to stiff reddish brown with occasional black speckling slightly gravelly sandy CLAY. (Black speckling is coal).		
				47.87		(1.20) 3.00	Firm locally stiff reddish brown silty sandy CLAY. Rare gravel.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	Dry. Hole terminated at on sandstone bedrock.

All dimensions in metres Scale 1:25	Client Redrow Homes (Lancashire)	Method/ Plant Used Competitor Rig	Logged By SM

Betts Geoenvironmental Ltd
Old Marsh Farm Barns, Unit 6-7, Welsh Road
Flintshire, CH5 2LY
Telephone: 01244 288 179

BOREHOLE LOG

Project				BOREHOLE No
Watergate School, Woolton, Liverpool				WS5
Job No	Date	Ground Level (m)	Co-Ordinates ()	
14RED080	23-09-14	52.76		
Contractor				Sheet
BETTS GEOENVIRONMENTAL LTD				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
				52.56		(0.20) 0.20	MADE GROUND: Tarmac.		
				52.51		0.25	MADE GROUND: Orange fine SAND.		
0.50	ES			52.16		(0.35) 0.60	MADE GROUND: Blackish brown slightly gravelly clayey silty SAND. Ashy to very ashy. Slight hydrocarbon odour. Rare timber.		
				51.66		(0.50) 1.10	Medium dense orangish brown silty fine SAND.		
				51.16		(0.50) 1.60	Firm to stiff reddish brown silty sandy CLAY. Occasional gravel.		
				51.06		1.70	Weak to very weak reddish brown fine grained SANDSTONE.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	Dry. Hole terminated at on sandstone bedrock.

All dimensions in metres Scale 1:25	Client Redrow Homes (Lancashire)	Method/ Plant Used Competitor Rig	Logged By SM

Betts Geoenvironmental Ltd
Old Marsh Farm Barns, Unit 6-7, Welsh Road
Flintshire, CH5 2LY
Telephone: 01244 288 179

BOREHOLE LOG

Project				BOREHOLE No
Watergate School, Woolton, Liverpool				WS6
Job No	Date	Ground Level (m)	Co-Ordinates ()	
14RED080	23-09-14	55.55		
Contractor				Sheet
BETTS GEOENVIRONMENTAL LTD				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
				55.50		0.05	MADE GROUND: Flagstone.		
				55.40		0.15	MADE GROUND: Grey GRAVEL of tarmac. Concrete spots.		
						(0.40)	MADE GROUND: Greyish brown fine to coarse subrounded to subangualr GRAVEL. (Sub-base).		
				55.00		0.55			
0.60	ES					(0.30)	MADE GROUND: Greyish purple silty gravelly fine to coarse SAND. Strong hydrocarbon odour. Oily looking.		
				54.70		0.85			
				54.65		0.90	Weak to very weak reddish brown fine grained SANDSTONE.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Dry. Hole terminated at on 0.90m sandstone bedrock. 0.90m plain pipe installed with no encap with gravel at base and bentonite seal.

All dimensions in metres Scale 1:25	Client Redrow Homes (Lancashire)	Method/ Plant Used Competitor Rig	Logged By SM

Betts Geoenvironmental Ltd
Old Marsh Farm Barns, Unit 6-7, Welsh Road
Flintshire, CH5 2LY
Telephone: 01244 288 179

BOREHOLE LOG

Project				BOREHOLE No
Watergate School, Woolton, Liverpool				WS7
Job No	Date	Ground Level (m)	Co-Ordinates ()	
14RED080	23-09-14	60.73		
Contractor				Sheet
BETTS GEOENVIRONMENTAL LTD				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
				60.33		(0.40) 0.40	Grass over TOPSOIL: Dark brown with light orangish brown mottling slightly gravelly sandy CLAY. Occasional brick and sandstone gravel.		
							Boulder of concrete.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Dry. Hole terminated at 0.40m on concrete boulder.

All dimensions in metres Scale 1:25	Client Redrow Homes (Lancashire)	Method/ Plant Used Competitor Rig	Logged By SM

Betts Geoenvironmental Ltd
Old Marsh Farm Barns, Unit 6-7, Welsh Road
Flintshire, CH5 2LY
Telephone: 01244 288 179

BOREHOLE LOG

Project				BOREHOLE No
Watergate School, Woolton, Liverpool				WS7A
Job No	Date	Ground Level (m)	Co-Ordinates ()	
14RED080	23-09-14	60.49		
Contractor				Sheet
BETTS GEOENVIRONMENTAL LTD				1 of 1

SAMPLES & TESTS			Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						(0.90)	Grass over TOPSOIL: Dark brown with light orangish brown mottling slightly gravelly sandy CLAY. Occasional brick and sandstone gravel.		
				59.59		0.90			
						(0.55)	Medium dense locally loose reddish brown SAND & GRAVEL. (Weathered Sandstone).		
				59.04		1.45			
				58.99		1.50	Weak to very weak reddish brown fine grained SANDSTONE.		

Boring Progress and Water Observations						Chiselling			Water Added		GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt	From	To	Hours	From	To	
											Dry. Hole terminated at on sandstone bedrock.

All dimensions in metres Scale 1:25	Client Redrow Homes (Lancashire)	Method/ Plant Used Competitor Rig	Logged By SM

AGS3 UK BH 14RED080 - WATERGATE SCHOOL, WOOLTON, LIVERPOOL.GPJ GINT STD AGS 3_1.GDT 24/9/14

APPENDIX D

(i) Contamination Test Results

(ii) Geotechnical Test Results

BETTS ASSOCIATES
GEO ENVIRONMENTAL

SUMMARY OF CONTAMINATION ANALYSIS: TPH

Project Name Watergate School, Woolton, Liverpool
Project No 14RED080
Date 1st October 2014

SOIL TYPE	TS	MG	MG	MG	TS	MG	MG	N	MG	N	TS	TS	TS	MG	MG
SAMPLE LOCATION	TP1	TP1	TP2	TP3	TP4	TP5	TP5	TP5	WS1	TP1	WS2	WS3	WS4	WS5	WS6
DEPTH (m)	0.10	0.80	0.60	0.40	0.20	0.20	0.40	2.00	0.20	2.70	0.20	0.50	0.20	0.50	0.60
Ali >C5-C6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ali >C6-C8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ali >C8-C10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.47
Ali >C10-C12	<0.1	<0.1	<0.1	33.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	44.2
Ali >C12-C16	<0.1	<0.1	<0.1	55.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	358
Ali >C16-C21	<0.1	<0.1	<0.1	1.9	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	452
Ali >C21-C35	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	94.8
Total Aliphatics	<0.1	<0.1	<0.1	90.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	950
Aro >C5-C7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aro >C7-C8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aro >C8-C9	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.45
Aro >C9-C10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.47
Aro >C10-C12	<0.1	<0.1	<0.1	13.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	11.8
Aro >C12-C16	<0.1	<0.1	<0.1	23.9	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	114
Aro >C16-C21	<0.1	<0.1	0.2	6	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	169
Aro >C21-C35	<0.1	<0.1	0.3	6.5	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	38.5
Total Aromatics	<0.1	<0.1	0.6	50.2	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	335
TPH (Ali & Aro)	<0.1	<0.1	0.6	140	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1280
BTEX - Benzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BTEX - Toluene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BTEX - Ethyl Benzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BTEX - m & p Xylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
BTEX - o Xylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
MTBE	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Organic Matter	8.7	6	7.9	10.4	12.7	3.5	0.7	<0.1	3.1	<0.1	6.1	3.4	3.3	1.8	1.3

TPH	Mean Value Test *	Range		LQM / CIEH 2009 Guidelines For Residential use- WITH Homegrown Produce	LQM / CIEH 2009 Guidelines For Residential use- WITH Homegrown Produce	LQM / CIEH 2009 Guidelines For Residential use- WITH Homegrown
	US_{95}	Largest Value (mg/kg)	Smallest Value (mg/kg)	1% SOM WITHOUT Free Product***	2.5% SOM WITHOUT Free Product***	6% SOM WITHOUT Free Product***
Ali >C5-C6	0.01	<0.01	<0.01	30	55	110
Ali >C6-C8	0.01	<0.01	<0.01	73	160	370
Ali >C8-C10	0.09	0.5	<0.01	19	46	110
Ali >C10-C12	11.51	44.2	<0.1	48	118	283
Ali >C12-C16	69.69	358.0	<0.1	24	59	142
Ali >C16-C21	83.39	452.0	<0.1	45000	64000	76000
Ali >C21-C35	17.53	94.8	<0.1			
Total Aliphatics	180.72	950.0	<0.1			
Aro >C5-C7	0.01	<0.01	<0.01	65	130	280
Aro >C7-C8	0.01	<0.01	<0.01	120	270	611
Aro >C8-C9	0.09	0.5	<0.01	27	65	151
Aro >C9-C10	0.09	0.5	<0.01	27	65	151
Aro >C10-C12	3.83	13.8	<0.1	69	160	346
Aro >C12-C16	22.75	114.0	<0.1	140	310	593
Aro >C16-C21	31.57	169.0	<0.1	250	480	770
Aro >C21-C35	7.63	38.5	<0.1	890	1100	1230
Total Aromatics	65.17	335.0	<0.1			
TPH (Ali & Aro)	244.83	1280.0	<0.1			
BTEX - Benzene	0.01	<0.01	<0.01	0.08	0.18	0.33
BTEX - Toluene	0.01	<0.01	<0.01	120	320	610
BTEX - Ethyl Benzene	0.01	<0.01	<0.01	65	180	350
BTEX - m & p Xylene	0.01	<0.01	<0.01	42	120	230
BTEX - o Xylene	0.01	<0.01	<0.01	42	120	250
MTBE	0.01	<0.01	<0.01			

	UU Drinking Water Guidelines
	PE Threshold
Total BTEX &MTBE	0.1
EC5-EC10 Ali-Aro	2
EC10-EC16 Ali-Aro	10
EC16-EC40 Ali-Aro	500

Results expressed as mg/kg air dried unless otherwise stated.

* - The calculations for the mean value test include outliers

*** THESE RESULTS PRESENTED ARE ASSESSED UNDER THE COMBINED CLEA ASSESSMENT CRITERION AS OUTLINED WITHIN SR4 ASSUMING NO FREE PRODUCT WAS OBSERVED DURING FIELDWORK- SEE 'GUIDANCE NOTES ON CONTAMINATION'.

NOTES:

For the Purpose of this investigation- results will be assessed agains RESIDENTIAL GUIDELINES WITH HOMEGROWN PRODUCE WITH NO FREE PRODUCT.

BETTS ASSOCIATES
GEO ENVIRONMENTAL

SUMMARY OF CONTAMINATION ANALYSIS: METALS

Project Name Watergate School, Woolton, Liverpool
Project No 14RED080
Date 1st October 2014

SOIL TYPE	TS	MG	MG	MG	N	TS	MG	MG	N	MG	N	TS	TS	TS	N	MG	MG
SAMPLE LOCATION	TP1	TP1	TP2	TP3	TP2	TP4	TP5	TP5	TP5	WS1	TP1	WS2	WS3	WS4	WS4	WS5	WS6
DEPTH (m)	0.10	0.80	0.60	0.40	2.00	0.20	0.20	0.40	2.00	0.20	2.70	0.20	0.50	0.20	1.50	0.50	0.60
pH	8.09	8	7.83	7.79	7.92	7.68	8.77	8.32	8.18	11.17	7.99	7.39	7.11	6.91	7.38	7.6	8.79
Sulphate (water sol 2:1)	<0.01	<0.01	<0.01	0.18	<0.01	<0.01	0.02	<0.01	<0.01	0.04	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Organic matter	8.7	6	7.9	10.4		12.7	3.5	0.7	<0.1	3.1	<0.1	6.1	3.4	3.3		1.8	1.3
Arsenic	7	9	7	12		7	3	2	<1	3	4	9	9	5		2	3
Cadmium	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		<0.5	<0.5
Copper	24	29	27	36		82	22	7	2	10	13	26	23	17		7	3
Chromium (hexavalent)	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1
Lead	75	89	26	98		88	41	27	2	31	7	88	80	49		25	3
Mercury	<0.17	<0.17	<0.17	0.22		<0.17	<0.17	<0.17	<0.17	<0.17	<0.17	0.21	<0.17	<0.17		<0.17	<0.17
Nickel	15	15	15	19		17	13	15	6	10	30	15	12	10		12	8
Selenium	<1	<1	<1	<1		<1	<1	<1	<1	<1	<1	<1	<1	<1		<1	<1
Zinc	76	85	45	85		52	46	28	11	32	34	94	56	54		25	16
Asbestos in Soil	NAD		NAD	NAD		NAD	NAD	NAD		NAD		NAD		NAD			NAD
Asbestos Matrix																	

Metals	Mean Value Test *	Range		Residential Use with Homegrown ATRisk. (mg/kg)	Residential Use with Homegrown ATRisk. (mg/kg)
	US_{95}	Largest Value (mg/kg)	Smallest Value (mg/kg)	With Homegrown Produce (1% SOM)	With Homegrown Produce (6% SOM)
pH	8.35	11.17	6.91		
Sulphate (water sol 2:1)	0.04	0.18	0.01		
Organic matter	6.27	12.70	<0.1		
Arsenic	7	12	<1	32	32
Cadmium	0.50	<0.5	<0.5	10	10
Copper	31	82	2	3970	4020
Chromium (hexavalent)	1.00	<1	<1	14.2	14.2
Lead	64	98	2	276	342
Mercury**	0.18	0.22	<0.17	6.28	11
Nickel	17	30	6	130	130
Selenium	1	<1	<1	350	350
Zinc	61	94	11	16900	17200

NOTE:
Any individual results and mean value tests above SGVs are shown RED highlighted.
Any outlier values which exceed relevant SGVs are shown in red

* - The calculations for the mean value test include outliers

**- Results for this determinand are assessed with no background levels taken into account

Results are expressed as mg/kg unless otherwise stated

ALL RESULTS PRESENTED ARE ASSESSED UNDER THE COMBINED CLEA ASSESSMENT CRITERION AS OUTLINED WITHIN SR4 ASSUMING NO FREE PRODUCT WAS OBSERVED DURING FIELDWORK- SEE 'GUIDANCE NOTES ON CONTAMINATION'.

ALL SGVs / GAC ARE DERIVED FROM LQM/CIEH 2009 VALUES OTHER THAN THE FOLLOWING:CADNIUM, ARSENIC, NICKEL AND MERCURY VALUES FOR RESIDENTIAL ARE EA SGV 2009 VALUES. THE SGV OF LEAD IS FROM ATRISK March 2009
Note: The SGV for elemental mercury has been used to assess total mercury concentrations at the site. The Environment Agency's Science Report SC050021 / Mercury SGV states that 'for general surface contamination and to simplify the assessment the SGV's for inorganic mercury can normally be compared with chemical analysis for total mercury content….'. Based on the latter, SGV for elemental mercury (170mg/kg) in the soil assessment is used

BETTS ASSOCIATES
GEO ENVIRONMENTAL

SUMMARY OF CONTAMINATION ANALYSIS: PAH

Project Name Watergate School, Woolton, Liverpool
Project No 14RED080
Date 1st October 2014

SOIL TYPE	TS	MG	MG	MG	TS	MG	MG	N	MG	N	TS	TS	TS	MG	MG
SAMPLE LOCATION	TP1	TP1	TP2	TP3	TP4	TP5	TP5	TP5	WS1	TP1	WS2	WS3	WS4	WS5	WS6
DEPTH (m)	0.10	0.80	0.60	0.40	0.20	0.20	0.40	2.00	0.20	2.70	0.20	0.50	0.20	0.50	0.60
Acenaphthene	<0.01	0.02	0.02	0.07	<0.01	0.03	<0.01	<0.01	0.02	<0.01	<0.01	0.02	<0.01	<0.01	0.38
Acenaphthylene	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.21
Anthracene	0.02	0.04	0.04	0.09	<0.02	0.07	<0.02	<0.02	0.04	<0.02	<0.02	0.02	<0.02	<0.02	0.17
Benzo(a)anthracene	0.17	0.24	0.16	0.46	0.05	0.24	<0.04	<0.04	0.28	<0.04	0.14	0.17	0.05	<0.04	<0.04
Benzo(a)pyrene	0.2	0.27	0.18	0.48	0.09	0.35	<0.04	<0.04	0.28	<0.04	0.18	0.2	0.08	<0.04	<0.04
Benzo(b)fluoranthene	0.27	0.37	0.27	0.64	0.11	0.46	<0.05	<0.05	0.32	<0.05	0.23	0.26	0.11	<0.05	<0.05
Benzo(ghi)perylene	0.14	0.19	0.13	0.32	0.07	0.41	<0.05	<0.05	0.18	<0.05	0.14	0.13	0.06	<0.05	<0.05
Benzo(k)fluoranthene	0.11	0.15	0.1	0.22	<0.07	0.13	<0.07	<0.07	0.11	<0.07	0.09	0.09	<0.07	<0.07	<0.07
Chrysene	0.23	0.32	0.22	0.56	0.09	0.32	<0.06	<0.06	0.31	<0.06	0.18	0.22	0.09	<0.06	<0.06
Dibenzo(ah)anthracene	<0.04	<0.04	<0.04	0.07	<0.04	0.07	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Fluoranthene	0.27	0.4	0.28	0.85	0.1	0.41	<0.08	<0.08	0.49	<0.08	0.24	0.31	0.12	<0.08	<0.08
Fluorene	<0.01	0.02	<0.01	0.05	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	0.96
Indeno(123-cd)pyrene	0.13	0.18	0.13	0.34	0.07	0.34	<0.03	<0.03	0.17	<0.03	0.12	0.12	0.05	<0.03	<0.03
Naphthalene	<0.03	<0.03	<0.03	<0.03	<0.03	0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.1
Phenanthrene	0.12	0.2	0.11	0.44	0.05	0.22	<0.03	<0.03	0.22	<0.03	0.09	0.14	0.1	<0.03	1.86
Pyrene	0.26	0.37	0.26	0.71	0.09	0.38	<0.07	<0.07	0.47	<0.07	0.23	0.27	0.12	<0.07	0.24
Organic Matter	8.7	6	7.9	10.4	12.7	3.5	0.7	<0.1	3.1	<0.1	6.1	3.4	3.3	1.8	1.3

PAH	Mean Value Test *	Range		LQM / CIEH 2009 Guidelines For Residential use- WITH Homegrown Produce	LQM / CIEH 2009 Guidelines For Residential use- WITH Homegrown Produce	LQM / CIEH 2009 Guidelines For Residential use- WITH Homegrown
	US_{95}	Largest Value (mg/kg)	Smallest Value (mg/kg)	1% SOM WITHOUT Free Product***	2.5% SOM WITHOUT Free Product***	6% SOM WITHOUT Free Product***
Acenaphthene	0.09	0.38	0.02	210	480	1000
Acenaphthylene	0.05	0.21	0.03	170	400	850
Anthracene	0.06	0.17	0.02	2300	4900	9200
Benzo(a)anthracene	0.20	0.46	0.05	3.1	4.7	5.9
Benzo(a)pyrene	0.23	0.48	0.08	0.83	0.94	1
Benzo(b)fluoranthene	0.30	0.64	0.11	5.6	6.5	7
Benzo(ghi)perylene	0.18	0.41	0.06	44	46	47
Benzo(k)fluoranthene	0.12	0.22	0.09	8.5	9.6	10
Chrysene	0.26	0.56	0.09	6	8	9.3
Dibenzo(ah)anthracene	0.05	0.07	0.07	0.76	0.86	0.9
Fluoranthene	0.36	0.85	0.10	260	460	670
Fluorene	0.19	0.96	0.01	160	380	780
Indeno(123-cd)pyrene	0.17	0.34	0.05	3.2	3.9	4.2
Naphthalene	0.04	0.10	0.03	1.5	3.7	8.7
Phenanthrene	0.45	1.86	0.05	92	200	380
Pyrene	0.33	0.71	0.09	560	1000	1600

Results expressed as mg/kg air dried unless otherwise stated.

* - The calculations for the mean value test include outliers

*** THESE RESULTS PRESENTED ARE ASSESSED UNDER THE COMBINED CLEA ASSESSMENT CRITERION AS OUTLINED WITHIN SR4 ASSUMING NO FREE PRODUCT WAS OBSERVED DURING FIELDWORK- SEE 'GUIDANCE NOTES ON CONTAMINATION'.

NOTES:

For the Purpose of this investigation- results will be assessed agains RESIDENTIAL GUIDELINES WITH HOMEGROWN PRODUCE WITH NO FREE PRODUCT.

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Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 14/05144
Issue Number: 1 **Date:** 09 October, 2014

Client:
Betts Geo Environmental
Old Marsh Farm Barns
Welsh Road
Sealand
Flintshire
UK
CH5 2LY

Project Manager: Steven Millar
Project Name: Watergate
Project Ref: 14RED080
Order No: BG1273
Date Samples Received: 23/09/14
Date Instructions Received: 24/09/14
Date Analysis Completed: 07/10/14

Prepared by:

Melanie Marshall
Laboratory Coordinator

Approved by:

Iain Haslock
Analytical Consultant

mCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME
UKAS TESTING 1247

Envirolab Job Number: 14/05144

Client Project Name: Watergate

Client Project Ref: 14RED080

Lab Sample ID	14/05144/1	14/05144/2	14/05144/3	14/05144/4	14/05144/5	14/05144/6	14/05144/7	14/05144/8	Units	Method ref
Client Sample No										
Client Sample ID	TP1	TP1	TP2	TP3	TP2	TP4	TP5	TP5		
Depth to Top	0.10	0.80	0.60	0.40	2.00	0.20	0.20	0.40		
Depth To Bottom										
Date Sampled	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
MCERTS Sample Matrix Code	4AE	6AE	6A	4A	6A	4AE	4AB	4A		
% Stones >10mm$_A^{\#}$	<0.1	11.6	31.5	<0.1	<0.1	<0.1	22.6	10.1	% w/w	A-T-044
pH$_D^{M\#}$	8.09	8.00	7.83	7.79	7.92	7.68	8.77	8.32	pH	A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	<0.01	<0.01	<0.01	0.18	<0.01	<0.01	0.02	<0.01	g/l	A-T-026s
Organic matter$_D^{M\#}$	8.7	6.0	7.9	10.4	-	12.7	3.5	0.7	% w/w	A-T-032 OM
Arsenic$_D^{M\#}$	7	9	7	12	-	7	3	2	mg/kg	A-T-024s
Cadmium$_D^{M\#}$	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	mg/kg	A-T-024s
Copper$_D^{M\#}$	24	29	27	36	-	82	22	7	mg/kg	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1	<1	-	<1	<1	<1	mg/kg	A-T-040s
Lead$_D^{M\#}$	75	89	26	98	-	88	41	27	mg/kg	A-T-024s
Mercury$_D$	<0.17	<0.17	<0.17	0.22	-	<0.17	<0.17	<0.17	mg/kg	A-T-024s
Nickel$_D^{M\#}$	15	15	15	19	-	17	13	15	mg/kg	A-T-024s
Selenium$_D^{M\#}$	<1	<1	<1	<1	-	<1	<1	<1	mg/kg	A-T-024s
Zinc$_D^{M\#}$	76	85	45	85	-	52	46	28	mg/kg	A-T-024s

Envirolab Job Number: 14/05144

Client Project Name: Watergate

Client Project Ref: 14RED080

Lab Sample ID	14/05144/1	14/05144/2	14/05144/3	14/05144/4	14/05144/5	14/05144/6	14/05144/7	14/05144/8	Units	Method ref
Client Sample No										
Client Sample ID	TP1	TP1	TP2	TP3	TP2	TP4	TP5	TP5		
Depth to Top	0.10	0.80	0.60	0.40	2.00	0.20	0.20	0.40		
Depth To Bottom										
Date Sampled	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
MCERTS Sample Matrix Code	4AE	6AE	6A	4A	6A	4AE	4AB	4A		
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Ali >C8-C10$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Ali >C10-C12$_A^{\#}$	<0.1	<0.1	<0.1	33.3	-	<0.1	<0.1	<0.1	mg/kg	A-T-023s
Ali >C12-C16$_A^{\#}$	<0.1	<0.1	<0.1	55.1	-	<0.1	<0.1	<0.1	mg/kg	A-T-023s
Ali >C16-C21$_A^{\#}$	<0.1	<0.1	<0.1	1.9	-	<0.1	<0.1	<0.1	mg/kg	A-T-023s
Ali >C21-C35$_A^{\#}$	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	mg/kg	A-T-023s
Total Aliphatics$_A$	<0.1	<0.1	<0.1	90.2	-	<0.1	<0.1	<0.1	mg/kg	A-T-022+23s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C8-C9$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C9-C10$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C10-C12$_A^{\#}$	<0.1	<0.1	<0.1	13.8	-	<0.1	<0.1	<0.1	mg/kg	A-T-023s
Aro >C12-C16$_A^{\#}$	<0.1	<0.1	<0.1	23.9	-	<0.1	<0.1	<0.1	mg/kg	A-T-023s
Aro >C16-C21$_A^{\#}$	<0.1	<0.1	0.2	6.0	-	0.3	<0.1	<0.1	mg/kg	A-T-023s
Aro >C21-C35$_A^{\#}$	<0.1	<0.1	0.3	6.5	-	0.3	<0.1	<0.1	mg/kg	A-T-023s
Total Aromatics$_A$	<0.1	<0.1	0.6	50.2	-	0.7	<0.1	<0.1	mg/kg	A-T-022+23s
TPH (Ali & Aro)$_A$	<0.1	<0.1	0.6	140	-	0.7	<0.1	<0.1	mg/kg	A-T-022+23s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	mg/kg	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	mg/kg	A-T-022s
VPH total (>C5-C10)$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	mg/kg	A-T-022s
1.01 % Moisture BS1377 1990 pt2 cl 3.2 (NMC Natural Moisture Content)$^{\#}$	-	-	-	-	Appended	-	-	-		Subcon
1.02 Atterburg Plasticity 4 Pt Liq+Plast Limit BS1377 1990pt2cl4.4,5.3+5.4$^{\#}$	-	-	-	-	Appended	-	-	-		Subcon

Envirolab Job Number: 14/05144

Client Project Name: Watergate

Client Project Ref: 14RED080

Lab Sample ID	14/05144/1	14/05144/2	14/05144/3	14/05144/4	14/05144/5	14/05144/6	14/05144/7	14/05144/8	Units	Method ref
Client Sample No										
Client Sample ID	TP1	TP1	TP2	TP3	TP2	TP4	TP5	TP5		
Depth to Top	0.10	0.80	0.60	0.40	2.00	0.20	0.20	0.40		
Depth To Bottom										
Date Sampled	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
MCERTS Sample Matrix Code	4AE	6AE	6A	4A	6A	4AE	4AB	4A		
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_D^{\#}$	NAD	-	NAD	NAD	-	NAD	NAD	NAD		A-T-045
Asbestos ACM - Suitable for Water Absorption Test?$_D$	N/A	-	N/A	N/A	-	N/A	N/A	N/A		Gravimetry

Envirolab Job Number: 14/05144

Client Project Name: Watergate

Client Project Ref: 14RED080

Lab Sample ID	14/05144/1	14/05144/2	14/05144/3	14/05144/4	14/05144/5	14/05144/6	14/05144/7	14/05144/8	Units	Method ref
Client Sample No										
Client Sample ID	TP1	TP1	TP2	TP3	TP2	TP4	TP5	TP5		
Depth to Top	0.10	0.80	0.60	0.40	2.00	0.20	0.20	0.40		
Depth To Bottom										
Date Sampled	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
MCERTS Sample Matrix Code	4AE	6AE	6A	4A	6A	4AE	4AB	4A		
PAH 16										
Acenaphthene$_A^{M\#}$	<0.01	0.02	0.02	0.07	-	<0.01	0.03	<0.01	mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.01	<0.01	<0.01	<0.01	-	<0.01	0.03	<0.01	mg/kg	A-T-019s
Anthracene$_A^{M\#}$	0.02	0.04	0.04	0.09	-	<0.02	0.07	<0.02	mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	0.17	0.24	0.16	0.46	-	0.05	0.24	<0.04	mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	0.20	0.27	0.18	0.48	-	0.09	0.35	<0.04	mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	0.27	0.37	0.27	0.64	-	0.11	0.46	<0.05	mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	0.14	0.19	0.13	0.32	-	0.07	0.41	<0.05	mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	0.11	0.15	0.10	0.22	-	<0.07	0.13	<0.07	mg/kg	A-T-019s
Chrysene$_A^{M\#}$	0.23	0.32	0.22	0.56	-	0.09	0.32	<0.06	mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	<0.04	<0.04	<0.04	0.07	-	<0.04	0.07	<0.04	mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	0.27	0.40	0.28	0.85	-	0.10	0.41	<0.08	mg/kg	A-T-019s
Fluorene$_A^{M\#}$	<0.01	0.02	<0.01	0.05	-	<0.01	0.02	<0.01	mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	0.13	0.18	0.13	0.34	-	0.07	0.34	<0.03	mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	<0.03	<0.03	<0.03	<0.03	-	<0.03	0.03	<0.03	mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	0.12	0.20	0.11	0.44	-	0.05	0.22	<0.03	mg/kg	A-T-019s
Pyrene$_A^{M\#}$	0.26	0.37	0.26	0.71	-	0.09	0.38	<0.07	mg/kg	A-T-019s
PAH (total 16)$_A^{M\#}$	1.96	2.79	1.92	5.32	-	0.70	3.50	<0.08	mg/kg	A-T-019s

Envirolab Job Number: 14/05144

Client Project Name: Watergate

Client Project Ref: 14RED080

Lab Sample ID	14/05144/9	14/05144/10	14/05144/11	14/05144/12	14/05144/13	14/05144/14	14/05144/15	14/05144/16	Units	Method ref
Client Sample No										
Client Sample ID	TP5	WS1	TP1	WS2	WS3	WS4	WS4	WS5		
Depth to Top	2.00	0.20	2.70	0.20	0.50	0.20	1.50	0.50		
Depth To Bottom										
Date Sampled	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14		
Sample Type	Soil - ES	Soil - ES	Soil	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
MCERTS Sample Matrix Code	1A	4AE	6AE	4AE	4AE	4AE	5A	6A		
% Stones >10mm$_A^{\#}$	16.8	25.9	<0.1	<0.1	13.7	5.1	18.0	<0.1	% w/w	A-T-044
pH$_D^{M\#}$	8.18	11.17	7.99	7.39	7.11	6.91	7.38	7.60	pH	A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	<0.01	0.04	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	g/l	A-T-026s
Organic matter$_D^{M\#}$	<0.1	3.1	<0.1	6.1	3.4	3.3	-	1.8	% w/w	A-T-032 OM
Arsenic$_D^{M\#}$	<1	3	4	9	9	5	-	2	mg/kg	A-T-024s
Cadmium$_D^{M\#}$	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	mg/kg	A-T-024s
Copper$_D^{M\#}$	2	10	13	26	23	17	-	7	mg/kg	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1	<1	<1	<1	-	<1	mg/kg	A-T-040s
Lead$_D^{M\#}$	2	31	7	88	80	49	-	25	mg/kg	A-T-024s
Mercury$_D$	<0.17	<0.17	<0.17	0.21	<0.17	<0.17	-	<0.17	mg/kg	A-T-024s
Nickel$_D^{M\#}$	6	10	30	15	12	10	-	12	mg/kg	A-T-024s
Selenium$_D^{M\#}$	<1	<1	<1	<1	<1	<1	-	<1	mg/kg	A-T-024s
Zinc$_D^{M\#}$	11	32	34	94	56	54	-	25	mg/kg	A-T-024s

Envirolab Job Number: 14/05144

Client Project Name: Watergate

Client Project Ref: 14RED080

Lab Sample ID	14/05144/9	14/05144/10	14/05144/11	14/05144/12	14/05144/13	14/05144/14	14/05144/15	14/05144/16	Units	Method ref
Client Sample No										
Client Sample ID	TP5	WS1	TP1	WS2	WS3	WS4	WS4	WS5		
Depth to Top	2.00	0.20	2.70	0.20	0.50	0.20	1.50	0.50		
Depth To Bottom										
Date Sampled	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14		
Sample Type	Soil - ES	Soil - ES	Soil	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
MCERTS Sample Matrix Code	1A	4AE	6AE	4AE	4AE	4AE	5A	6A		
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Ali >C8-C10$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Ali >C10-C12$_A^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Ali >C12-C16$_A^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Ali >C16-C21$_A^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Ali >C21-C35$_A^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Total Aliphatics$_A$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	mg/kg	A-T-022+23s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Aro >C8-C9$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Aro >C9-C10$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Aro >C10-C12$_A^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Aro >C12-C16$_A^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Aro >C16-C21$_A^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Aro >C21-C35$_A^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Total Aromatics$_A$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	mg/kg	A-T-022+23s
TPH (Ali & Aro)$_A$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	mg/kg	A-T-022+23s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
VPH total (>C5-C10)$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
1.01 % Moisture BS1377 1990 pt2 cl 3.2 (NMC Natural Moisture Content)$^{\#}$	-	-	Appended	-	-	-	Appended	-		Subcon
1.02 Atterburg Plasticity 4 Pt Liq+Plast Limit BS1377 1990pt2cl4.4,5.3+5.4$^{\#}$	-	-	Appended	-	-	-	Appended	-		Subcon

Envirolab Job Number: 14/05144

Client Project Name: Watergate

Client Project Ref: 14RED080

Lab Sample ID	14/05144/9	14/05144/10	14/05144/11	14/05144/12	14/05144/13	14/05144/14	14/05144/15	14/05144/16	Units	Method ref
Client Sample No										
Client Sample ID	TP5	WS1	TP1	WS2	WS3	WS4	WS4	WS5		
Depth to Top	2.00	0.20	2.70	0.20	0.50	0.20	1.50	0.50		
Depth To Bottom										
Date Sampled	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14		
Sample Type	Soil - ES	Soil - ES	Soil	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
MCERTS Sample Matrix Code	1A	4AE	6AE	4AE	4AE	4AE	5A	6A		
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_D^{\#}$	-	NAD	-	NAD	-	NAD	-	-		A-T-045
Asbestos ACM - Suitable for Water Absorption Test?$_D$	-	N/A	-	N/A	-	N/A	-	-		Gravimetry

Envirolab Job Number: 14/05144

Client Project Name: Watergate

Client Project Ref: 14RED080

Lab Sample ID	14/05144/9	14/05144/10	14/05144/11	14/05144/12	14/05144/13	14/05144/14	14/05144/15	14/05144/16	Units	Method ref
Client Sample No										
Client Sample ID	TP5	WS1	TP1	WS2	WS3	WS4	WS4	WS5		
Depth to Top	2.00	0.20	2.70	0.20	0.50	0.20	1.50	0.50		
Depth To Bottom										
Date Sampled	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14	23-Sep-14		
Sample Type	Soil - ES	Soil - ES	Soil	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
MCERTS Sample Matrix Code	1A	4AE	6AE	4AE	4AE	4AE	5A	6A		
PAH 16										
Acenaphthene$_A^{M\#}$	<0.01	0.02	<0.01	<0.01	0.02	<0.01	-	<0.01	mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-019s
Anthracene$_A^{M\#}$	<0.02	0.04	<0.02	<0.02	0.02	<0.02	-	<0.02	mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	<0.04	0.28	<0.04	0.14	0.17	0.05	-	<0.04	mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	<0.04	0.28	<0.04	0.18	0.20	0.08	-	<0.04	mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	<0.05	0.32	<0.05	0.23	0.26	0.11	-	<0.05	mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	<0.05	0.18	<0.05	0.14	0.13	0.06	-	<0.05	mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	<0.07	0.11	<0.07	0.09	0.09	<0.07	-	<0.07	mg/kg	A-T-019s
Chrysene$_A^{M\#}$	<0.06	0.31	<0.06	0.18	0.22	0.09	-	<0.06	mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	-	<0.04	mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	<0.08	0.49	<0.08	0.24	0.31	0.12	-	<0.08	mg/kg	A-T-019s
Fluorene$_A^{M\#}$	<0.01	<0.01	<0.01	<0.01	0.01	0.01	-	<0.01	mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	<0.03	0.17	<0.03	0.12	0.12	0.05	-	<0.03	mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	<0.03	0.22	<0.03	0.09	0.14	0.10	-	<0.03	mg/kg	A-T-019s
Pyrene$_A^{M\#}$	<0.07	0.47	<0.07	0.23	0.27	0.12	-	<0.07	mg/kg	A-T-019s
PAH (total 16)$_A^{M\#}$	<0.08	2.94	<0.08	1.65	1.97	0.79	-	<0.08	mg/kg	A-T-019s

Envirolab Job Number: 14/05144

Client Project Name: Watergate

Client Project Ref: 14RED080

Lab Sample ID	14/05144/17								Units	Method ref
Client Sample No										
Client Sample ID	WS6									
Depth to Top	0.60									
Depth To Bottom										
Date Sampled	23-Sep-14									
Sample Type	Soil - ES									
MCERTS Sample Matrix Code	4A									
% Stones >10mm$_A^{\#}$	36.1								% w/w	A-T-044
pH$_D^{M\#}$	8.79								pH	A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	0.01								g/l	A-T-026s
Organic matter$_D^{M\#}$	1.3								% w/w	A-T-032 OM
Arsenic$_D^{M\#}$	3								mg/kg	A-T-024s
Cadmium$_D^{M\#}$	<0.5								mg/kg	A-T-024s
Copper$_D^{M\#}$	3								mg/kg	A-T-024s
Chromium (hexavalent)$_D$	<1								mg/kg	A-T-040s
Lead$_D^{M\#}$	3								mg/kg	A-T-024s
Mercury$_D$	<0.17								mg/kg	A-T-024s
Nickel$_D^{M\#}$	8								mg/kg	A-T-024s
Selenium$_D^{M\#}$	<1								mg/kg	A-T-024s
Zinc$_D^{M\#}$	16								mg/kg	A-T-024s

Envirolab Job Number: 14/05144

Client Project Name: Watergate

Client Project Ref: 14RED080

Lab Sample ID	14/05144/17									Units	Method ref
Client Sample No											
Client Sample ID	WS6										
Depth to Top	0.60										
Depth To Bottom											
Date Sampled	23-Sep-14										
Sample Type	Soil - ES										
MCERTS Sample Matrix Code	4A										
TPH CWG											
Ali >C5-C6$_A^\#$	<0.01									mg/kg	A-T-022s
Ali >C6-C8$_A^\#$	<0.01									mg/kg	A-T-022s
Ali >C8-C10$_A^\#$	0.47									mg/kg	A-T-022s
Ali >C10-C12$_A^\#$	44.2									mg/kg	A-T-023s
Ali >C12-C16$_A^\#$	358									mg/kg	A-T-023s
Ali >C16-C21$_A^\#$	452									mg/kg	A-T-023s
Ali >C21-C35$_A^\#$	94.8									mg/kg	A-T-023s
Total Aliphatics$_A$	950									mg/kg	A-T-022+23s
Aro >C5-C7$_A^\#$	<0.01									mg/kg	A-T-022s
Aro >C7-C8$_A^\#$	<0.01									mg/kg	A-T-022s
Aro >C8-C9$_A^\#$	0.45									mg/kg	A-T-022s
Aro >C9-C10$_A^\#$	0.47									mg/kg	A-T-022s
Aro >C10-C12$_A^\#$	11.8									mg/kg	A-T-023s
Aro >C12-C16$_A^\#$	114									mg/kg	A-T-023s
Aro >C16-C21$_A^\#$	169									mg/kg	A-T-023s
Aro >C21-C35$_A^\#$	38.5									mg/kg	A-T-023s
Total Aromatics$_A$	335									mg/kg	A-T-022+23s
TPH (Ali & Aro)$_A$	1280									mg/kg	A-T-022+23s
BTEX - Benzene$_A^\#$	<0.01									mg/kg	A-T-022s
BTEX - Toluene$_A^\#$	<0.01									mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^\#$	<0.01									mg/kg	A-T-022s
BTEX - m & p Xylene$_A^\#$	<0.01									mg/kg	A-T-022s
BTEX - o Xylene$_A^\#$	<0.01									mg/kg	A-T-022s
MTBE$_A^\#$	<0.01									mg/kg	A-T-022s
VPH total (>C5-C10)$_A^\#$	1.40									mg/kg	A-T-022s
Asbestos in Soil (inc. matrix)											
Asbestos in soil$_D^\#$	NAD										A-T-045
Asbestos ACM - Suitable for Water Absorption Test?$_D$	N/A										Gravimetry

Envirolab Job Number: 14/05144

Client Project Name: Watergate

Client Project Ref: 14RED080

Lab Sample ID	14/05144/17								Units	Method ref
Client Sample No										
Client Sample ID	WS6									
Depth to Top	0.60									
Depth To Bottom										
Date Sampled	23-Sep-14									
Sample Type	Soil - ES									
MCERTS Sample Matrix Code	4A									
PAH 16										
Acenaphthene$_A^{M\#}$	0.38								mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	0.21								mg/kg	A-T-019s
Anthracene$_A^{M\#}$	0.17								mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	<0.04								mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	<0.04								mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	<0.05								mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	<0.05								mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	<0.07								mg/kg	A-T-019s
Chrysene$_A^{M\#}$	<0.06								mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	<0.04								mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	<0.08								mg/kg	A-T-019s
Fluorene$_A^{M\#}$	0.96								mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	<0.03								mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	0.10								mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	1.86								mg/kg	A-T-019s
Pyrene$_A^{M\#}$	0.24								mg/kg	A-T-019s
PAH (total 16)$_A^{M\#}$	3.97								mg/kg	A-T-019s

REPORT NOTES

Notes - Soil chemical analysis
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones >10mm are removed or excluded from the sample prior to analysis and reported results corrected to a whole sample basis. For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis.

Notes - General
This report shall not be reproduced, except in full, without written approval from Envirolab.
Subscript "A" indicates analysis performed on the sample as received. "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve, unless asbestos is found to be present in which case all analysis is performed on the sample as received.
All analysis is performed on the dried and crushed sample for samples with Matrix Code 7 and this supercedes any "A" subscripts.
All analysis is performed on the sample as received for soil samples from outside the European Union and this supercedes any "D" subscripts.
Superscript "M" indicates method accredited to MCERTS.
If results are in italic font they are associated with an AQC failure. These are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

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

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

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER.
Samples with Matrix Code 7 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations.

Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

IS indicates Insufficient sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Analytical results reflect the quality of the sample at the time of analysis only. Opinions and interpretations expressed are outside the scope of our accreditation.

Please contact us if you need any further information.

STRUCTURAL SOILS LTD

TEST REPORT

Report No. 781369 R1 1774

Date 07-October-2014 Contract 14RED080

Client Envirolab Ltd
Address Units 7 & 8 Sandpits Business Park
Mottram Road
Hyde
SK14 3AR

For the Attention of Carrie Field

Samples submitted by client	25/09/2014	Client Reference	14/05144
Testing Started	25/09/2014	Client Order No.	P0731018
Testing Completed	07/10/2014	Instruction Type	Written

UKAS Accredited Tests Undertaken

Moisture Content (oven drying method) BS1377:Part 2:1990,clause 3.2
Liquid Limit (definitive method) BS1377:Part 2:1990,clause 4.3
Plastic Limit BS1377:Part 2:1990,clause 5.3
Plasticity Index Derivation BS1377:Part 2:1990,clause 5.4

* Tests were undertaken on samples 'as received' unless otherwise stated

Please Note: Remaining samples will be retained for a period of one month from today and will then be disposed of

Structural Soils Ltd The Potteries Pottery Street Castleford WF10 1NJ Tel: 01977 552255 e-mail mark.athorne@soils.co.uk

SUMMARY OF SOIL CLASSIFICATION TESTS

In accordance with clauses 3.2,4.3,4.4,5.3,5.4,7.2,8.2,8.3 of BS1377:Part 2:1990

Exploratory Position ID	Sample Ref	Sample Type	Depth (m)	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index %	% <425um	Description of Sample
TP1	14/05144/11	D	2.70	15	31	13	18	88	Red brown slightly sandy slightly gravelly CLAY
TP2	14/05144/5	D	2.00	17	32	13	19	82	Red brown slightly sandy slightly gravelly CLAY
WS4	14/05144/15	D	1.50	16	33	13	20	82	Brown slightly sandy slightly gravelly CLAY

STRUCTURAL SOILS LTD

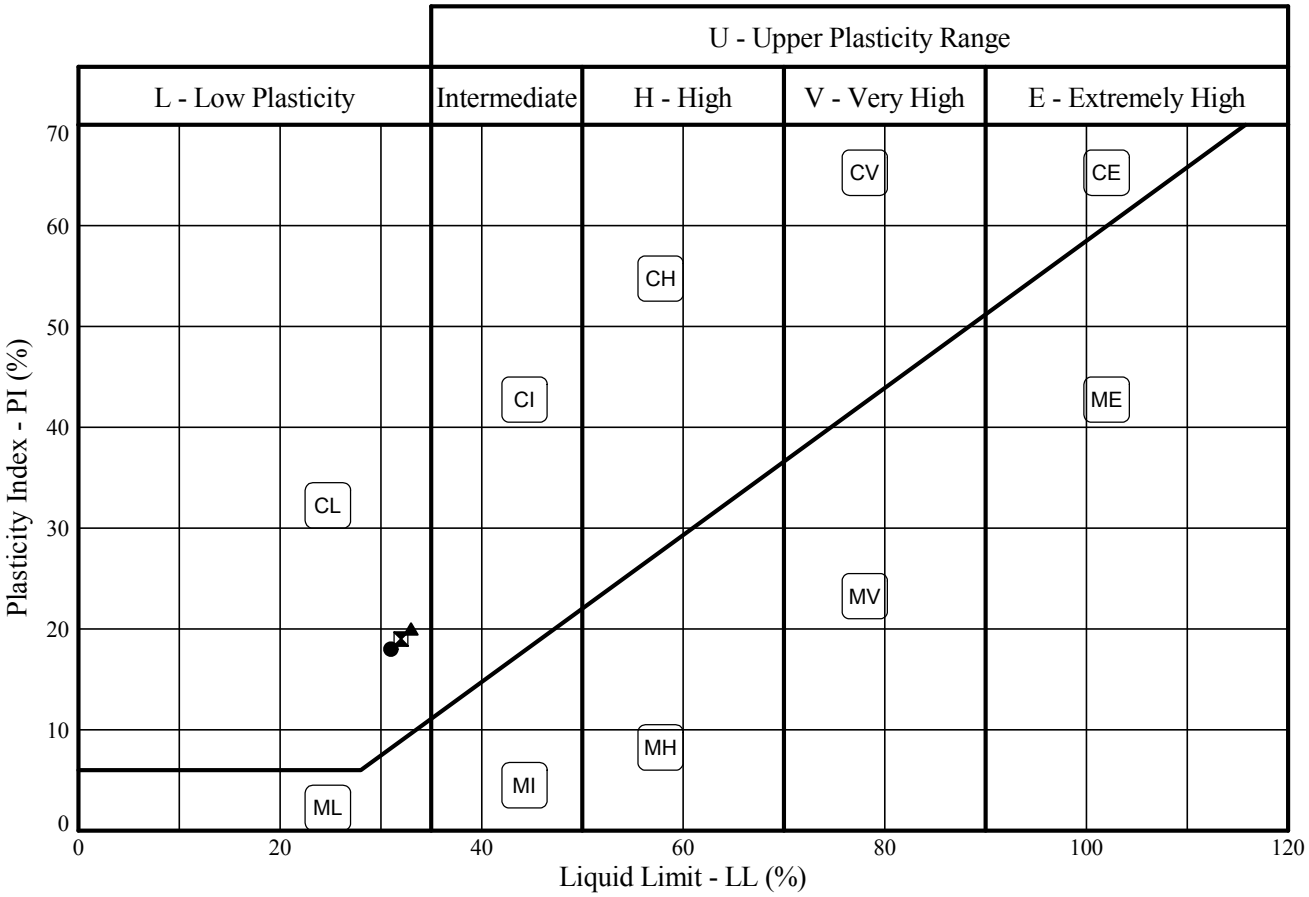
Contract: **14RED080**

Contract Ref: **781369**

AGS

PLASTICITY CHART - PI Vs LL

In accordance with clause 42.3 of BS5930:1999
Testing in accordance with BS1377-2:1990



Sample Identification				BS Test Method #	Preparation Method +	MC %	LL %	PL %	PI %	<425um %
Exploratory Position ID	Sample		Depth (m)							
● TP1	14/05144/11D		2.70	3.2/4.3/5.3/5.4	4.2.4	15	31	13	18	88
⊠ TP2	14/05144/5D		2.00	3.2/4.3/5.3/5.4	4.2.4	17	32	13	19	82
▲ WS4	14/05144/15D		1.50	3.2/4.3/5.3/5.4	4.2.4	16	33	13	20	82

Tested in accordance with the following clauses of BS1377-2:1990.

3.2 - Moisture Content
4.3 - Cone Penetrometer Method
4.4 - One Point Cone Penetrometer Method
4.6 - One Point Casagrande Method
5.3 - Plastic Limit Method
5.4 - Plasticity Index

+ Tested in accordance with the following clauses of BS1377-2:1990.

4.2.3 - Natural State
4.2.4 - Wet Sieved

Key: * = Non standard test, NP = Non plastic.

Approved Signatories: J.BARRETT M.ATHORNE A.FROST M.RANDERSON R.CLARKSON M.FISHER C.COLE M.STOKES

STRUCTURAL SOILS
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Compiled By		Date
M. Fisher.	MAUREEN FISHER	07/10/14

Contract	Contract Ref:
14RED080	781369

AGS

TESTING VERIFICATION CERTIFICATE

1774

The test results included in this report are certified as:-

ISSUE STATUS: **FINAL**

In accordance with Structural Soils Ltd Laboratory Quality Assurance Manual, Issue 6, January 2010 all results sheets and summaries of results issued by the laboratory are checked by an approved signatory. This check will also involve checking of at least 10% of calculations for each test type to ensure that data has been correctly entered into the computer and calculated. The integrity of the test data and results are ensured by control of the computer system employed by the laboratory as part of the Software Verification Program as detailed in the Laboratory Quality Assurance Manual.

This testing verification certificate covers all testing compiled on or before the following datetime: **07/10/2014 16:26:03**.

Testing reported after this date is not covered by this Verification Certificate.

Approved Signatory
Mark Athorne (Laboratory Quality Manager)

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Contract:	Job No:
14RED080	**781369**

APPENDIX E

(i) Gas Monitoring Data

Site: Watergate School, Woolton, Liverpool
Job Number: 14RED080
Date of Monitoring: 2nd Oct 2014

Ground Gas Monitoring Round 1

BETTS ASSOCIATES
GEO ENVIRONMENTAL

Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Methane CH_4(%v/v)		Carbon Dioxide CO_2 (% v/v)		Oxygen (%v/v)		Other Gases (ppm)			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H_2S	CO	(mbgl)	BH depth
WS1	0.0	1025	0.0	0.0	0.1	0.0	20.4	20.7	-	-	-	Dry	0.74
WS4	0.0	1025	0.0	0.0	1.2	1.2	19.9	19.9	-	-	-	Dry	3.00
WS5	0.1	1025	0.0	0.0	0.6	0.6	19.9	19.9	-	-	-	1.58	1.62
WS6	0.2	1025	0.0	0.0	0.1	0.0	20.4	20.4	-	-	3	Dry	0.65
WS7A	0.2	1025	0.0	0.0	0.9	0.8	20.2	20.2	-	-	-	Dry	1.37

Notes:
Monitoring order is left to right across the table
Monitoring should be for **not less** than 3 minutes. However, if high concentrations of gases are initially recorded, monitoring should be for up to 10 minutes

Relevant Information at the Time of Monitoring	
Monitored by:	SM
Weather:	Sunny, warm
Equipment Used:	GA2000+
Visible signs of damage/stress:	
Other Comments/Observations:	

Site: Watergate School, Woolton, Liverpool
Job Number: 14RED080
Date of Monitoring: 17th Oct 2014

Ground Gas Monitoring Round 2

BETTS ASSOCIATES
GEO ENVIRONMENTAL

Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Methane CH_4(%v/v)		Carbon Dioxide CO_2 (% v/v)		Oxygen (%v/v)		Other Gases (ppm)			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H_2S	CO	(mbgl)	BH depth
WS1	0.1	1002	0.0	0.0	0.1	0.0	20.8	20.8	-	-	-	Dry	0.73
WS4	0.0	1002	0.0	0.0	1.3	1.3	19.9	19.9	-	-	-	Dry	3.00
WS5	0.1	1002	0.0	0.0	0.3	0.1	20.6	20.6	-	-	-	Dry	1.63
WS6	0.2	1002	0.0	0.0	0.3	0.3	20.7	20.7	-	-	-	Dry	0.64
WS7A	0.3	1002	0.0	0.0	0.8	0.7	20.1	20.1	-	-	-	Dry	1.49

Notes:
Monitoring order is left to right across the table
Monitoring should be for **not less** than 3 minutes. However, if high concentrations of gases are initially recorded, monitoring should be for up to 10 minutes

Relevant Information at the Time of Monitoring	
Monitored by:	SM
Weather:	Sunny, warm
Equipment Used:	GA2000+
Visible signs of damage/stress:	
Other Comments/Observations:	

Site: Watergate School, Woolton, Liverpool
Job Number: 14RED080
Date of Monitoring: 31st Oct 2014

Ground Gas Monitoring Round 3

BETTS ASSOCIATES
GEO ENVIRONMENTAL

Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Methane CH_4(%v/v)		Carbon Dioxide CO_2 (% v/v)		Oxygen (%v/v)		Other Gases (ppm)			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H_2S	CO	(mbgl)	BH depth
WS1	0.1	1007	0.0	0.0	0.6	0.1	19.9	20.4	-	-	-	Dry	0.73
WS4	0.1	1007	0.0	0.0	2.3	2.3	17.7	17.7	-	-	-	Dry	2.98
WS5	0.1	1007	0.0	0.0	0.3	0.2	20.3	20.4	-	-	-	1.48	1.58
WS6	0.0	1007	0.0	0.0	0.1	0.0	20.6	20.6	-	-	3	0.50	0.63
WS7A	0.1	1007	0.0	0.0	0.6	0.6	20.2	20.2	-	-	-	Dry	1.36

Notes:
Monitoring order is left to right across the table
Monitoring should be for **not less** than 3 minutes. However, if high concentrations of gases are initially recorded, monitoring should be for up to 10 minutes

Relevant Information at the Time of Monitoring	
Monitored by:	SM
Weather:	High cloud, breezy
Equipment Used:	GA2000+
Visible signs of damage/stress:	
Other Comments/Observations:	

Site: Watergate School, Woolton, Liverpool
Job Number: 14RED080
Date of Monitoring: 21st November 2014

Ground Gas Monitoring Round 4

BETTS ASSOCIATES
GEO ENVIRONMENTAL

Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Methane CH_4(%v/v)		Carbon Dioxide CO_2 (% v/v)		Oxygen (%v/v)		Other Gases (ppm)			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H_2S	CO	(mbgl)	BH depth
WS1	0.0	1018	0.0	0.0	0.7	0.1	20.3	20.4	-	-	-	Dry	0.75
WS4	0.0	1018	0.0	0.0	2.9	2.9	18.8	18.8	-	-	-	2.87	2.99
WS5	0.0	1018	0.0	0.0	0.6	0.6	20.6	20.6	-	-	-	1.57	1.61
WS6	0.0	1018	0.0	0.0	0.1	0.0	20.8	20.8	-	-	-	Dry	0.62
WS7A	0.2	1018	0.0	0.0	0.7	0.7	20.5	20.5	-	-	-	Dry	1.37

Notes:
Monitoring order is left to right across the table
Monitoring should be for **not less** than 3 minutes. However, if high concentrations of gases are initially recorded, monitoring should be for up to 10 minutes

Relevant Information at the Time of Monitoring	
Monitored by:	SM
Weather:	Cloudy, cold.
Equipment Used:	GA2000+
Visible signs of damage/stress:	
Other Comments/Observations:	

Site: Watergate School, Woolton, Liverpool
Job Number: 14RED080
Date of Monitoring: 1st Dec 2014

Ground Gas Monitoring Round 5

BETTS ASSOCIATES
GEO ENVIRONMENTAL

Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Methane CH_4(%v/v)		Carbon Dioxide CO_2 (% v/v)		Oxygen (%v/v)		Other Gases (ppm)			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H_2S	CO	(mbgl)	BH depth
WS1	0.3	1012	0.0	0.0	0.1	0.1	20.7	20.7	-	-	-	Dry	0.75
WS4	0.4	1012	0.0	0.0	2.4	2.4	17.9	17.9	-	-	-	2.61	3.00
WS5	0.0	1012	0.0	0.0	0.7	0.7	19.7	19.7	-	-	-	1.55	1.60
WS6	0.1	1012	0.0	0.0	0.1	0.0	20.7	20.7	-	-	-	Dry	0.62
WS7A	0.0	1012	0.0	0.0	0.5	0.5	20.7	20..7	-	-	-	Dry	1.37

Notes:
Monitoring order is left to right across the table
Monitoring should be for **not less** than 3 minutes. However, if high concentrations of gases are initially recorded, monitoring should be for up to 10 minutes

Relevant Information at the Time of Monitoring	
Monitored by:	SM
Weather:	cloudy
Equipment Used:	GA2000+
Visible signs of damage/stress:	
Other Comments/Observations:	

Site: Watergate School, Woolton, Liverpool
Job Number: 14RED080
Date of Monitoring: 19th Dec 2014

Ground Gas Monitoring Round 6

BETTS ASSOCIATES
GEO ENVIRONMENTAL

Borehole	Gas Flow (l/hr)	Atmospheric Pressure (mb)	Methane CH_4(%v/v)		Carbon Dioxide CO_2 (% v/v)		Oxygen (%v/v)		Other Gases (ppm)			Depth to Water	
			Peak	Steady	Peak	Steady	Min	Steady	PID	H_2S	CO	(mbgl)	BH depth
WS1	0.0	1000	0.0	0.0	0.1	0.1	21.0	21.1	-	-	-	Dry	0.75
WS4	14.9	1000	0.0	0.0	1.4	1.4	20.3	20.3	-	-	-	0.61	3.00
WS5	0.0	1000	0.0	0.0	0.7	0.2	20.9	21.0	-	-	-	0.91	1.60
WS6	0.1	1000	0.0	0.0	0.1	0.0	20.9	21.0	-	-	-	Dry	0.62
WS7A	0.0	1000	0.0	0.0	0.4	0.4	20.9	20.9	-	-	-	Dry	1.37

Notes:
Monitoring order is left to right across the table
Monitoring should be for **not less** than 3 minutes. However, if high concentrations of gases are initially recorded, monitoring should be for up to 10 minutes

Relevant Information at the Time of Monitoring	
Monitored by:	SM
Weather:	Sunny, cloudy, windy
Equipment Used:	GA2000+
Visible signs of damage/stress:	
Other Comments/Observations:	

APPENDIX F

(i) Conceptual Model

The report aims to identify land which could potentially be affected by contamination, such that it could affect the value or re-use of the land, or such that mitigation would be required for certain proposed end uses of the land.

The assessment also aims to identify land which would be regarded as 'contaminated land' under the terms of the Environmental Protection Act 1990, Part IIa. This act includes a stricter test for contaminated land than that outlined above. Land is considered to be contaminated if either:

- the land is causing significant harm to people, ecosystems or infrastructure; or
- there is a significant possibility that such harm could be caused; or
- Pollution of controlled waters is being, or is likely to be, caused.

The following situations are defined as being where harm is to be regarded as significant:

- chronic or quite toxic effect, serious injury or death to humans;
- irreversible or other adverse harm to the ecological system;
- substantial damage to or failure of buildings;
- death of, or disease or other physical damage affecting, livestock or crops;
- Pollution of controlled waters.

The risk assessment uses a 'Source-Pathway-Receptor' methodology for assessing whether a source of contamination could potentially lead to harmful consequences. This means that there needs to be a pollutant linkage from source to receptor for harm to be caused, this linkage consisting of:

- a source of pollution;
- a pathway for the pollutant to move along;
- A receptor that is affected by the pollutant.

As an example, the pollutant source could be an identified leak of oil or an area of dumped waste.

The pathways could include transport of the contaminant by groundwater, surface water, windblown dust, or vapours, and for human receptors will include the means, by which contaminants enter the body, for example skin contact, ingestion and inhalation.

Receptors include people, other living organisms, the built environment and groundwater and surface waters (these latter two also being contaminant pathways).

The source-pathway-receptor methodology relationship allows an assessment of the environmental risk to be determined, based on the nature of the source, the degree of exposure of the receptor to the source and the sensitivity of the receptor.

This section of the report is based on the information set out in the previous sections of the report and should not be read independently of such sections.

Initial Conceptual Model

From the available information the preliminary conceptual model is visualised as follows:

Target (Receptor)	POTENTIAL SOURCE-PATHWAY LINKAGE
Site users / residents	Inhalation of soil gas, odours or dust.
	Ingestion of, and skin contact with, contaminated soil.
	Ingestion of contaminants in vegetables etc. or in soils adhering to vegetables, etc.
Construction/ maintenance workers.	Inhalation of soil gas, odours or dust
	Ingestion of, and skin contact with, contaminated soil
Plants	Adverse effects on growth caused by presence of contaminants in soil
Buildings and Structures	Flow of ground gas into buildings. Asphyxiation, toxicity, explosion and fire hazards
	Sulphate attack of foundations
	Hydrocarbons penetrating plastic water supply pipes
Groundwater	Migration of soluble contaminants into groundwater on or off site. Migration of oils into groundwater on or off site.
Surface water	Migration of soluble contaminants and/or direct run-off of contaminants. Migration of oils into groundwater on or off site.

Initial Environmental Risk Assessment

General

It is accepted that an environmental risk assessment can be based on a source-pathway-target model. An examination is carried out as to whether a target will be at risk from a contamination source, that a source exists, and whether there are any pathways (routes of exposure) which might actually link the source to the target.

Environmental risk assessments rely heavily on numerical trigger concentrations or guidelines because exposure of targets to contamination is difficult to quantify directly. Quantification of risk is therefore mainly undertaken for general scenarios in order to derive trigger levels. These are derived for various contaminants for particular targets and routes of exposure. An example of a sensitive target would be users of a domestic back garden, where routes of exposure might be skin contact, dust inhalation, direct ingestion and indirect ingestion via cultivation and consumption of fruit and vegetables.

In March 2002, the first parts of the new CLEA risk assessment guidance were released by DEFRA/Environment Agency.

The risk assessment approach is an extension of the 'fit for use' concept whereby land is cleaned up to a standard fit for the proposed use, that is, so all remaining risks are acceptable. However, as well as being 'fit for use', the environmental risk assessment approach also addresses the soil and water environment so that these are also safeguarded where necessary. For example if a site was contaminated with heavy metals and the development comprised the proposed construction of hard standings and buildings only, the fit-for-use approach might require no remediation for the site. However, consideration of the wider environment needs to address whether groundwater is being contaminated, and if so whether remediation is required for this reason.

The following classification presented by CIRIA has been used in the assessment of risk:

Estimation of risk from consideration of magnitude, consequences and probabilities				
Probability	**Consequences**			
	Severe	**Moderate**	**Mild**	**Minor**
High	Very high	High	Moderate	Moderate / Low
Medium	High	Moderate	Moderate / Low	Low
Low	Moderate	Moderate / Low	Low	Very Low
Unlikely	Moderate / Low	Low	Very Low	Very Low

Reference: Contaminated Land Risk Management; A Guide to Good Practice, CIRIA C552:2001

CIRIA C665 Situation A Ground Gas Conceptual Model

The risk table contained in C665 is basically a modified risk assessment from CIRIA 152 1995, by which a conceptual model and semi-quantitative risk assessment can be made.

APPENDIX G

(i) Notes on Ground Gas

Ground Gas

The Building Regulations and BRE Report 212 state that precautions are not mandatory against carbon dioxide unless 5.0% volume is exceeded. These documents do not give a threshold level for methane, but Baker suggests that this level is 0.1% volume. For methane up to 1.0% volume, and carbon dioxide above 5.0% volume, the Building Regulations and BRE Report state that passive measures may be adopted. Above 1.0% methane further specific guidance must be sought.

CIRIA Report 149 gives further guidance on the appropriate precautions for various gas regimes, called characteristic situations in this report. In the DETR Guide for Design by Ove Arup, various types of passive measures are assessed for performance with different gas regimes. The assessments used computational fluid dynamic (CFD) modelling.

A gas regime is essentially defined by two parameters:

i) The concentration of the gas (e.g. % methane)

ii) The emission rate of the gas from the ground.

The fact that two parameters are used is problematic if the site is to be classified on the basis of Table 28 in CIRIA Report 149. This is because high gas concentrations are often encountered which fall into an onerous gas regime; whereas the low flow rates which are also frequently encountered fall into less onerous gas regimes.

In order to use the Guide for Design to decide if passive measures are suitable, it is necessary to combine the gas concentration and the emission rate.

Three recent publications are used for ground gas risk assessment:

- CIRIA C665 for high rise residential / flats
- 'Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present' Report Edition No.04 March 2007 NHBC – designed for use with low rise residential properties
- BS8485:2007 'Code of practice for the characterization and remediation from ground gas in affected developments'

These documents improve upon the approach used in previous CIRIA and Wilson /Card Papers, by placing emphasis on gas flow rates, but still retain some reliance on the gas concentrations themselves.

CIRIA C665 Situation A Ground Gas Conceptual Model

The risk table contained in C665 is basically a modified risk assessment from CIRIA 152 1995, by which a conceptual model and semi-quantitative risk assessment can be made.

High Rise / Flats (CIRIA 665 Table 8.5)

Characteristic Situation (CIRIA Report 149)	Risk Classification	Gas Screening Value (CH4 or CO2) (l/hr) [1]	Additional factors	Typical source of generation
1	Very low risk	<0.07	Typically methane ≤1%v/v and/or carbon dioxide ≤5%v/v. Otherwise consider increase to Situation 2	Natural soils with low Organic content. "Typical" Made Ground
2	Low risk	<0.7	Borehole flow rate not to exceed 70l/hr. Otherwise consider increase to Situation 3	Natural soil, high peat/organic content. "Typical" Made Ground
3	Moderate risk	<3.5		Old landfill, inert waste, mineworking flooded
4	Moderate to high risk	<15	Quantitative risk assessment required to evaluate scope of protective measures	Mineworking susceptible to flooding, completed landfill (WMP 26B criteria)
5	High risk	<70		Mineworking unflooded inactive with shallow workings near surface
6	Very high risk	>70		Recent landfill site

Notes:
1. Gas screening value: litres of gas/hour is calculated by multiplying the gas concentration (%) by the measured borehole flow rate (l/hr);
2. Site characterisation should be based on gas monitoring of concentrations and borehole flow rates for the minimum periods as defined within within CIRIA Report 665;
3. Source of gas and generation potential/performance must be identified;
4. Soil gas investigation to be in accordance with guidance contained within CIRIA Report 665;
5. If there is no detectable flow, use the limit of detection of the instrument;
6. The boundaries between the Partners in Technology classifications do not fit exactly with the boundaries for the above classification.

Typical scope of protective measures (extract from CIRIA Report 665 Table 8.6)

Characteristic Situation (from Table 8.5)	Number of levels of protection	Typical scope of protective measures for residential building (not low-rise traditional housing)[1]
1	None	No special precautions
2	2	a) Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft) with at least 1200g DPM and under-floor venting b) Beam and block or pre-cast concrete and 2000 g DPM/reinforced gas membrane and under-floor venting. All joints and penetrations sealed.
3	2	All types of floor slab as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated or positively pressurised under-floor sub-space.
4	3	All types of floor slab as above. All joints and penetrations sealed. Proprietary gas resistant membrane and passively ventilated under-floor subspace or positively pressurised under-floor sub-space, over-site capping or blinding and in ground venting layer
5	4	Reinforced concrete cast in situ floor slab (suspended, non-suspended or raft). All joints and penetrations sealed. Proprietary gas resistant membrane and ventilated or positively pressurised under-floor sub-space, over-site capping and in ground venting layer and in ground venting wells or barriers.
6	5	Not suitable unless gas regime is reduced first and quantitative risk assessment carried out to assess design of protection measures in conjunction with foundation design.

Notes:

1. Not suitable for use with low rise traditional housing. (Use the NHBC document instead);
2. Typical scope of protective measures may be rationalised for specific developments on the basis of quantitative risk assessments;
3. Note the type of protection is given for illustration purposes only. Information on the detailing and construction of passive protection measures is given in BR414 (Johnson, 2001). Individual site specific designs should provide the same number of separate protective methods for any given characteristic situation. See CIRIA Report 49;
4. In all cases there should be minimum penetration of ground slabs by services and minimum number of confined spaces such as cupboards above the ground slab. Any confined spaces should be ventilated;
5. Foundation design must minimise differential settlement particularly between structural elements and ground-bearing slabs;
6. Commercial buildings with basement car parks, provided with ventilation in accordance with the Building Regulations, may not require gas protection for Characteristic Situations 3 and 4;
7. Floor slabs should provide an acceptable formation on which to lay the gas membrane. If a block beam floor is used it should be well detailed so it has no voids in it that membranes have to span, and all holes for service penetrations should be filled. The minimum density of the blocks should be 600kg/m3 and the top surface should have a 4:1 ratio sand to cement grout brushed into all joints before placing any membrane (this is also good practice to stabilise the floor and should be carried out regardless of the need for ground gas membranes);
8. The ground gas-resistant membrane can also act as the damp-proof membrane;
9. Based on Building Regulations Approved Document C (Office of the Deputy Prime Minister, 2004a),which states that "a membrane below the concrete could be formed with a sheet of polyethylene, which should be at least 300mu thick (1200 gauge)". Please note the alteration from 300mm (as stated in the Approved Document C) to 300mu, as 300mm is a typographical error that has been recognised and corrected for within this report and CIRIA Report 665.

Low Rise Residential (NHBC)

Table 14.1: Gas Risk Assessment - Traffic Lights with Typical Maximum Concentrations and Gas Screening Values

	Methane [1]		Carbon Dioxide [1]	
Classification	Typical Maximum Concentration [3] (%v/v)	Gas Screening Value [2,4] (l/hr)	Typical Maximum Concentration [3] (%v/v)	Gas Screening Value [2,4] (l/hr)
Green				
	1	0.13	5	0.78
Amber 1				
	5	0.63	10	1.60
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.

Table 14.2: Ground Gas Protection Measures Required for the Traffic Lights

Traffic Light	Ground Gas Protection Measures Required
Green	Ground gas protection measures are not required. (note based on standard NHBC house detail with 150mm void space under suspended floor)
Amber 1	Low-level ground gas protection measures are required, using a membrane and ventilated sub-floor void that creates a permeability contrast to limit the ingress of gas into buildings. Gas protection measures are to be installed as prescribed in BRE 414. Ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours.
Amber 2	High-level ground gas protection measures are required, creating a permeability contrast to prevent ingress of gas into buildings. Gas protection measures are to be installed as prescribed in BRE 414. Membranes used should always be fitted by a specialist contractor and should be fully certified (see Appendix G). As with Amber 1, ventilation of the sub-floor void should be designed to provide a minimum of one complete volume change per 24 hours.
Red	Standard residential housing is not normally acceptable without further Ground Gas Risk Assessment and/or possible remedial mitigation measures to reduce/remove the source of the ground gases. In certain circumstances, active protection methods could be applied, but only when there is a legal agreement assuring the management and maintenance of the system for the life of the property.

Table 2: Required Gas Protection By Characteristic Gas Situation & Type Of Building

Characteristic gas situation, CS	NHBC traffic light	Required gas protection			
		Non-managed property, e.g. private housing	Public building [A]	Commercial buildings	Industrial buildings [B]
1	Green	0	0	0	0
2	Amber 1	3	3	2	1 [C]
3	Amber 2	4	3	2	2
4	Red	6 [D]	5 [D]	4	3
5			6 [E]	5	4
6				7	6

NOTE Traffic light indications are taken from NHBC Report no.: 10627-R01 (04) [3] and are mainly applicable to low-rise residential housing. These are for comparative purposes but the boundaries between the traffic light indications and CS values do not coincide.

A) Public buildings include, for example, managed apartments, schools and hospitals.
B) Industrial buildings are generally open and well ventilated. However, areas such as office pods might require a separate assessment and may be classified as commercial buildings and require a different scope of gas protection to the main building.
C) Maximum methane concentration 20% otherwise consider an increase to CS3.
D) Residential building on higher traffic light/CS sites is not recommended 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.
E) Consideration of issues such as ease of evacuation and how false alarms will be handled are needed when completing the design specification of any protection scheme.

Table 3: Solutions Scores

PROTECTION ELEMENT/SYSTEM		SCORE	COMMENTS
a) Venting/dilution (See Annex A)			
Passive sub floor ventilation (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.) A)	Very good performance	2.5	Ventilation performance in accordance with Annex A. If passive ventilation is poor this is generally unacceptable and some form of active system will be required.
	Good performance	1	
Subfloor ventilation with active abstraction/pressurization (venting layer can be a clear void or formed using gravel,		2.5	There have to be robust management systems in place to ensure the continued maintenance of any ventilation system.

geocomposites, polystyrene void formers, etc.) A)			Active ventilation can always be designed to meet good performance. Mechanically assisted systems come in two main forms: extraction and positive pressurization.
Ventilated car park (basement or undercroft)		4	Assumes car park is vented to deal with car exhaust fumes, designed to Building Regulations Document F [5] and IStructE guidance [6].
b) Barriers			
Floor slabs			It is good practice to install ventilation in all foundation systems to effect pressure relief as a minimum. Breaches in floor slabs such as joints have to be effectively sealed against gas ingress in order to maintain these performances.
Block and beam floor slab		0	
Reinforced concrete ground bearing floor slab		0.5	
Reinforced concrete ground bearing foundation raft with limited service penetrations that are cast into slab		1.5	
Reinforced concrete cast in situ suspended slab with minimal service penetrations and water bars around all slab penetrations and at joints		1.5	
Fully tanked basement		2	
c) Membranes			
Taped and sealed membrane to reasonable levels of workmanship/in line with current good practice with validation B), C)		0.5	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
Proprietary gas resistant membrane to reasonable levels of workmanship/in line with current good practice under independent inspection (CQA) B), C)		1	
Proprietary gas resistant membrane installed to reasonable levels of workmanship/in line with current good practice under CQA with integrity testing and independent validation		2	
d) Monitoring and detection (not applicable to non-managed property, or in isolation)			
Intermittent monitoring using hand held equipment		0.5	
Permanent monitoring and alarm system A)	Installed in the underfloor venting/ dilution system	2	Where fitted, permanent monitoring systems ought to be installed in the underfloor venting/dilution system in the first instance but can also be provided within the occupied space as a fail safe
	Installed in the building	1	
e) Pathway Intervention			
Pathway intervention		-	This can consist of site protection measures for off-site or on-site sources (see Annex A).

NOTE In practice the choice of materials might well rely on factors such as construction method and the risk of damage after installation. It is important to ensure that the chosen combination gives an appropriate level of protection

A) It is possible to test ventilation systems by installing monitoring probes for post installation validation.

B) If a 1 200 g DPM material is to function as a gas barrier it should be installed according to BRE 212 [8]/BRE 414 [9], being taped and sealed to all penetrations.

C) Polymeric Materials >1 200 g can be used to improve confidence in the barrier. Remember that their gas resistance is robust and resistant to site damage.

APPENDIX H

(i) Off-site Disposal of Surplus Soil Guidance Notes

The disposal of waste (including surplus soils and contaminated soils) to landfill sites is governed by the *Landfill (England & Wales) Regulations 2002*, the *Hazardous Waste Technical Guidance document WM2 (2003)* and associated legislation.

One of the aims of the above legislation is to encourage waste producers (including developers disposing of surplus soils etc) to reduce their waste (and not just discard and disown it). This can be achieved by recycling or reusing the waste. In the case of contaminated sites where leaving contaminated material in-situ poses a risk to a potential receptor such as groundwater resources, further testing and assessment for such risk could reduce the quantities requiring disposal. If there is still unacceptable risk from contaminated soil being left in place, then it may be possible to reduce the risk to an acceptable level (such that the material can be left in place) by in-situ or ex-situ clean-up of the soils.

Before waste can be disposed of, the producer of the waste must undertake a number of steps. '*Initial Waste Testing and Characterisation'* is firstly undertaken to determine whether the waste is non-hazardous or hazardous. The exceptions are that some wastes such as coal tars, 'tank bottom sludge's', etc are immediately classed as hazardous, regardless of any testing or threshold concentrations.

Any inert or hazardous waste destined for landfill must undergo '*Compliance Testing'* using the Waste Acceptance Criteria (WAC). There are different inert and hazardous WAC limits relating to landfill sites that are correspondingly licensed to accept inert or hazardous waste.

If the '*Initial Waste Testing and Characterisation'* shows a waste to be hazardous, then it is a requirement that the material be tested against the WAC-hazardous suite of tests. If it *passes* the WAC-hazardous testing, then it can be taken to a hazardous waste landfill site. If the material *fails* the WAC-hazardous testing, then the material must be treated before undergoing re-characterisation, further WAC-hazardous testing and then potential disposal at a hazardous waste disposal site.

If the '*Initial Waste Testing and Characterisation'* shows a waste to be non-hazardous, then it can be taken to a non hazardous waste landfill site, without further testing. The producer may however decide to undertake WAC-inert testing, in an attempt to reclassify the waste as inert, in which case the waste could then go to an inert landfill site.

The volumes of soils associated with potential hotspots on a site (be they hazardous or non hazardous) which might require off-site disposal, could potentially be reduced by further on-site sampling and subsequent testing.

With regard to the *Compliance Testing*, it should be noted that some landfill sites are permitted to increase the standard WAC-hazardous/inert limit concentrations, such that they might accept waste that would normally fail such limits.

We would recommend that the contamination testing results (including the history of the site) be presented to the proposed landfills, to determine if they will accept waste generated at the site and what classification they would impose.

APPENDIX I

(i) Validation Report Guidance Notes

Unforeseen Hotspots of Contamination

Given the existence of made ground on the site it would be prudent to maintain vigilance during site clearance and construction, in case any further areas of suspected contamination are encountered.

If areas are found then a suitably qualified person should undertake appropriate sampling, testing and further risk assessment.

Any hotspots encountered during site clearance, not previously encountered in the ground investigation, are to be removed to a suitably licensed landfill site.

A validation report (see below) will be produced on completion of these works. This report will serve to confirm that the works were undertaken in accordance with the relevant legislation, the method statement, specification and planning conditions.

Validation Report Recommendations

It is suggested that the following records will be kept on site to provide a basis for the validation report:

- Daily record sheets of the remediation works to include a summary of the day's activities
- Weather conditions
- Plant, personnel and visitors to the remediation site
- Aspects relating to Health & Safety, environmental control or non-compliance with the specification or the Method Statements.
- All in situ and laboratory testing results.

All requirements of the remediation specification should be complied with; on completion of the remediation a validation report should be provided. This report will comprise the relevant site records and act as certification that the remedial and ground preparation works have been carried out in accordance with the specification.

The validation report will include the following:

- A description of the works undertaken.
- Records of any remediation works, including daily diary sheets.
- Progress photographs.
- Any chemical and geotechnical validation test results.
- As built surveys, including base excavations and top and bottom of capping layer.
- A statement that the works have been undertaken in accordance with the agreed specification

APPENDIX J

(i) Notes on Limitations

This report does not consider ecological impacts (e.g. bats) or botanical risks (e.g. Japanese knotweed). It is recommended that these are considered as part of the assessment of development constraints for the site.

The assessment and judgements given in this report are directed by both the finite data on which they are based and the proposed works to which they are addressed. The data essentially comprised a study of available documented information from various sources (including Client Furnished reports) together with discussions with relevant authorities and other interested parties. There may also be circumstances at the site that are not documented. The information reviewed is not exhaustive and has been accepted in good faith as providing representative and true data pertaining to site conditions. If additional information becomes available which might impact our environmental conclusions, we request the opportunity to review the information, reassess the potential concerns and modify our opinion if warranted.

It should be noted that any risks identified in this report are perceived risks based on the available information. Actual risks can only be assessed following a physical investigation of the site.

The site investigation has been carried out to provide information concerning the type and degree of contamination, and ground and groundwater conditions to allow a reasonable risk assessment to be made. Betts Geo Environmental Ltd undertake to exercise all reasonable skill, care and due diligence in the exercise of the investigation with respect to sampling techniques, sample storage and report interpretation.

The assessments and judgement given in this report are directed by both the finite data on which they are based and the proposed works to which they are addressed. Data acquisition is subject to the limitations of the methods of investigation used. Exploratory holes undertaken during fieldwork investigate small a small volume of ground in relation to the size of the site and as such can only provide an indication of site conditions. There may be conditions pertaining to the site and the proposed development i.e. localised “hotspots” of contamination, which have not been disclosed by the investigations.

The findings and opinions are relevant to the dates of our site works and should not be relied upon to represent conditions at substantially later dates. Conditions at the site will change over time due to natural variations and anthropogenic activities. Groundwater, surface water and soil gas conditions should be anticipated to change with diurnal, seasonal and meteorological variations.

The opinions expressed in this report regarding any contamination are based on simple statistical analysis and comparison with available guidance values. No liability can be accepted for the retrospective effects of any changes or amendments to these values.

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