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consulting engineers

59 Redington Road
London NW3 7RP

Basement Impact Assessment Audit

For

London Borough of Camden

Project Number: 12336-55

Revision: F1

October 2016

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Appendix

1.0 NON-TECHNICAL SUMMARY

1.1. CampbellReith was instructed by London Borough of Camden, (LBC) to carry out an audit on the Basement Impact Assessment submitted as part of the Planning Submission documentation for 59 Redington Road, London, NW3 7RP (planning reference 2015/5882/P). The basement is considered to fall within Category A as defined by the Terms of Reference.

1.2. The Audit reviewed the Basement Impact Assessment for potential impact on land stability and local ground and surface water conditions arising from basement development in accordance with LBC's policies and technical procedures.

1.3. CampbellReith was able to access LBC's Planning Portal and gain access to the latest revision of submitted documentation and reviewed it against an agreed audit check list.

1.4. The BIA has been carried out by firms of engineering consultants using individuals who possess the necessary and suitable qualifications.

1.5. The BIA has confirmed that the proposed basement will be founded within the Claygate Member of the London Clay. In advance of construction, design shear strengths at foundation level should be confirmed.

1.6. It is likely that the ground water table will not be encountered during basement foundation excavation. Following further exploratory soil investigations, groundwater was encountered at 4.5mbgl.

1.7. The BIA indicates that the proposed development is close to a tributary of the "lost" River Westbourne. The exact location of the buried river channel was not identified during the additional soil investigation works and the updated BIA recommends that further investigation across the development footprint is recommended.

1.8. Subject to confirmation by further investigation (as per 1.8), on the assumption that alluvial soils relating to the lost river are not encountered, it is accepted that the development will not impact on the wider hydrogeology of the area and is not in an area subject to flooding.

1.9. No Structural Strategy Report (SSR) has been prepared to discuss proposals on how to construct the basement including potential groundwater ingress into excavations and the temporary works which will be necessary to form the proposed structure. Prior to tender and in support of any planning documents, the Tendering contractor should provide detailed method statements for all aspects of the construction.

1.10. The update BIA information indicates that an attenuation SUDS scheme will be implemented, which should be designed to attenuate discharge flows to sewers in line with appropriate

planning guidelines. On this basis, the proposed development will not impact the wider hydrological environment.

1.11. It is accepted that there are no land stability issues relating to slopes.

1.12. Queries and requests for clarification are described in Section 4 and summarised in Appendix 2.

2.0 INTRODUCTION

2.1. CampbellReith was instructed by London Borough of Camden (LBC) on 08.04.16 to carry out a Category A Audit on the Basement Impact Assessment (BIA) submitted as part of the Planning Submission documentation for 59 Redington Road, London, NW3 7RP (planning reference 2015/5882/P).

2.2. The Audit was carried out in accordance with the Terms of Reference set by LBC. It reviewed the Basement Impact Assessment for potential impact on land stability and local ground and surface water conditions arising from basement development.

2.3. A BIA is required for all planning applications with basements in Camden in general accordance with policies and technical procedures contained within

- Guidance for Subterranean Development (GSD). Issue 01. November 2010. Ove Arup & Partners.
- Camden Planning Guidance (CPG) 4: Basements and Lightwells.
- Camden Development Policy (DP) 27: Basements and Lightwells.
- Camden Development Policy (DP) 23: Water.

2.4. The BIA should demonstrate that schemes:

a) maintain the structural stability of the building and neighbouring properties;

b) avoid adversely affecting drainage and run off or causing other damage to the water environment; and,

c) avoid cumulative impacts upon structural stability or the water environment in the local area

and evaluate the impacts of the proposed basement considering the issues of hydrology, hydrogeology and land stability via the process described by the GSD and to make recommendations for the detailed design.

2.5. LBC's Audit Instruction described the planning proposal as *"The excavation of a new swimming pool and erection of associated pitched roof single-storey enclosure with dressing room within the rear garden area and a pergola connecting the main house with the pool."*

2.6. CampbellReith accessed LBC's Planning Portal on 23.05.16 and gained access to the following relevant documents for audit purposes:

- Basement Impact Assessment Report (BIA) for Surface Water and Groundwater
  (ESI Ltd., report ref: 64538R1, report status: Final, April 2016)
- Basement Screening and Scoping – Land stability
  (Key GeoSolutions Ltd., report ref: 16-065-R-002, report status: Final, February 2016)
- Planning Application Drawings consisting of
  Location Plan – (SIAW drawing RR23-59 Redington Road-A-00, rev: -)
  Existing Plans – (SIAW drawing RR23-59 Redington Road-A-02, rev: -)
  Proposed Plans – (SIAW drawing RR23-59 Redington Road-A-00, rev: -)
- Design & Access Statement
- Arboricultural Report (Geoffrey Bunyan Associates, May 2009) and Addendum Note (Marcus Foster Arboricultural Design & Consultancy, December 2015)
- Preliminary calculations on proposed attenuation tank required

2.7. Additional information including a Desk Study and Report on Ground Investigation was received on 04.10.16.

- Desk Study and Report on Ground Investigation (ref 16-248-R-001) dated 4 October 2016 by Key GeoSolutions Limited.

3.0 BASEMENT IMPACT ASSESSMENT AUDIT CHECK LIST

Item	Yes/No/NA	Comment
Are BIA Author(s) credentials satisfactory?	Yes	
Is data required by Cl.233 of the GSD presented?	Yes	Proposed construction method and work programme for construction, operation and commissioning phases to be developed.
Does the description of the proposed development include all aspects of temporary and permanent works which might impact upon geology, hydrogeology and hydrology?	Yes	Following Key GeoSolution Ltd (KGS) desk study and report on ground investigation (issued on 04.10.16) groundwater is not expected to be encountered during the construction works. Further works are required to confirm if alluvial soils associated with the lost river are present over the site footprint. Design shear strengths to be confirmed.
Are suitable plan/maps included?	Yes	Refer to ESI and KGS BIA documents.
Do the plans/maps show the whole of the relevant area of study and do they show it in sufficient detail?	Yes	
Land Stability Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	Refer to Section 3.0 of KGS "Basement Screening and Scoping-Land Stability" February 2016 document.
Hydrogeology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	Refer to Section 2.2 of ESI "Basement Impact Assessment: 59 Redington Road, London NW3 7RP (Surface Water and Groundwater)" April 2016 document.
Hydrology Screening: Have appropriate data sources been consulted? Is justification provided for 'No' answers?	Yes	Refer to Section 2.1 of ESI "Basement Impact Assessment: 59 Redington Road, London NW3 7RP (Surface Water and Groundwater)" April 2016 document.
Is a conceptual model presented?	Yes	
Land Stability Scoping Provided? Is scoping consistent with screening outcome?	Yes	Refer to Section 5.0 of KGS "Basement Screening and Scoping-Land Stability" February 2016 document.

Item	Yes/No/NA	Comment
Hydrogeology Scoping Provided? Is scoping consistent with screening outcome?	Yes	Refer to Section 3.2 of ESI "Basement Impact Assessment: 59 Redington Road, London NW3 7RP (Surface Water and Groundwater)" April 2016 document and KGS desk study and report on ground investigation (August 2016).
Hydrology Scoping Provided? Is scoping consistent with screening outcome?	Yes	Refer to Section 3.1 of ESI "Basement Impact Assessment: 59 Redington Road, London NW3 7RP (Surface Water and Groundwater)" April 2016 document.
Is factual ground investigation data provided?	Yes	
Is monitoring data presented?	No	
Is the ground investigation informed by a desk study?	Yes	
Has a site walkover been undertaken?	Yes	
Is the presence/absence of adjacent or nearby basements confirmed?	NA	The proposed development has an average excavation depth of 1.65m and is located more than 20m from the neighbouring properties. It is considered that the proposed development will not cause any damage/movement to the adjacent or nearby basements. However appropriate support will be required to be provided in order to maintain the stability of boundaries to the adjacent properties.
Is a geotechnical interpretation presented?	Yes	
Does the geotechnical interpretation include information on retaining wall design?	No	Structural engineering calculations have not been submitted.
Are reports on other investigations required by screening and scoping presented?	No	Section 5.1 of KGS "Basement Screening and Scoping-Land Stability" and KGS desk study and report on ground investigation recommend that the route of an historic watercourse (located close to the site boundary) should be further investigated.

Item	Yes/No/NA	Comment
Are the baseline conditions described, based on the GSD?	Yes	
Do the base line conditions consider adjacent or nearby basements?	NA	The proposed development is located more than 20m from the neighbouring properties. It is considered that the proposed development will not cause any damage/movement to the adjacent or nearby properties and/or basements.
Is an Impact Assessment provided?	NA	
Are estimates of ground movement and structural impact presented?	NA	The proposed development has an average excavation depth of 1.65m. Above ground, the proposed building will be single storey, constructed in timber, and will not exceed 4.5m in height. It is unlikely that the proposed scheme will cause significant ground movement. However, a robust temporary works solution will be required. Contractor to be responsible for the design, erection and maintenance of all temporary works in accordance with the relevant British Standards.
Is the Impact Assessment appropriate to the matters identified by screen and scoping?	NA	
Has the need for mitigation been considered and are appropriate mitigation methods incorporated in the scheme?	Yes	
Has the need for monitoring during construction been considered?	NA	As above.
Have the residual (after mitigation) impacts been clearly identified?	Yes	Further works are required to confirm if alluvial soils associated with the lost river are present over the site footprint.
Has the scheme demonstrated that the structural stability of the building and neighbouring properties and infrastructure will be maintained?	No	Structural design TBC. Construction works to be carried out by an experienced contractor.
Has the scheme avoided adversely affecting drainage and run-off or causing other damage to the water environment?	Yes	With attenuation SUDS.

Item	Yes/No/NA	Comment
Has the scheme avoided cumulative impacts upon structural stability or the water environment in the local area?	NA	
Does report state that damage to surrounding buildings will be no worse than Burland Category 2?	NA	As above. It is unlikely that the proposed development will cause any damage to the adjacent properties; however appropriate support will be required to be provided so as to maintain the stability of boundaries to the adjacent properties.
Are non-technical summaries provided?	Yes	Provided in ESI Ltd report. Refer to Conclusions section in Key GeoSolutions report.

4.0 DISCUSSION

4.1. The Basement Impact Assessment (BIA) has been carried out by firms of engineering consultants, ESI Ltd. (ESI) and Key GeoSolutions Ltd. (KGS). The individuals possess suitable qualifications, broadly in accordance with the requirements of CPG4.

4.2. To date, there has been no Structural Strategy (SSR) carried out.

4.3. The proposed development comprises constructing a covered swimming pool and associated single storey enclosure to the rear of the existing dwelling house at 59 Redington Road, London, NW3 7RP. To the North, South and West, the proposed site borders directly on gardens of properties of Redington Road and Ferncroft Avenue. The proposed poolhouse is to be lightweight, constructed in timber and will not exceed 4.5m in height. Planning permissions were granted in 2004 and 2009 but were never implemented.

4.4. With reference to the British Geological Survey maps and information extracted from exploratory investigation works undertaken in a neighbouring property, the existing site is underlain by Claygate Member extending to approx. 5.0mbgl. Made Ground was encountered to a depth of 1.50mbgl. SPT N values obtained in the site investigation were variable and do not support the design bearing capacity presented. In advance of construction, design shear strengths at foundation level should be confirmed as appropriate by the designer.

4.5. The BIA refers to an average basement depth of construction of 1.65m and a total area of 70m^2. The proposed Architect's drawings received to date (SIAW drawing RR23-59 Redington Road-A-00, rev: -) have reduced depths of basement to approx. 1.1 metres. During this audit, an assumption has been made that the former BIA proposal is correct.

4.6. The BIA indicated that groundwater might be present at approximately 1.0 mbgl. During further investigation works carried out on 4th August 2016 (ref: KGS desk study and report on ground investigation) water was encountered at approximately 4.50mbgl. No post fieldwork groundwater monitoring was however carried out. The contractor should ensure they are aware of groundwater levels in advance of construction and that suitable mitigation measures are in place, which should be reviewed and approved by the designer.

4.7. The KGS desk study and report on ground investigation did not identify the location of the "lost" watercourse close to the site. Further investigations of this matter are recommended in the BIA. The presence of alluvial soils will have an effect on both land stability and the risk of hydrogeological impacts, both to the proposed development and to surrounding properties. Alluvial soils are likely to have a lower bearing capacity than the Claygate Member and may be water bearing, providing a preferential pathway for groundwater flow.

4.8. Subject to confirmation by further investigation (as per 4.7), on the assumption that alluvial soils relating to the lost river are not encountered, it is accepted that the development will not impact on the wider hydrogeology of the area and is not in an area subject to flooding. If alluvial soils are encountered, the BIA should be re-issued to address and mitigate against these ground / groundwater conditions.

4.9. Irrespective of the route of the existing watercourse, a waterproofing proposal needs to be developed to relevant British Standard requirements.

4.10. No proposals are provided for a movement monitoring strategy during excavation and construction. The proposed development has an average excavation depth of 1.65m and is located more than 20m from the neighbouring properties. Above ground, the proposed building will be single storey, constructed in timber, and will not exceed 4.5m in height. It is considered that the proposed development will not cause any damage/movement to the adjacent or nearby properties and/or basements. A robust temporary works solution will be required with the contractor being responsible for the design, erection and maintenance of all temporary works in accordance with the relevant British Standards/Eurocodes.

4.11. It is understood that the existing proposal will not adversely impact upon the amenities of the neighbouring properties. There would be some overhang from the roof of the proposed swimming pool which would be parallel to the boundary wall; but not against it.

4.12. It is accepted that there are no slope stability concerns regarding the proposed development and it is not in an area prone to flooding.

5.0 CONCLUSIONS

5.1. The BIA has been carried out by well-known firms of engineering consultants using individuals who we are satisfied that possess the necessary and suitable qualifications.

5.2. The BIA has confirmed that the proposed basement will be founded within the Claygate Member of the London Clay. In advance of construction, design shear strengths at foundation level should be confirmed.

5.3. Following further exploratory site investigations, it has been indicated that groundwater is not expected to be encountered during basement foundation excavation.

5.4. The BIA notes that the proposed development is close to a tributary of the "lost" River Westbourne. The exact location of the buried river channel was not identified during additional soil investigation works and further investigation on the location of this buried river channel is recommended by the BIA.

5.5. Subject to confirmation by further investigation (as per 5.4), on the assumption that alluvial soils relating to the lost river are not encountered, it is accepted that the development will not impact on the wider hydrogeology of the area and is not in an area subject to flooding.

5.6. No Structural Strategy Report (SSR) has been prepared to discuss proposals on how to construct the basement including the temporary works which will be necessary to form the proposed structure and potential groundwater ingress into excavations. Prior to tender and in support of any planning documents, the Tendering contractor should provide detailed method statements for all aspects of the construction.

5.7. It is accepted that there are no land stability impacts relating to slopes.

5.8. Assuming that the additional works and recommendations as indicated are undertaken, the BIA meets the criteria of CPG4. If alluvial soils are encountered during further investigation, the BIA should be re-issued to address the potential impacts and appropriate mitigation should be proposed.

Appendix 1: Residents' Consultation Comments

None pertinent to BIA

Appendix 2: Audit Query Tracker

Audit Query Tracker

Query No	Subject	Query	Status	Date closed out
1	Stability	The absence of the hidden watercourse is to be confirmed No site specific ground investigation report submitted. Report to cover existing and past uses of the site and ground conditions; covering also groundwater monitoring.	Closed – KGS desk study and report on ground investigation (August 2016) submitted and accepted.	24.10.16
2	Stability	Indicative construction and temporary works sequence to be provided.	Closed – Prior to tender and in support of any planning documents, the Tendering contractor should provide detailed method statements for all aspects of the construction.	24.10.16
3	Stability / hydrogeology	Bearing capacity and presence / absence of alluvial soils associated with the lost river.	Closed - In advance of construction, design shear strengths at foundation level should be confirmed. Exploratory works should also confirm that alluvial soils associated with the lost river will not be encountered within the development footprint. If alluvial soils are encountered, the BIA should be re-issued to address the potential impacts and appropriate mitigation should be proposed.	24.10.16

Appendix 3: Supplementary Supporting Documents

Key GeoSolutions Ltd Desk Study and Report on Ground Investigation (Aug 2016)

KEY GS

Geological & Geotechnical Consultants

59 Redington Road, London NW3 7RP

Desk Study & Report on Ground Investigation (Aug 2016)

Prepared for SIAW

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Job Number: 16-248

Report Number: 16-248-R-001

SIAW

59 Redington Road

Desk Study & Report on Ground Investigation

Prepared by:

R Westnedge BSc (Hons) MSc FGS .....

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Report Distribution List

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KGS File	pdf	1	04/10/16						

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1.0 INTRODUCTION

Key GeoSolutions Ltd (KGS) have been commissioned by SIAW LTD to undertake a ground investigation at 59 Redington Road, London in order to ascertain the ground conditions for a proposed new swimming pool and erection of associated pitched roof single-storey enclosure with dressing room within the rear garden area.

As part of the planning application for the swimming pool a Basement Impact Assessment (BIA) was submitted and reviewed by the London Borough of Camden's Consultant's Campbell Reith and reported in their BIA Audit report, Project No 12336-55 revision – D1 dated May 2016. This audit highlighted the fact that the absence of a hidden watercourse supposedly running to the rear of the gardens had not been confirmed and no site specific ground investigation report submitted. Consequently, this investigation comprises;

- a Desk Study highlighting previous uses of the site
- exploratory holes using window sampling techniques;
- samples recovered for chemical and geotechnical testing; and
- groundwater monitoring installations.

The report comprises a desk study review of publicly available information related to the site and the surrounding area, an Envirocheck report, provided by the Landmark Information Group (a copy of which can found in Appendix 1), together with the results of the Ground Investigation.

The ground investigation comprised 2No. window sample holes sunk, with water monitoring standpipe installations, close to the proposed footprints of the new structures where access allowed, to define the ground conditions and provide samples for geotechnical testing and chemical analysis.

The comments given in this report and any opinions expressed are based on the ground conditions encountered during the site work, the results of tests made in the field and in the laboratory and on information made available by SIAW LTD and other Third Parties. KGS has proceeded in good faith on the assumption that this information is accurate and accepts no liability for any inaccurate conclusions, assumptions or actions taken resulting from any inaccurate information supplied. There may be, however, conditions pertaining to the site which have not been disclosed by the investigation and which therefore could not be taken into account in this report. In particular underground services may be present that could affect the proposed development.

It should also be noted that the effects of ground and water borne contamination on the environment are constantly under review, and authoritative guidance values are potentially subject to change.

The conclusions presented herein are based on the guidance available at the time this report was prepared, and no liability can be accepted for the retrospective effects of any changes or amendments to the legislation or guidance.

2.0 SITE OVERVIEW

2.1 Site Location and Description

The site may be located by National Grid Reference 525597mE, 185959mN, the location is shown on Figure 1.

The proposed structure is to be located to the west of the existing building in what is currently a garden area. The area is bounded by other gardens to the north and west, access to the site is via the existing building at 59 Redington road.

The current layout is shown on Figure 2. From the site topographic survey provided the site falls from the front of the property at approximately 97.5mAOD to 94.0mAOD at the end of the rear garden.

2.2 Land Use History

2.2.1 General

Landmark Information Group (Landmark) was commissioned to provide an Envirocheck® Report. This report, including the Historical Ordnance Survey Maps, is presented in its entirety, in Appendix 1. The maps have been reviewed to determine the historical on-site and off-site land use. Where appropriate these have been supplemented/correlated by other information from web-based sources.

2.2.2 Historical Land uses and features

The review focuses on the land use within the boundary and the land immediately adjacent to the sites. Additional comment on the land use further from the site is added if noteworthy from a geotechnical or land contamination context.

Site – fields from 1864 until 1896, on the 1896 map the site and surrounding area are marked as being fields with Redington Road being established, a covered Reservoir (Water Works) is also noted to the south west of the site. On the 1915 map, the site and surrounding area are no longer fields, with numerous roads being established around Redington Road.

Between 1915 and 2016 the site remains undeveloped as a domestic garden.

2.2.3 Contemporary Surrounding Land Use

There has been one contemporary trade located within the surrounding 250m of the site this is an inactive furniture manufacture and is located 247m from the site. The closest was Garage Services (24 Hour Euro Windscreen Ltd) at 571, Finchley Road approximately 443m to the south west of the site, this site is currently inactive. The closest active operation is a Packaging Materials Manufacturers & Supplies (Ravtex Uk Ltd) 95 Platts Lane, Hampstead approximately 368m to the north west of the site, although this operation does not require a Local Authority Pollution Prevention and Control permit. The closest company requiring such a permit is Esso Filling Station, which is 526m to the west.

The nearest obsolete fuel station was located 538m to the west of the site at 617, Finchley Road; the nearest open fuel station is located 526m to the west adjacent to the obsolete fuel station at 617, Finchley Road (Esso).

2.3 Geo-Environmental Setting

2.3.1 Geology

The site is covered by BGS 1: 50,000 Geological Sheet No. 256 (North London) Bedrock and Superficial Deposits Published 2006. This indicates the site to be underlain by strata of the Claygate Member (clay and silt) of the Palaeogene Period, which is in turn underlain by the London Clay Formation. Based on the BGS boreholes the London Clay is anticipated to be in the order of 60m thick in this area.

2.3.2 Hydrogeology and Groundwater Vulnerability

The hydrogeology and groundwater vulnerability at the site has been assessed and is summarised in the following sections.

2.3.3 Classification of Aquifer

The bedrock strata are identified as a Secondary A Aquifer, defined by the Environment Agency as:-
“Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.”

The Superficial deposits are identified as an Unproductive Strata.

2.3.4 Soil Vulnerability

The soils on site are classified as having a High leaching potential (U).

2.3.5 Groundwater

There is limited potential for groundwater flooding to occur on site or the surrounding area. It is estimated that the groundwater is between 15m AOD and 20mAOD this value is taken from monitoring undertaken in January 2016.

2.3.6 Source Protection Zone

The site is not within any source protection zones however 1.8Km to the south east of the site a Source Protection Zone Outer Zone (Zone 2) is visible.

2.3.7 Groundwater Abstraction

There are no recorded water abstraction points within 1000m of the site.

2.4 Other Significant Geo-environmental Information

2.4.1 Hydrology

The nearest surface water feature is a pond and river area, located approximately 617m north-east of the site.

The information contained within the Envirocheck® Report (Appendix 1) indicates that the site and surrounding area is an area with “Limited Potential for Groundwater Flooding to Occur”. The pond and river, located approximately 617m to the north-east of the site, is an area marked as a “Limited Potential for Groundwater Flooding to Occur”.

The 1879 OS 1: 2500 map shows a minor watercourse running to the west of the site boundary in a north - south direction. This is likely to be the tributary of the Westbourne River previously identified in the BIA.

2.4.2 Surfacewater Abstraction

There are no recorded surface water abstraction points within 1000m of the site.

2.4.3 Radon

With reference to Annex A and B of *Radon: Protective Measures for New Dwellings (BR211, 2007)*, the site is located in an area where basic radon protection is not required. The information contained within the Envirocheck® Report (Appendix 1) also confirms this assessment concluding that *'no radon protective measures are necessary in the construction of new dwellings or extensions'*.

2.4.4 BGS Estimated Soil Chemistry

The table below lists the BGS Estimated Soil Chemistry Values for arsenic, cadmium, chromium, lead and nickel; these are assumed to represent the background concentrations for the soil chemistry. The high values for Lead concentrations is confined to a small location north of the site and does not represent the surrounding values of lead concentration.

Table 2.4.4 - BGS Measured Urban Soil Chemistry

Arsenic	Minimum Concentration (for London)	1.00 mg/kg
	Average Concentration (for London)	17.00 mg/kg
	Maximum Concentration (for London)	161.00 mg/kg
	Measured Values (local to site)	***8.5-23 mg/kg***
Cadmium	Minimum Concentration (for London)	0.10 mg/kg
	Average Concentration (for London)	0.90 mg/kg
	Maximum Concentration (for London)	165.20 mg/kg
	Measured Values (local to site)	***<1.5 mg/kg***
Chromium	Minimum Concentration (for London)	13.00 mg/kg
	Average Concentration (for London)	79.00 mg/kg
	Maximum Concentration (for London)	2094.00 mg/kg
	Measured Values (local to site)	***50-160 mg/kg***
Lead	Minimum Concentration (for London)	11.00 mg/kg
	Average Concentration (for London)	280.00 mg/kg
	Maximum Concentration (for London)	10000.00 mg/kg
	Measured Values (local to site)	***99-1130 mg/kg***
Nickel	Minimum Concentration (for London)	2.00 mg/kg
	Average Concentration (for London)	28.00 mg/kg
	Maximum Concentration (for London)	506.00 mg/kg
	Measured Values (local to site)	***7-50 mg/kg***

2.4.5 Waste

Based on the Envirocheck report there is no Historical Landfill Sites located within 1000m of the site, however Potentially Infilled Land (Non – Water and Water) have been noted.

There is a record of Potentially Infilled Land (Non-Water) located 297m to west of the site; and is described as Unknown Filled Ground (Pit quarry etc.). The historical maps for the Potentially Infilled Land show houses occupying the site from 1915 to the present day with only minor changes relating to the width of the main road. The Envirocheck® report indicates that the date the fill was mapped was 1996 but buildings have occupied this site since 1896. There is also three other Potentially infilled Land (Water) described as Unknown Filled Ground (Pond, marsh, river, stream, dock etc) located 356m south of the site, 841m and 886m to the north of the site. The two sites to the north were filled in in 1896 with the infilled land to the south being infilled in 1996.

2.4.6 Ground Stability, Mineral Workings and Coal Mining

As would be expected based on the published geology the site is noted as being in an area *'that might not be affected by coal mining'.*

The Envirocheck report indicates that there is no hazard associated with non-coal mining activity.

There are no BGS recorded Mineral Sites within 250m of the site,

The Envirocheck® Report indicates the soils found on site are classified as being 'No Hazard' or having 'very low hazard potential' for the following:

- Potential for collapsible ground
- Potential for ground dissolution
- Potential for landslide
- Potential for running sand

The Envirocheck® Report indicates the soils found on site are classified as having 'moderate hazard potential' for the potential for shrinking or swelling clay ground.

2.4.7 Environmentally Sensitive Land Uses

There is an Ancient Woodland and a Site of Special Scientific Interest located, approximately 900m to the north west of the site.

2.5 Review of Previous Reports / Investigations

2.5.1 BGS Records

A search for any available reports, which may provide relevant information with regards to the site development, has been undertaken. This includes the borehole records kept at the British Geological Survey (BGS).

The BGS has records of a number of boreholes within 1000m of the site. The nearest of these, which is not confidential, (located approximately 340m to the north west of the site) encountered 0.90m of topsoil, below which stiff brown silty clays were encountered.

The thickness of the London Clay and the depth of the underlying Lambeth Group and Chalk were approximated using the deep wells around the site approximately; two located approximately 742m and 740m the north-east of the site drilled in 1985, one located approximately 225m to the south-west of the site drilled in 1872.

3.0 GROUND INVESTIGATION

The site work was carried out on the 4th August 2016 and generally in accordance with the guidelines laid down in BS EN 1997-2:2007 (1).

Two window sample holes (WS01 to WS02) were sunk, one in the vicinity of the footprint of the proposed new building and one close to the existing building to investigate the ground conditions and provide samples for geotechnical testing and chemical analysis. Due to access restrictions it was not possible to investigate the full extent of the proposed build area. All exploratory holes were located based on geotechnical requirements as other than a general risk of contamination being present on site the Desk Study had not identified any specific targets.

The holes were sunk using a window sampling rig provided by Dynamic Sampling UK. The approximate locations of the boreholes are shown on Figure 2. The depths of the boreholes and descriptions of the soils encountered are given in the borehole records (Appendix 2).

Disturbed samples and SPT's (Standard Penetration Tests) were taken at the depths shown on the borehole record. The results are provided on the borehole logs. The results are provided within Appendix 2.

Samples taken for contamination purposes were recovered in labelled 250g amber jars, 60g amber jars and 1kg plastic tubs. The samples were then stored in cool boxes prior to being delivered to ALcontrol Laboratories in Hawarden. Samples were delivered, and scheduled using Sample Custody forms provided by ALcontrol.

Gas standpipes were installed in WS01 and WS02 details of installations are on the borehole logs (see Appendix 2).

4.0 LABORATORY TESTING

Samples were selected and scheduled for chemical analysis by KeyGS: the analysis was carried out by ALcontrol Laboratories, a UKAS accredited laboratory with MCERTs accreditation for the majority of test scheduled. The range of chemical analyses was based on the known previous land use history of the site and include asbestos screen, total cyanide, water soluble sulphate, polyaromatic hydrocarbons (PAH), soil organic matter (SOM), Total Petroleum Hydrocarbons Criteria Working Group (TPH CWG) banded aliphatics and aromatics hydrocarbons, waste acceptance Criteria (WAC) (complete & leachate suite), and metals (Arsenic, Barium, Beryllium, Boron, water soluble, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Vanadium, Zinc).

Whilst every effort has been made to schedule tests suitable for the known previous land use, there is no guarantee that other contaminants are not present on site for which analyses have not been carried out or which were not sampled in the programme of exploratory holes.

Given the relatively thin veneer of made ground the chemical testing was limited to two but generally representative samples of the ground encountered in WS01 and WS02, the results are given in Appendix 3.

In addition, three samples was also submitted to TerraTek Ltd for Atterberg testing, water soluble sulphate and pH value analyses.

5.0 DISCUSSIONS ON GROUND CONDITIONS AND RECOMMENDATIONS

5.1 Ground Conditions

The following strata were encountered during the investigation:-

- Made Ground
- Clay (thought to be the Claygate Member)

Made ground was encountered in borehole WS01 to a depth of 1.50m, it contained very occasional pieces of brick and concrete in a clay matrix.

Beneath the made ground, all boreholes encountered a generally soft to firm brown sandy clay with gravel; this was thought to represent superficial Head Deposits. Below the Head Deposits a firm grey sandy clay was encountered (Claygate Member).

- WS01 was terminated in the clay at a depth of 6.45m below ground level (bgl),
- WS02 was terminated in the clay at a depth of 6.45m bgl,

Water was encountered at approximately 4.5m bgl in both WS01 and WS02 during the drilling program. It should be noted that this report does not include post fieldwork groundwater monitoring. Given the depth of the proposed development it is considered unlikely that significant groundwater volumes will be encountered during the construction works. The exact location of the buried river channel, shown on the old OS maps as being directly to the west of the proposed development, was not identified by the site investigation it is recommended that allowance be made for the excavation of a trial trench on the site boundary at the commencement of the construction works.

With regard to foundations the made ground will be an unsuitable founding strata. If traditional foundations are to be employed then a bearing capacity of 60kN/m² should be employed for design purposes.

The Atterberg Limits tests carried out show that the ground may be classified as clay of intermediate to high plasticity and therefore will be have a medium volume change potential. The foundation designs should account for this and the location of trees on and adjacent to the site whether they are retained or removed.

Visual and olfactory evidence where present is recorded on the exploratory hole logs within the relevant soil descriptions. Anthropogenic material recorded within the made ground included brick and concrete.

5.2 Chemical Considerations

5.2.1 Human health

The results of the chemical analysis are presented in full in Appendix 3. Given the proposed development which is a building to house a swimming pool with associated paved areas around the building it is considered that none of the results present a concern with regard to human health in relation to the end users of the development.

With regard to the short term exposure to construction workers the use of the correct PPE and provision of appropriate welfare facilities should mitigate any risk presented.

5.2.2 Potable Water Supply Pipes

Plastic pipes can be affected by the presence of contamination leading to stress cracking and or permeation. Following an initial screen as set out in the table below the results indicate the near surface soils are suitable for plastic water supply pipes. If water supply pipes are required as part of the works early consultation with the local water supplier is recommended in order to confirm their acceptance of these findings.

5.2.3 Buried Concrete

The presence of sulphate can have a deleterious effect on concrete. Given the results of the pH tests (6.58 to 8.6) and sulphate tests (<0.01 – 0.0549 g/l), the soils tested in WS01 and WS02 are classified as DS-1 for concrete design.

5.2.4 Classification of Arising's for Disposal to Landfill

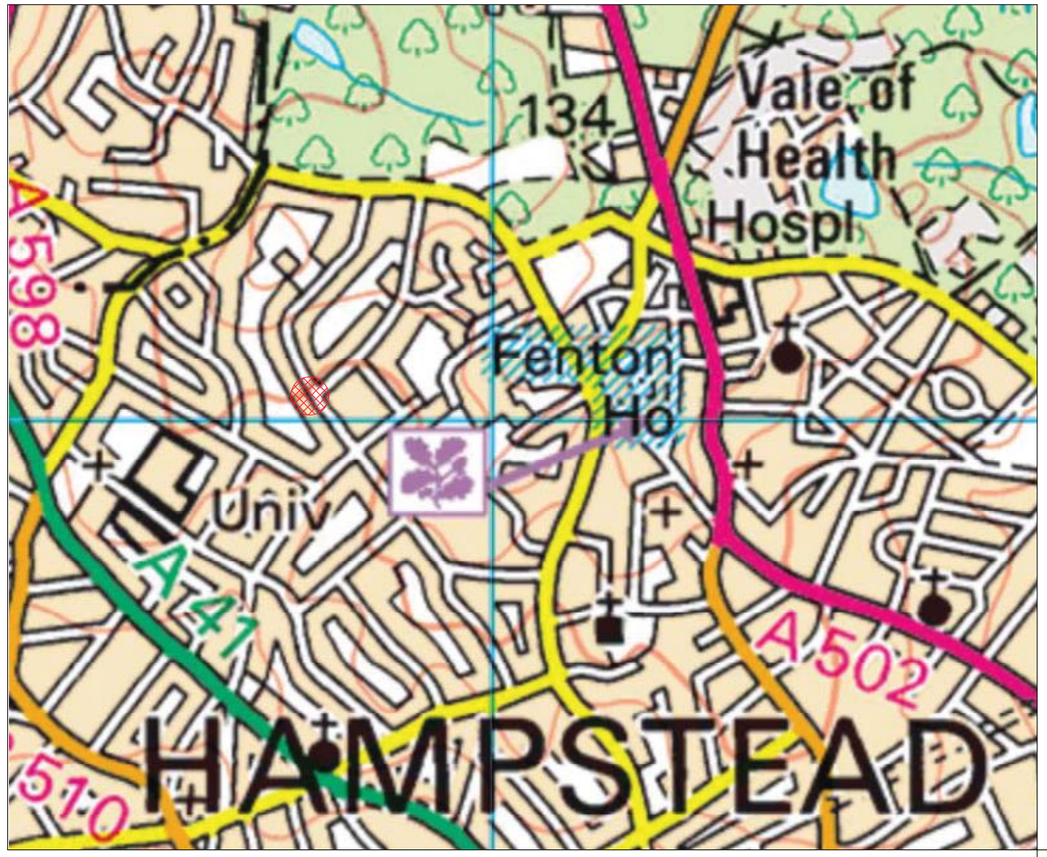
The two waste acceptance criteria (WAC) tests undertaken on samples indicate that the arisings from the excavation works will be suitable for disposal to an inert landfill. Similarly, natural soils free from the impact of the overlying made ground or from historic spillages of contaminants should classify as listed inert. The results of the WAC tests should be made available to all interested parties.

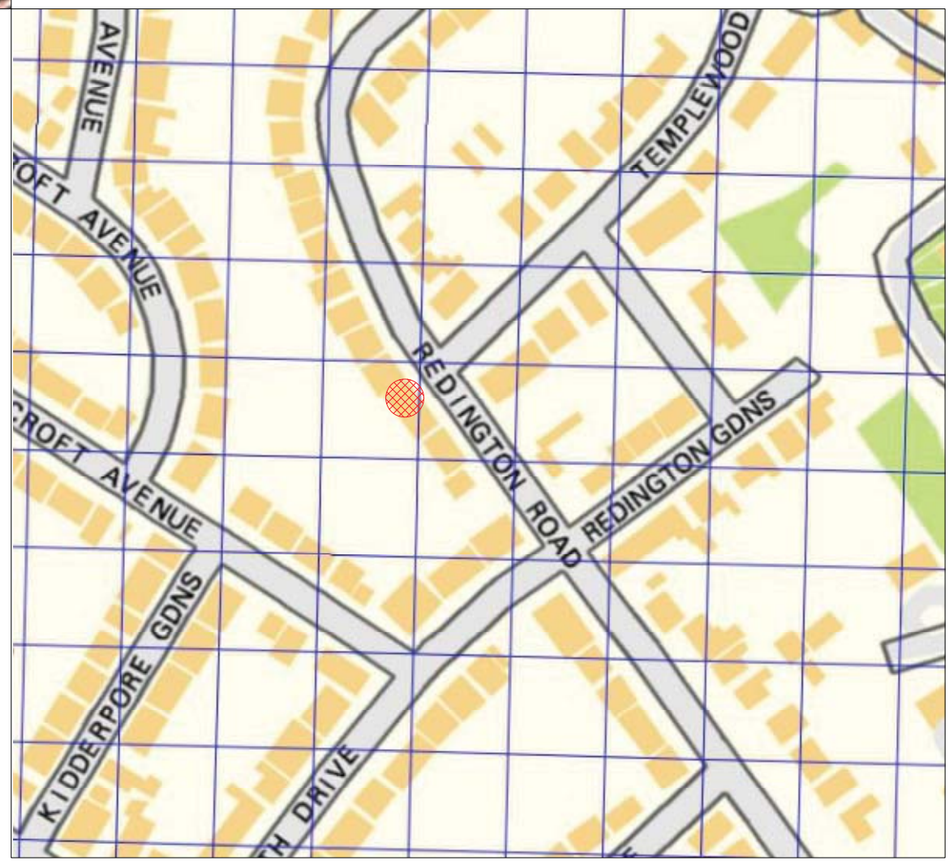
6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

- It is proposed to construct an indoor swimming pool at the end of the rear garden 59 Redington Road.
- The site is underlain by Head Deposits overlying the Claygate Member (clay and silt), with 1.50m of made ground being encountered in borehole WS01.
- For foundation design purposes a bearing capacity of 60kN/m² should be employed, assuming traditional foundations within the Head Deposits.
- Further assessment should be undertaken on the risks the trees pose to foundation depths due to the plastic nature of the clays.
- Groundwater is not expected to be encountered within the excavation works, however further investigation of the location of the buried river channel close to the western boundary of the site is recommended.
- There are no significant concerns with regard to ground contamination and the proposed development.
- It is recommended that the water supply company is contacted to confirm acceptance that plastic pipes are suitable.
- Vigilance should be maintained during groundworks in case different ground conditions from those anticipated are encountered.

FIGURES





NOTES

1.

Rev.	Revision Detail	Drawn	Date
01	First Issue	RW	30/08/16

CLIENT:

PROJECT:

59 Redington Road

TITLE:

Site Location Plan

Drawn:	Checked:	Date:
RW	BD	Aug '16
Scale: NTS	Original Sheet Size: A3	Status:

Drawing No.

Figure 1

Revision: **01**

Key GeoSolutions Ltd
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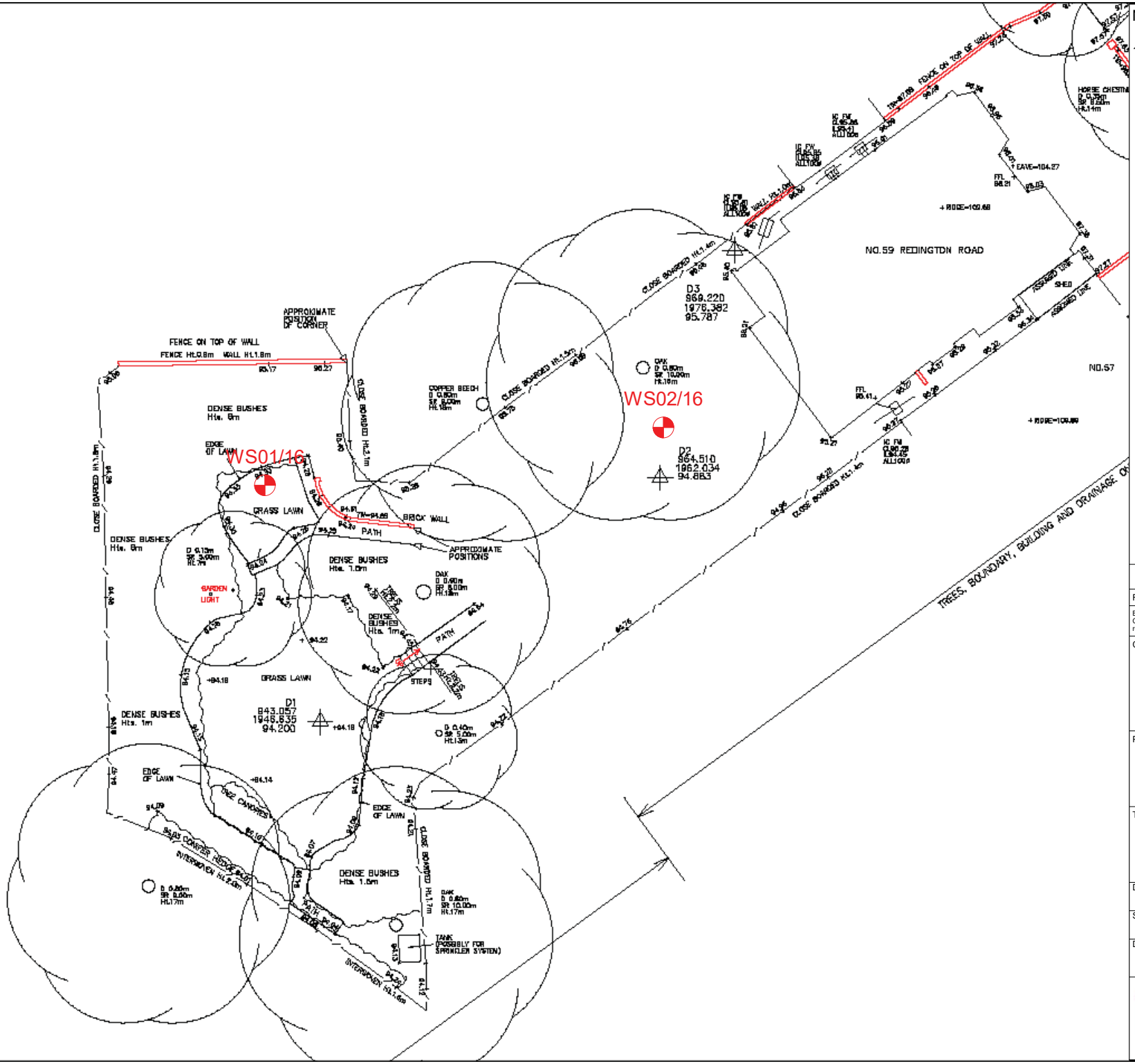

NOTES

1.

Rev.	Revision Detail	Drawn	Date
01	First Issue	RW	30/08/16

CLIENT:

PROJECT:

Redington Road

TITLE:

BH Location Plan

Drawn:	Checked:	Date:
RW	BD	Aug '16
Scale:	Original Sheet Size:	Status:
NTS	A4	DRAFT

Drawing No.: **Figure 2**

Revision: **01**

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APPENDICES

APPENDIX 1

Envirocheck Report

APPENDIX 2

Window Sample Logs

Key GeoSolutions
info@keygs.com
Telephone: 01952 822960
Fax: 01952 822961

WELL NUMBER WS01

CLIENT SIAW **PROJECT NAME** 59 Redington Road

PROJECT NUMBER 16-248 **PROJECT LOCATION** London, NW3 7RP

DATE STARTED 4/8/16 **COMPLETED** 4/8/16 **CO-ORDINATES** 525596 mE, 186001 mN

DRILLING CONTRACTOR Dynamic Sampling UK **GROUND ELEVATION** _____ **HOLE SIZE** _____

DRILLING METHOD Windowless Sampler **LOGGED BY** Ruby Westnedge **CHECKED BY** BD

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (SPT N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION & REMARKS	WELL DIAGRAM
	J	()			0.10 Dark brown clayey SILT with rootlets rare coarse gravel of various lithologies (TOPSOIL)	
1					Soft light brown mottled sandy gravelly CLAY. Gravel is fine to coarse of various lithologies with occasional brick and concrete. [MADEGROUND]	
	SPT	1-1-2-2 (6)			1.50	
2					Soft dark brown black sandy CLAY with rare fine to coarse gravel of various lithologies	
	SPT	1-2-1-1 (5)			2.40	
3					Soft light brown mottled sandy CLAY with rare cobble	
	SPT	1-0-1-1 (3)			3.60	
4					Soft mottled grey yellow sandy CLAY	
	SPT	2-2-2-3 (9)			4.00 NO RECOVERY	
5					▽	
	SPT	2-2-2-2 (8)			5.40	
6					Firm light mottled grey brown slightly sandy CLAY	
	SPT	2-2-3-4 (11)			6.45	

Bottom of borehole at 6.45 metres.

NOTES Water seepage at 4.50m

SAMPLE TYPE KEY U = Undisturbed D = Disturbed B = Bulk J = Jar VA = Shear Vane SPT = Standard Penetration Test

Key GeoSolutions
info@keygs.com
Telephone: 01952 822960
Fax: 01952 822961

WELL NUMBER WS02

CLIENT SIAW **PROJECT NAME** 59 Redington Road

PROJECT NUMBER 16-248 **PROJECT LOCATION** London, NW3 7RP

DATE STARTED 4/8/16 **COMPLETED** 4/8/16 **CO-ORDINATES** 525609 mE, 186005 mN

DRILLING CONTRACTOR Dynamic Sampling UK **GROUND ELEVATION** _____ **HOLE SIZE** _____

DRILLING METHOD Windowless Sampler **LOGGED BY** Ruby Westnedge **CHECKED BY** BD

DEPTH (m)	SAMPLE TYPE NUMBER	BLOW COUNTS (SPT N VALUE)	TESTS	GRAPHIC LOG	MATERIAL DESCRIPTION & REMARKS	WELL DIAGRAM
	J	()			0.05 Dark brown clayey SILT with rootlets rare coarse gravel of various lithologies (TOPSOIL)	
1					Soft to firm light brown mottled grey sandy CLAY with rootlets and medium to coarse gravel	
	SPT	2-2-2-2 (8)				
2						
	SPT	2-3-3-3 (11)			2.20 Firm reddish brown sandy CLAY with rare fine to medium gravel	
3						
	SPT	4-4-5-5 (18)				
4					3.60 Firm grey sandy CLAY	
	SPT	3-3-3-3 (12)			▽	
5					5.00 Firm light mottled grey slightly sandy CLAY with light yellow orange sand pockets	
	SPT	3-4-3-4 (14)				
6						
	SPT	4-5-5-5 (19)			6.45	

Bottom of borehole at 6.45 metres.

NOTES Water seepage at 4.50m

SAMPLE TYPE KEY U = Undisturbed D = Disturbed B = Bulk J = Jar VA = Shear Vane SPT = Standard Penetration Test

APPENDIX 3

Results of Chemical Analyses

(Undertaken by Alcontrol Laboratories)

ALcontrol Laboratories

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528700
Fax: (01244) 528701
email: mkt@alcontrol.com
Website: www.alcontrol.com

Key Geosolutions Limited
Nova House
Audley Avenue
Newport
Shropshire
TF10 7DW

Attention:

CERTIFICATE OF ANALYSIS

Date:	22 August 2016
Customer:	H_KEYGEO_NPT
Sample Delivery Group (SDG):	160810-122
Your Reference:	
Location:	Redington Road
Report No:	374532

We received 3 samples on Wednesday August 10, 2016 and 2 of these samples were scheduled for analysis which was completed on Monday August 22, 2016. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

All chemical testing (unless subcontracted) is performed at ALcontrol Hawarden Laboratories.

Approved By:

Sonia McWhan

Operations Manager

CERTIFICATE OF ANALYSIS

SDG:	160810-122	**Location:**	Redington Road	**Order Number:**	
Job:	H_KEYGEO_NPT-118	**Customer:**	Key Geosolutions Limited	**Report Number:**	374532
Client Reference:		**Attention:**		**Superseded Report:**	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
13942271	WS01		0.10 - 0.30	04/08/2016
13942272	WS01		0.20 - 0.40	04/08/2016
13942273	WS02		0.10 - 0.30	04/08/2016

Only received samples which have had analysis scheduled will be shown on the following pages.

CERTIFICATE OF ANALYSIS

SDG:	160810-122	**Location:**	Redington Road	**Order Number:**	
Job:	H_KEYGEO_NPT-118	**Customer:**	Key Geosolutions Limited	**Report Number:**	374532
Client Reference:		**Attention:**		**Superseded Report:**	

SOLID

Results Legend

X **Test**

N **No Determination Possible**

			Lab Sample No(s)	13942272	13942273
			Customer Sample Reference	WS01	WS02
			AGS Reference		
			Depth (m)	0.20 - 0.40	0.10 - 0.30
			Container	1kg TUB	250g Amber Jar (AL
					400g Tub (ALE214)
					60g VOC (ALE215)
				1kg TUB	250g Amber Jar (AL
					400g Tub (ALE214)
					60g VOC (ALE215)
ANC at pH4 and ANC at pH 6	All	NDPs: 0 Tests: 2			X X
Anions by Kone (soil)	All	NDPs: 0 Tests: 2			X X
Anions by Kone (w)	All	NDPs: 0 Tests: 2	X		X
Asbestos ID in Solid Samples	All	NDPs: 0 Tests: 2		X	X
Boron Water Soluble	All	NDPs: 0 Tests: 2		X	X
CEN Readings	All	NDPs: 0 Tests: 2	X		X
Cyanide Comp/Free/Total/Thiocyanate	All	NDPs: 0 Tests: 2		X	X
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 2	X		X
Dissolved Organic/Inorganic Carbon	All	NDPs: 0 Tests: 2	X		X
EPH CWG (Aliphatic) GC (S)	All	NDPs: 0 Tests: 2		X	X
EPH CWG (Aromatic) GC (S)	All	NDPs: 0 Tests: 2		X	X
Fluoride	All	NDPs: 0 Tests: 2	X		X
GRO by GC-FID (S)	All	NDPs: 0 Tests: 2		X	X
Loss on Ignition in soils	All	NDPs: 0 Tests: 2		X	X
Mercury Dissolved	All	NDPs: 0 Tests: 2	X		X

CERTIFICATE OF ANALYSIS

SDG:	160810-122	**Location:**	Redington Road	**Order Number:**	
Job:	H_KEYGEO_NPT-118	**Customer:**	Key Geosolutions Limited	**Report Number:**	374532
Client Reference:		**Attention:**		**Superseded Report:**	

SOLID

Results Legend

X **Test**

N **No Determination Possible**

			Lab Sample No(s)	13942272	13942273
			Customer Sample Reference	WS01	WS02
			AGS Reference		
			Depth (m)	0.20 - 0.40	0.10 - 0.30
			Container	1kg TUB / 250g Amber Jar (AL / 400g Tub (ALE214) / 60g VOC (ALE215)	1kg TUB / 250g Amber Jar (AL / 400g Tub (ALE214) / 60g VOC (ALE215)
Metals in solid samples by OES	All	NDPs: 0 Tests: 2		X	X
Mineral Oil	All	NDPs: 0 Tests: 2		X	X
NO3, NO2 and TON by KONE (s)	All	NDPs: 0 Tests: 2		X	X
PAH by GCMS	All	NDPs: 0 Tests: 2		X	X
PAH Value of soil	All	NDPs: 0 Tests: 2		X	X
PCBs by GCMS	All	NDPs: 0 Tests: 2		X	X
pH	All	NDPs: 0 Tests: 2		X	X
Phenols by HPLC (W)	All	NDPs: 0 Tests: 2	X	X	
Sample description	All	NDPs: 0 Tests: 2		X	X
Total Dissolved Solids	All	NDPs: 0 Tests: 2	X	X	
Total Organic Carbon	All	NDPs: 0 Tests: 2		X	X
TPH CWG GC (S)	All	NDPs: 0 Tests: 2		X	X

CERTIFICATE OF ANALYSIS

SDG:	160810-122	**Location:**	Redington Road	**Order Number:**	
Job:	H_KEYGEO_NPT-118	**Customer:**	Key Geosolutions Limited	**Report Number:**	374532
Client Reference:		**Attention:**		**Superseded Report:**	

Sample Descriptions

Grain Sizes

very fine	<0.063mm	**fine**	0.063mm - 0.1mm	**medium**	0.1mm - 2mm	**coarse**	2mm - 10mm	**very coarse**	>10mm

Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Grain size	Inclusions	Inclusions 2
13942272	WS01	0.20 - 0.40	Dark Brown	Sandy Clay	0.063 - 2.00 mm	Stones	Vegetation
13942273	WS02	0.10 - 0.30	Dark Brown	Loamy Sand	0.063 - 2.00 mm	Stones	Fibres

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally ocurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

CERTIFICATE OF ANALYSIS

SDG:	160810-122	**Location:**	Redington Road	**Order Number:**	
Job:	H_KEYGEO_NPT-118	**Customer:**	Key Geosolutions Limited	**Report Number:**	374532
Client Reference:		**Attention:**		**Superseded Report:**	

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample R	WS01	WS02				
			Depth (m)	0.20 - 0.40	0.10 - 0.30				
			Sample Type	Soil/Solid	Soil/Solid				
			Date Sampled	04/08/2016	04/08/2016				
			Sample Time	-	-				
			Date Received	10/08/2016	10/08/2016				
			SDG Ref	160810-122	160810-122				
			Lab Sample No.(s)	13942272	13942273				
			AGS Reference						
Moisture Content Ratio (% of as received sample)	%	PM024		15	12				
Loss on ignition	<0.7 %	TM018		5.25 M	7.43 M				
Mineral oil >C10-C40	<1 mg/kg	TM061		38.6	29.8				
Mineral Oil Surrogate % recovery**	%	TM061		88.9	98.8				
Organic Carbon, Total	<0.2 %	TM132		2.14 M	1.02 M				
Soil Organic Matter (SOM)	<0.35 %	TM132		3.69 #	1.76 #				
pH	1 pH Units	TM133		6.58 M	7.31 M				
Cyanide, Total	<1 mg/kg	TM153		<1 M	<1 M				
PCB congener 28	<3 µg/kg	TM168		<3 M	<3 M				
PCB congener 52	<3 µg/kg	TM168		<3 M	<3 M				
PCB congener 101	<3 µg/kg	TM168		<3 M	<3 M				
PCB congener 118	<3 µg/kg	TM168		<3 M	<3 M				
PCB congener 138	<3 µg/kg	TM168		<3 M	<3 M				
PCB congener 153	<3 µg/kg	TM168		<3 M	<3 M				
PCB congener 180	<3 µg/kg	TM168		<3 M	<3 M				
Sum of detected PCB 7 Congeners	<21 µg/kg	TM168		<21	<21				
Arsenic	<0.6 mg/kg	TM181		10.2 M	10.3 M				
Barium	<0.6 mg/kg	TM181		151 #	38.3 #				
Beryllium	<0.01 mg/kg	TM181		0.818 M	0.563 M				
Cadmium	<0.02 mg/kg	TM181		0.281 M	0.279 M				
Chromium	<0.9 mg/kg	TM181		29.9 M	25.5 M				
Copper	<1.4 mg/kg	TM181		24.3 M	22.4 M				
Lead	<0.7 mg/kg	TM181		130 M	80.3 M				
Mercury	<0.14 mg/kg	TM181		<0.14 M	<0.14 M				
Nickel	<0.2 mg/kg	TM181		15.2 M	12.5 M				
Selenium	<1 mg/kg	TM181		<1 #	<1 #				
Vanadium	<0.2 mg/kg	TM181		46.4 #	40.5 #				
Zinc	<1.9 mg/kg	TM181		72.3 M	56.8 M				
ANC @ pH 4	<0.03 mol/kg	TM182		0.0916	0.115				
ANC @ pH 6	<0.03 mol/kg	TM182		0.0398	0.0413				
Polyaromatic hydrocarbons, Total 17	<10 mg/kg	TM213		21.1	<10				
Boron, water soluble	<1 mg/kg	TM222		<1 M	<1 M				

CERTIFICATE OF ANALYSIS

SDG:	160810-122	**Location:**	Redington Road	**Order Number:**	
Job:	H_KEYGEO_NPT-118	**Customer:**	Key Geosolutions Limited	**Report Number:**	374532
Client Reference:		**Attention:**		**Superseded Report:**	

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample R	WS01	WS02				
			Depth (m)	0.20 - 0.40	0.10 - 0.30				
			Sample Type	Soil/Solid	Soil/Solid				
			Date Sampled	04/08/2016	04/08/2016				
			Sample Time	.	.				
			Date Received	10/08/2016	10/08/2016				
			SDG Ref	160810-122	160810-122				
			Lab Sample No.(s)	13942272	13942273				
			AGS Reference						
Water Soluble Sulphate as SO4 2:1 Extract	<0.004 g/l	TM243		0.0451 M	0.0549 M				
Chloride 2:1 water/soil extract BRE	<0.0025 g/l	TM243		0.0086 M	0.0074 M				
Nitrate as NO3, 2:1 water soluble (BRE)	<0.0003 g/l	TM243		0.00244	0.00785				

CERTIFICATE OF ANALYSIS

SDG:	160810-122	**Location:**	Redington Road	**Order Number:**	
Job:	H_KEYGEO_NPT-118	**Customer:**	Key Geosolutions Limited	**Report Number:**	374532
Client Reference:		**Attention:**		**Superseded Report:**	

PAH by GCMS

Results Legend		Customer Sample R	WS01	WS02				
#	ISO17025 accredited.							
M	*m*CERTS accredited.							
aq	Aqueous / settled sample.	Depth (m)	0.20 - 0.40	0.10 - 0.30				
diss.filt	Dissolved / filtered sample.	Sample Type	Soil/Solid	Soil/Solid				
tot.unfilt	Total / unfiltered sample.	Date Sampled	04/08/2016	04/08/2016				
*	Subcontracted test.	Sample Time	-	-				
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery	Date Received	10/08/2016	10/08/2016				
		SDG Ref	160810-122	160810-122				
(F)	Trigger breach confirmed	Lab Sample No.(s)	13942272	13942273				
1-5&+§@	Sample deviation (see appendix)	AGS Reference						

Component	LOD/Units	Method						
Naphthalene-d8 % recovery**	%	TM218	88.3	99				
Acenaphthene-d10 % recovery**	%	TM218	91.7	102				
Phenanthrene-d10 % recovery**	%	TM218	92.5	102				
Chrysene-d12 % recovery**	%	TM218	85.2	93.1				
Perylene-d12 % recovery**	%	TM218	94.4	106				
Naphthalene	<9 µg/kg	TM218	321 M	15 M				
Acenaphthylene	<12 µg/kg	TM218	325 M	20.9 M				
Acenaphthene	<8 µg/kg	TM218	699 M	9.61 M				
Fluorene	<10 µg/kg	TM218	797 M	<10 M				
Phenanthrene	<15 µg/kg	TM218	8800 M	170 M				
Anthracene	<16 µg/kg	TM218	2480 M	41 M				
Fluoranthene	<17 µg/kg	TM218	11500 M	438 M				
Pyrene	<15 µg/kg	TM218	8760 M	379 M				
Benz(a)anthracene	<14 µg/kg	TM218	4550 M	209 M				
Chrysene	<10 µg/kg	TM218	3640 M	210 M				
Benzo(b)fluoranthene	<15 µg/kg	TM218	5180 M	369 M				
Benzo(k)fluoranthene	<14 µg/kg	TM218	1970 M	136 M				
Benzo(a)pyrene	<15 µg/kg	TM218	4340 M	250 M				
Indeno(1,2,3-cd)pyrene	<18 µg/kg	TM218	2150 M	158 M				
Dibenzo(a,h)anthracene	<23 µg/kg	TM218	647 M	42.4 M				
Benzo(g,h,i)perylene	<24 µg/kg	TM218	2430 M	206 M				
PAH, Total Detected USEPA 16	<118 µg/kg	TM218	58600	2650				

CERTIFICATE OF ANALYSIS

SDG:	160810-122	**Location:**	Redington Road	**Order Number:**	
Job:	H_KEYGEO_NPT-118	**Customer:**	Key Geosolutions Limited	**Report Number:**	374532
Client Reference:		**Attention:**		**Superseded Report:**	

TPH CWG (S)

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample R	WS01	WS02				
			Depth (m)	0.20 - 0.40	0.10 - 0.30				
			Sample Type	Soil/Solid	Soil/Solid				
			Date Sampled	04/08/2016	04/08/2016				
			Sample Time	-	-				
			Date Received	10/08/2016	10/08/2016				
			SDG Ref	160810-122	160810-122				
			Lab Sample No.(s)	13942272	13942273				
			AGS Reference						
GRO Surrogate % recovery**	%	TM089		110	88				
GRO TOT (Moisture Corrected)	<44 µg/kg	TM089		<44 M	<44 M				
Methyl tertiary butyl ether (MTBE)	<5 µg/kg	TM089		<5 #	<5 #				
Benzene	<10 µg/kg	TM089		<10 M	<10 M				
Toluene	<2 µg/kg	TM089		<2 M	<2 M				
Ethylbenzene	<3 µg/kg	TM089		3.51 M	<3 M				
m,p-Xylene	<6 µg/kg	TM089		<6 M	<6 M				
o-Xylene	<3 µg/kg	TM089		<3 M	<3 M				
sum of detected mpo xylene by GC	<9 µg/kg	TM089		<9	<9				
sum of detected BTEX by GC	<24 µg/kg	TM089		<24	<24				
Aliphatics >C5-C6	<10 µg/kg	TM089		<10	<10				
Aliphatics >C6-C8	<10 µg/kg	TM089		<10	<10				
Aliphatics >C8-C10	<10 µg/kg	TM089		<10	<10				
Aliphatics >C10-C12	<10 µg/kg	TM089		<10	<10				
Aliphatics >C12-C16	<100 µg/kg	TM173		<100	<100				
Aliphatics >C16-C21	<100 µg/kg	TM173		<100	353				
Aliphatics >C21-C35	<100 µg/kg	TM173		2940	6320				
Aliphatics >C35-C44	<100 µg/kg	TM173		<100	263				
Total Aliphatics >C12-C44	<100 µg/kg	TM173		2940	6930				
Aromatics >EC5-EC7	<10 µg/kg	TM089		<10	<10				
Aromatics >EC7-EC8	<10 µg/kg	TM089		<10	<10				
Aromatics >EC8-EC10	<10 µg/kg	TM089		<10	<10				
Aromatics >EC10-EC12	<10 µg/kg	TM089		<10	<10				
Aromatics >EC12-EC16	<100 µg/kg	TM173		266	377				
Aromatics >EC16-EC21	<100 µg/kg	TM173		4710	1950				
Aromatics >EC21-EC35	<100 µg/kg	TM173		15800	18700				
Aromatics >EC35-EC44	<100 µg/kg	TM173		4240	4520				
Aromatics >EC40-EC44	<100 µg/kg	TM173		1510	1600				
Total Aromatics >EC12-EC44	<100 µg/kg	TM173		25100	25500				
Total Aliphatics & Aromatics >C5-C44	<100 µg/kg	TM173		28000	32400				

ALcontrol Laboratories

Validated

CERTIFICATE OF ANALYSIS

SDG:	160810-122	**Location:**	Redington Road	**Order Number:**	
Job:	H_KEYGEO_NPT-118	**Customer:**	Key Geosolutions Limited	**Report Number:**	374532
Client Reference:		**Attention:**		**Superseded Report:**	

Asbestos Identification - Solid Samples

		Date of Analysis	Analysed By	Comments	Amosite (Brown) Asbestos	Chrysotile (White) Asbestos	Crocidolite (Blue) Asbestos	Fibrous Actinolite	Fibrous Anthophyllite	Fibrous Tremolite	Non-Asbestos Fibre
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	WS01 0.20 - 0.40 SOLID 04/08/2016 00:00:00 13/08/2016 11:05:40 160810-122 13942272 TM048	18/08/16	Lauren Sargeant	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected
Cust. Sample Ref. Depth (m) Sample Type Date Sampled Date Receieved SDG Original Sample Method Number	WS02 0.10 - 0.30 SOLID 04/08/2016 00:00:00 13/08/2016 11:09:09 160810-122 13942273 TM048	18/08/16	Lauren Sargeant	-	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected (#)	Not Detected

CERTIFICATE OF ANALYSIS

SDG:	160810-122	**Location:**	Redington Road	**Order Number:**	
Job:	H_KEYGEO_NPT-118	**Customer:**	Key Geosolutions Limited	**Report Number:**	374532
Client Reference:		**Attention:**		**Superseded Report:**	

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Redington Road
Mass Sample taken (kg)	0.105	**Natural Moisture Content (%)**	17.6
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	85
Particle Size <4mm	>95%		

Case	
SDG	160810-122
Lab Sample Number(s)	13942272
Sampled Date	04-Aug-2016
Customer Sample Ref.	WS01
Depth (m)	0.20 - 0.40

Solid Waste Analysis	**Result**	**Landfill Waste Acceptance Criteria Limits**		
		Inert Waste Landfill	**Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon (%)	2.14	3	5	6
Loss on Ignition (%)	5.25	-	-	10
Sum of BTEX (mg/kg)	<0.024	6	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg)	38.6	500	-	-
PAH Sum of 17 (mg/kg)	21.1	100	-	-
pH (pH Units)	6.58	-	>6	-
ANC to pH 6 (mol/kg)	0.0398	-	-	-
ANC to pH 4 (mol/kg)	0.0916	-	-	-

Eluate Analysis	**C_2 Conc^n in 10:1 eluate (mg/l)**		**A_2 10:1 conc^n leached (mg/kg)**		**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
	Result	**Limit of Detection**	**Result**	**Limit of Detection**			
Arsenic	0.00106	<0.00051	0.0106	<0.0051	0.5	2	25
Barium	0.0139	<0.0002	0.139	<0.002	20	100	300
Cadmium	<0.00008	<0.00008	<0.0008	<0.0008	0.04	1	5
Chromium	0.00259	<0.0012	0.0259	<0.012	0.5	10	70
Copper	0.00362	<0.00085	0.0362	<0.0085	2	50	100
Mercury Dissolved (CVAF)	0.0000129	<0.00001	0.000129	<0.0001	0.01	0.2	2
Molybdenum	<0.00062	<0.00062	<0.0062	<0.0062	0.5	10	30
Nickel	0.0013	<0.00044	0.013	<0.0044	0.4	10	40
Lead	0.00238	<0.0001	0.0238	<0.001	0.5	10	50
Antimony	0.000296	<0.00016	0.00296	<0.0016	0.06	0.7	5
Selenium	<0.00081	<0.00081	<0.0081	<0.0081	0.1	0.5	7
Zinc	0.00428	<0.0013	0.0428	<0.013	4	50	200
Chloride	<2	<2	<20	<20	800	15000	25000
Fluoride	<0.5	<0.5	<5	<5	10	150	500
Sulphate (soluble)	<2	<2	<20	<20	1000	20000	50000
Total Dissolved Solids	15.5	<5	155	<50	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	4.22	<3	42.2	<30	500	800	1000

Leach Test Information

Date Prepared	15-Aug-2016
pH (pH Units)	7.98
Conductivity (µS/cm)	17.00
Temperature (ºC)	18.30
Volume Leachant (Litres)	0.884

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ALcontrol cannot be held responsible for any discrepancies with current legislation
Mcerts Certification does not apply to leachates

22/08/2016 16:22:22

16:22:07 22/08/2016

CERTIFICATE OF ANALYSIS

SDG:	160810-122	**Location:**	Redington Road	**Order Number:**	
Job:	H_KEYGEO_NPT-118	**Customer:**	Key Geosolutions Limited	**Report Number:**	374532
Client Reference:		**Attention:**		**Superseded Report:**	

CEN 10:1 SINGLE STAGE LEACHATE TEST

WAC ANALYTICAL RESULTS

REF : BS EN 12457/2

Client Reference		**Site Location**	Redington Road
Mass Sample taken (kg)	0.102	**Natural Moisture Content (%)**	13.6
Mass of dry sample (kg)	0.090	**Dry Matter Content (%)**	88
Particle Size <4mm	>95%		

Case	
SDG	160810-122
Lab Sample Number(s)	13942273
Sampled Date	04-Aug-2016
Customer Sample Ref.	WS02
Depth (m)	0.10 - 0.30

Solid Waste Analysis	**Result**	**Landfill Waste Acceptance Criteria Limits**		
		Inert Waste Landfill	**Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon (%)	1.02	3	5	6
Loss on Ignition (%)	7.43	-	-	10
Sum of BTEX (mg/kg)	<0.024	6	-	-
Sum of 7 PCBs (mg/kg)	<0.021	1	-	-
Mineral Oil (mg/kg)	29.8	500	-	-
PAH Sum of 17 (mg/kg)	<10	100	-	-
pH (pH Units)	7.31	-	>6	-
ANC to pH 6 (mol/kg)	0.0413	-	-	-
ANC to pH 4 (mol/kg)	0.115	-	-	-

Eluate Analysis	**C_2** Conc^n in 10:1 eluate (mg/l)		**A_2** 10:1 conc^n leached (mg/kg)		**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg**		
	Result	**Limit of Detection**	**Result**	**Limit of Detection**			
Arsenic	0.000747	<0.00051	0.00747	<0.0051	0.5	2	25
Barium	0.00336	<0.0002	0.0336	<0.002	20	100	300
Cadmium	<0.00008	<0.00008	<0.0008	<0.0008	0.04	1	5
Chromium	<0.0012	<0.0012	<0.012	<0.012	0.5	10	70
Copper	0.0051	<0.00085	0.051	<0.0085	2	50	100
Mercury Dissolved (CVAF)	<0.00001	<0.00001	<0.0001	<0.0001	0.01	0.2	2
Molybdenum	0.000885	<0.00062	0.00885	<0.0062	0.5	10	30
Nickel	0.00105	<0.00044	0.0105	<0.0044	0.4	10	40
Lead	0.00113	<0.0001	0.0113	<0.001	0.5	10	50
Antimony	0.000622	<0.00016	0.00622	<0.0016	0.06	0.7	5
Selenium	<0.00081	<0.00081	<0.0081	<0.0081	0.1	0.5	7
Zinc	0.00295	<0.0013	0.0295	<0.013	4	50	200
Chloride	<2	<2	<20	<20	800	15000	25000
Fluoride	<0.5	<0.5	<5	<5	10	150	500
Sulphate (soluble)	<2	<2	<20	<20	1000	20000	50000
Total Dissolved Solids	30	<5	300	<50	4000	60000	100000
Total Monohydric Phenols (W)	<0.016	<0.016	<0.16	<0.16	1	-	-
Dissolved Organic Carbon	8.45	<3	84.5	<30	500	800	1000

Leach Test Information

Date Prepared	15-Aug-2016
pH (pH Units)	7.68
Conductivity (µS/cm)	34.40
Temperature (ºC)	18.70
Volume Leachant (Litres)	0.888

Solid Results are expressed on a dry weight basis, after correction for moisture content where applicable
Stated limits are for guidance only and ALcontrol cannot be held responsible for any discrepancies with current legislation
Mcerts Certification does not apply to leachates

22/08/2016 16:22:22

16:22:07 22/08/2016

CERTIFICATE OF ANALYSIS

SDG:	160810-122	**Location:**	Redington Road	**Order Number:**	
Job:	H_KEYGEO_NPT-118	**Customer:**	Key Geosolutions Limited	**Report Number:**	374532
Client Reference:		**Attention:**		**Superseded Report:**	

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample [1]	Surrogate Corrected
PM001		Preparation of Samples for Metals Analysis		
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material		
PM115		Leaching Procedure for CEN One Stage Leach Test 2:1 & 10:1 1 Step		
TM018	BS 1377: Part 3 1990	Determination of Loss on Ignition		
TM048	HSG 248, Asbestos: The analysts' guide for sampling, analysis and clearance procedures	Identification of Asbestos in Bulk Material		
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)		
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)		
TM090	Method 5310, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 415.1 & 9060	Determination of Total Organic Carbon/Total Inorganic Carbon in Water and Waste Water		
TM104	Method 4500F, AWWA/APHA, 20th Ed., 1999	Determination of Fluoride using the Kone Analyser		
TM123	BS 2690: Part 121:1981	The Determination of Total Dissolved Solids in Water		
TM132	In - house Method	ELTRA CS800 Operators Guide		
TM133	BS 1377: Part 3 1990;BS 6068-2.5	Determination of pH in Soil and Water using the GLpH pH Meter		
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS		
TM153	Method 4500A,B,C, I, M AWWA/APHA, 20th Ed., 1999	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate using the Skalar SANS+ System Segmented Flow Analyser		
TM168	EPA Method 8082, Polychlorinated Biphenyls by Gas Chromatography	Determination of WHO12 and EC7 Polychlorinated Biphenyl Congeners by GC-MS in Soils		
TM173	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GC-FID		
TM181	US EPA Method 6010B	Determination of Routine Metals in Soil by iCap 6500 Duo ICP-OES		
TM182	CEN/TC 292 - WI 292046-chacterization of waste-leaching Behaviour Tests- Acid and Base Neutralization Capacity Test	Determination of Acid Neutralisation Capacity (ANC) Using Autotitration in Soils		
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry		
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers		
TM213	In-house Method	Rapid Determination of PAHs by GC-FID		
TM218	Microwave extraction – EPA method 3546	Microwave extraction - EPA method 3546		
TM222	In-House Method	Determination of Hot Water Soluble Boron in Soils (10:1 Water:soil) by IRIS Emission Spectrometer		
TM243		Mixed Anions In Soils By Kone		
TM259	by HPLC	Determination of Phenols in Waters and Leachates by HPLC		

[1] Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.

CERTIFICATE OF ANALYSIS

SDG:	160810-122	**Location:**	Redington Road	**Order Number:**	
Job:	H_KEYGEO_NPT-118	**Customer:**	Key Geosolutions Limited	**Report Number:**	374532
Client Reference:		**Attention:**		**Superseded Report:**	

Test Completion Dates

Lab Sample No(s)	13942272	13942273
Customer Sample Ref.	WS01	WS02
AGS Ref.		
Depth	0.20 - 0.40	0.10 - 0.30
Type	SOLID	SOLID
ANC at pH4 and ANC at pH 6	18-Aug-2016	18-Aug-2016
Anions by Kone (soil)	19-Aug-2016	19-Aug-2016
Anions by Kone (w)	17-Aug-2016	17-Aug-2016
Asbestos ID in Solid Samples	19-Aug-2016	19-Aug-2016
Boron Water Soluble	19-Aug-2016	19-Aug-2016
CEN 10:1 Leachate (1 Stage)	15-Aug-2016	15-Aug-2016
CEN Readings	17-Aug-2016	17-Aug-2016
Cyanide Comp/Free/Total/Thiocyanate	17-Aug-2016	17-Aug-2016
Dissolved Metals by ICP-MS	18-Aug-2016	18-Aug-2016
Dissolved Organic/Inorganic Carbon	18-Aug-2016	18-Aug-2016
EPH CWG (Aliphatic) GC (S)	19-Aug-2016	19-Aug-2016
EPH CWG (Aromatic) GC (S)	19-Aug-2016	19-Aug-2016
Fluoride	18-Aug-2016	18-Aug-2016
GRO by GC-FID (S)	18-Aug-2016	18-Aug-2016
Loss on Ignition in soils	22-Aug-2016	22-Aug-2016
Mercury Dissolved	18-Aug-2016	18-Aug-2016
Metals in solid samples by OES	18-Aug-2016	18-Aug-2016
Mineral Oil	18-Aug-2016	18-Aug-2016
NO3, NO2 and TON by KONE (s)	19-Aug-2016	19-Aug-2016
PAH by GCMS	19-Aug-2016	19-Aug-2016
PAH Value of soil	16-Aug-2016	16-Aug-2016
PCBs by GCMS	18-Aug-2016	18-Aug-2016
pH	18-Aug-2016	18-Aug-2016
Phenols by HPLC (W)	18-Aug-2016	18-Aug-2016
Sample description	13-Aug-2016	13-Aug-2016
Total Dissolved Solids	17-Aug-2016	17-Aug-2016
Total Organic Carbon	19-Aug-2016	19-Aug-2016
TPH CWG GC (S)	19-Aug-2016	19-Aug-2016

SDG:	160810-122	**Location:**	Redington Road	**Order Number:**	
Job:	H_KEYGEO_NPT-118	**Customer:**	Key Geosolutions Limited	**Report Number:**	374532
Client Reference:		**Attention:**	Ruby	**Superseded Report:**	

Appendix

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as “Not detected”. If no asbestos fibre types are found all will be reported as “Not detected” and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt . However, the integrity of the data may be compromised.

9. NDP - No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals - total metals must be requested separately.

11. Results relate only to the items tested.

12. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%, they are generally wider for volatiles analysis, 50-150%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment . Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect .

14. **Product analyses** - Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethyphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

General

20. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

21. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

24. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as “mixed hydrocarbons”. Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

Sample Deviations

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Holding time exceeded before sample received**
5	**Samples exceeded holding time before presevation was performed**
§	**Sampled on date not provided**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to sampled on date**
&	**Sample Holding Time exceeded - Late arrival of instructions.**

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than : - Trace - Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

APPENDIX 4

Results of Physical & Chemical Analyses

(Undertaken by Terra Tek Laboratories)

TERRA TEK
SITE INVESTIGATION & LABORATORY SERVICES

Key GeoSolutions Limited
Suite 6
Nova House
Audley Avenue Enterprise Park
Newport
Shropshire, TF10 7DW
For the attention of Ruby Westnedge

Report No: B20218
Issue No 01

LABORATORY TEST REPORT

Project Name	**REDINGTON ROAD**		
Project Number	**B20218**	Date samples received	10/08/2016
Your Ref		Date written instructions received	10/08/2016
Purchase Order	16-59	Date testing commenced	10/08/2016

Please find enclosed the results as summarised below

Figure / Table	Test Quantity	Description	ISO 17025 Accredited
1	~	Summary of Geotechnical Tests	See Table
2	3	BRE Suite - Soil	See Report
3 - 5	3	Atterberg Limit	Yes
App X	~	Sample Descriptions - Soil	N/A
App Y	~	Summary of In-House Analytical Test Methods - Soil	N/A

Remarks :

Issued by : Stephen Langman Date of Issue : 24/08/2016

Approved Signatories : S. Langman 24/08/2016

G Wilson (JMD/Laboratories Director), S Langman (Laboratory Coordinator)

Key to symbols used in this report
S/C : Testing was sub-contracted

Unless we are notified to the contrary, samples will be disposed after a period of one month from this date.
The results reported relate to samples received in the laboratory only.
All results contained in this report are provisional unless signed by an approved signatory
This report should not be reproduced except in full without the written approval of the laboratory.
Under multisite accreditation the testing contained in this report may have been performed at another Terra Tek laboratory.
The enclosed results remain the property of Terra Tek Limited and we reserve the right to withdraw
our report if we have not received cleared funds in accordance with our standard terms and conditions
Only those results indicated in this report are UKAS accredited and any opinions or interpretations expressed are outside the scope of UKAS accreditation.
Feedback on the this report may be left via our website www.terratek.co.uk/contact-us

mCERTS UKAS TESTING 0126 25 YEARS 1990-2015

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TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site: REDINGTON ROAD

Client: Key GeoSolutions Limited

Engineer:

Contract No B20218

Sample Identification							Atterberg limits						Density		Total Stress			
Exploratory Hole	Depth m	Sample Ref	Sample Type	Lab Sample ID	Non Engineering Sample Description	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	Percentage retained 425µm %	Atterberg Classification	Particle Density Mg/m³	Bulk Mg/m³	Dry Mg/m³	Shear Strength kPa	Apparent Cohesion C kPa	Angle of Shearing Resistance Phi	Other Tests
WS01	1.00-1.20		T	298210	Brown silty SAND	29	56	22	34	8	CH							BRE SD1 Suite
WS01	5.90-6.00		D	298211	Brown sandy CLAY with occasional fine gravel.	28	47	21	26	0	CI							BRE SD1 Suite
WS02	1.00-1.50		T	298212	Brown SAND	26	60	22	38	0	CH							BRE SD1 Suite
Notes	Opinions and interpretations are outside the scope of UKAS accreditation				UKAS Accredited Test Y/N	Test details are given on the 'Notes on Laboratory Procedures' sheet												See individual report sheets
						Y	Y	Y	Y	Y	-	Y	Y	Y	Y	Y	Y	

Originator	Approved
ME	S. Longman 24/08/2016

SUMMARY OF GEOTECHNICAL TESTS

Figure 1

Sheet 1 of 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site: REDINGTON ROAD

Client: Key GeoSolutions Limited

Engineer:

Contract No B20218

Sample Identification				Lab Sample ID	Sulphate (acid soluble as SO4) %	Sulphate (water soluble in 2:1 extract) as SO4 g/l	pH	Chloride (water soluble) %	Magnesium (water soluble in 2:1 extract) mg/l	Ammoniacal Nitrogen (as N) mg/kg	Nitrate mg/kg	Total Sulphur %
Hole	Depth m	Sample Ref	Sample Type									
WS01	1.00-1.20		T	298210	<0.02	<0.01	8.6	<0.01	25	<1.0	<1	<0.05
WS01	5.90-6.00		D	298211	0.08	0.02	8.4	<0.01	23	<1.0	<1	<0.05
WS02	1.00-1.50		T	298212	0.10	<0.01	8.6	<0.01	19	<1.0	<1	<0.05
Limits of Detection					0.02	0.01	~	0.01	1	<1.0	1	0.05
Terra Tek Analysis Method					TP029	TP043	TP019	TP134	S/C	TP072	S/C	S/C
Accreditation M=Mcerts U=UKAS N=No accreditation					M	M	M	M	N	N	N	N

Originator	Checked & Approved
TGH	S. Langman 24/08/2016

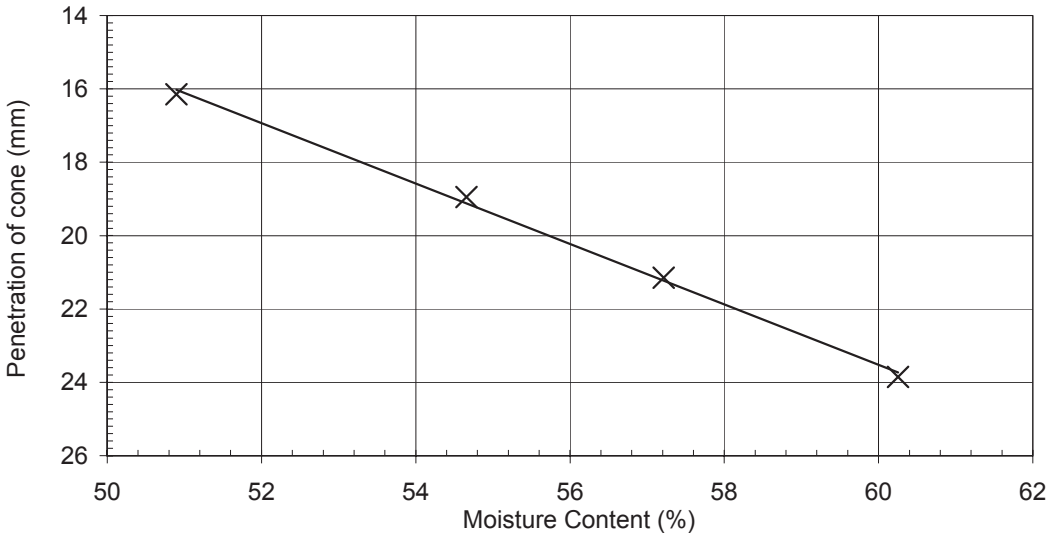
BRE SD1 SUITE - SOIL

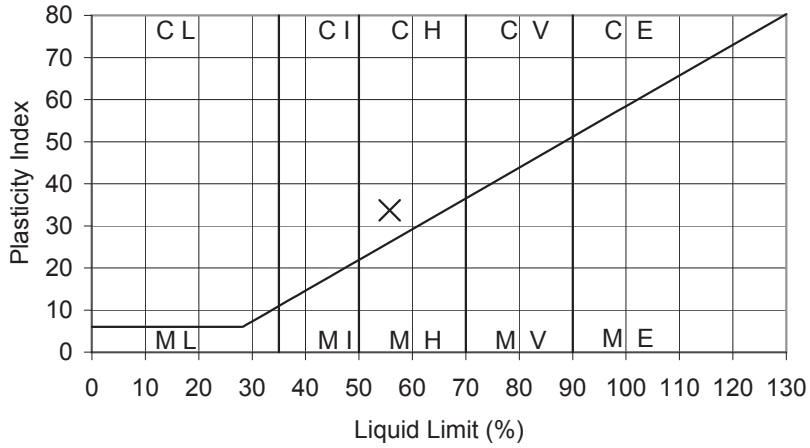
Figure 2

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES	Site	REDINGTON ROAD	**Contract No.**	**B20218**
	Client	Key GeoSolutions Limited	Hole ID	WS01
	Engineer		Sample Ref	
			Depth (m)	1.00-1.20
			Sample Type	T

Non Engineering Description : Brown sandy CLAY with some gravel. Gravel is fine to medium.

Preparation : Sample as received





Results :

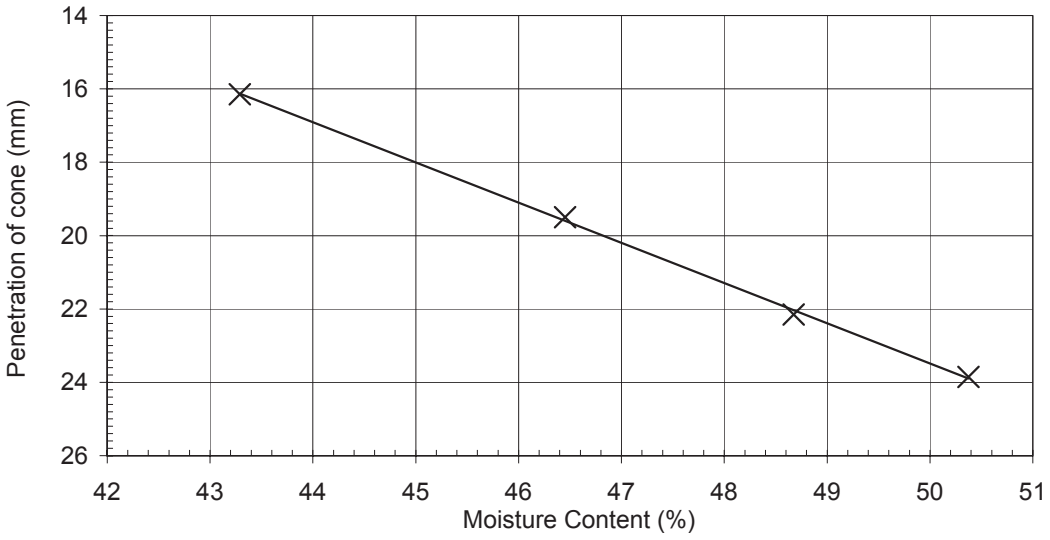
As Received Moisture Content : (BS1377:Part 2:Clause 3:1990)	29	%
Percentage retained on 425µm sieve :	8	%
Liquid Limit :	56	%
Plastic Limit :	22	%
Plasticity Index :	34	
Equivalent moisture content of material passing 425µm sieve :	32	%
Liquidity Index :	0.29	

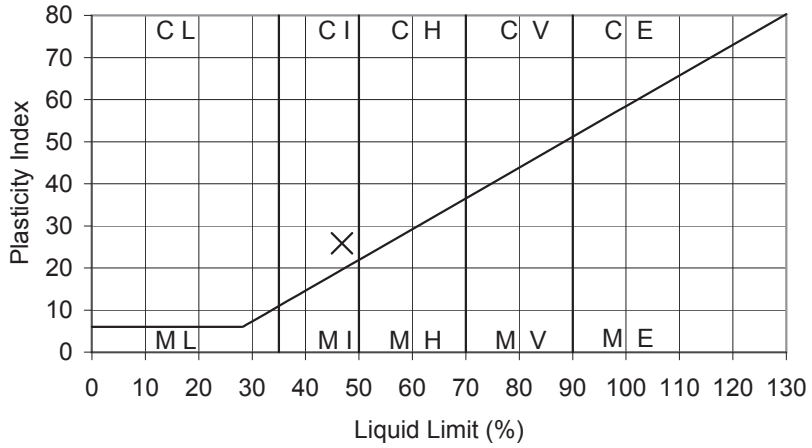
Originator	Checked & Approved	**Liquid Limit (Four Point Cone Penetrometer Method)** **Plastic Limit, Plasticity Index & Liquidity Index** BS 1377:Part 2:Clause 4.3:1990 BS 1377:Part 2:Clause 5:1990	**Figure 3**
TE/ME	S. Langman 24/08/2016		Sheet 1 of 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES	Site	REDINGTON ROAD	Contract No.	B20218
	Client	Key GeoSolutions Limited	Hole ID	WS01
	Engineer		Sample Ref	
			Depth (m)	5.90-6.00
			Sample Type	D

Non Engineering Description : Brown mottled grey slightly sandy CLAY.

Preparation : Sample as received





Results :

As Received Moisture Content : (BS1377:Part 2:Clause 3:1990)	28	%
Percentage retained on 425µm sieve :	0	%
Liquid Limit :	47	%
Plastic Limit :	21	%
Plasticity Index :	26	
Equivalent moisture content of material passing 425µm sieve :	28	%
Liquidity Index :	0.27	

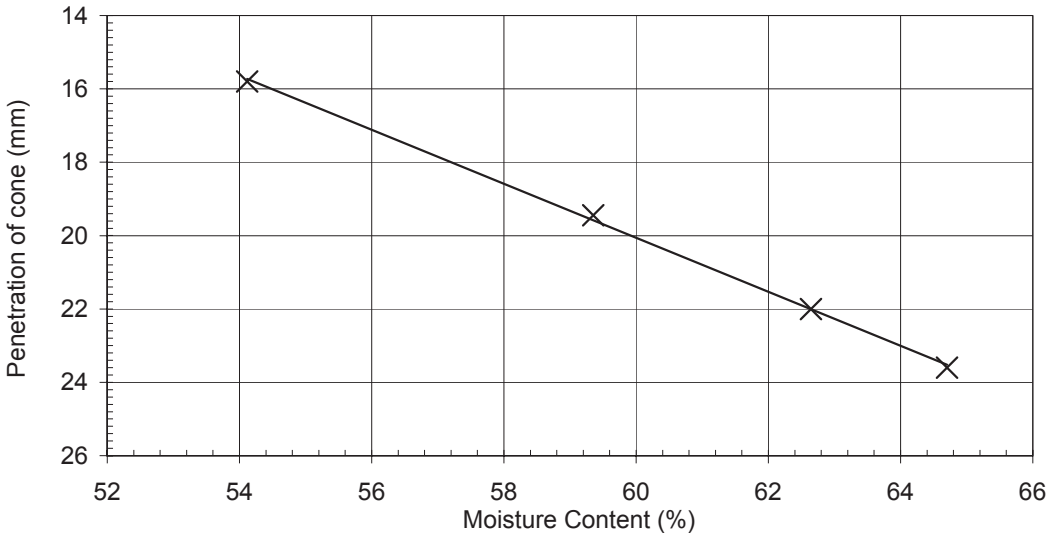
Originator	Checked & Approved	**Liquid Limit (Four Point Cone Penetrometer Method)** **Plastic Limit, Plasticity Index & Liquidity Index** BS 1377:Part 2:Clause 4.3:1990 BS 1377:Part 2:Clause 5:1990	**Figure 4**
TE/ME	S. Langman 24/08/2016		Sheet 1 of 1

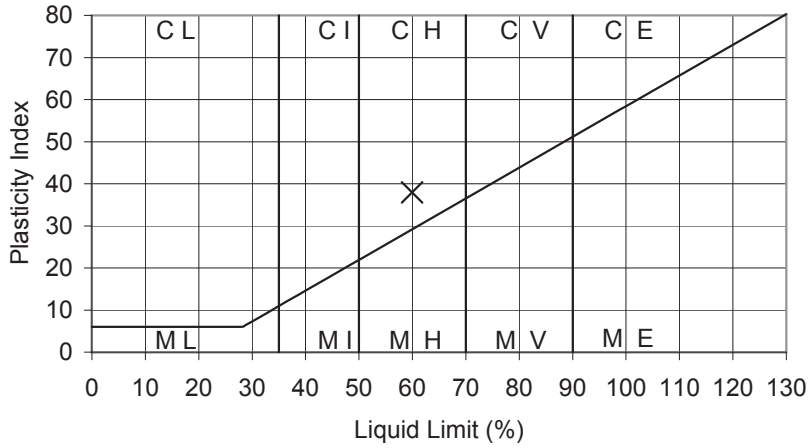
TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site	REDINGTON ROAD	**Contract No.**	**B20218**
Client	Key GeoSolutions Limited	Hole ID	WS02
Engineer		Sample Ref	
		Depth (m)	1.00-1.50
		Sample Type	T

Non Engineering Description : Brown slightly sandy CLAY.

Preparation : Sample as received





Results :

As Received Moisture Content : (BS1377:Part 2:Clause 3:1990)	26	%
Percentage retained on 425µm sieve :	0	%
Liquid Limit :	60	%
Plastic Limit :	22	%
Plasticity Index :	38	
Equivalent moisture content of material passing 425µm sieve :	26	%
Liquidity Index :	0.11	

Originator	Checked & Approved	**Liquid Limit (Four Point Cone Penetrometer Method)** **Plastic Limit, Plasticity Index & Liquidity Index** BS 1377:Part 2:Clause 4.3:1990 BS 1377:Part 2:Clause 5:1990	**Figure 5**
TE/ME	S. Langman 24/08/2016		Sheet 1 of 1

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site REDINGTON ROAD

Client Key GeoSolutions Limited

Engineer

Contract No B20218

Sample Identification				Lab Sample ID	Date Sampled	Temperature of cool box on receipt °C	Description
Exploratory Hole	Depth m	Sample Ref	Sample Type				
WS01	1.00-1.20		T	298210	04/08/16	10.2	Brown silty SAND
WS01	5.90-6.00		D	298211	04/08/16	10.2	Brown sandy CLAY with occasional fine gravel.
WS02	1.00-1.50		T	298212	04/08/16	10.2	Brown SAND

Notes

1. Where a date of sampling is not provided, the sample is classified as deviating.
2. Temperatures exceeding 6°C on receipt may be deviating, but will be dependent upon the suite of tests carried out.
3. Samples are considered deviating if the incorrect sample container type has been used. This is indicated within the report tables.
4. Results reported for samples classified as deviating may be compromised.

Originator	Checked & Approved
TGH	S. Langman 24/08/2016

LABORATORY DESCRIPTIONS

Appendix X

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site REDINGTON ROAD

Client Key GeoSolutions Limited

Engineer

Contract No B20218

Method Code	Reference	Description of Method	ISO17025 Accredited	MCERTS Accredited	Wet/Dry Sample Tested
GP001	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Preparation of soil samples for chemical analysis	Yes	Yes	N/A
GP012	BS EN 12457-3: Characterisation of Waste - Compliance test for leaching of granular waste materials and sludges (two-stage batch test)	Preparation of soil samples for two-stage leachate test			Dry
TP019	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of pH in 2.5:1 water/soil extract using pH meter.	Yes	Yes	Dry
TP029	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of acid soluble sulfate by gravimetry.	Yes	Yes	Dry
TP032	MAFF Book 427: The Analysis of Agricultural Materials: Method 8	Determination of water soluble boron by colorimetry	Yes		Dry
TP033	APHA/AWWA, 19th edition: Method 5520E	Determination of Toluene Extractable Matter by soxhlet extraction.	Yes		Dry
TP040	APHA/AWWA, 19th edition: Method 3500Cr-D	Determination of hexavalent chromium by colorimetry.	Yes		Dry
TP041	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of organic matter by titrimetry.	Yes		Dry
TP042	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of loss on ignition at 50-440°C by gravimetry	Yes	Yes	Dry
TP043	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of water soluble sulfate in 2:1 water/soil extract	Yes	Yes	Dry
TP045	GACHAMJA A.M. Chromatography and Analysis: 1992 9-11 (modified)	Determination of polyaromatic hydrocarbons extractable in dichloromethane, by GC/MS	Yes	Yes	Dry
TP046	MEWAM method: Phenols in water and Effluents: 4-aminoantipyrine method	Determination of monohydric phenols by steam distillation/colorimetry	Yes	Yes	Dry
TP047	MEWAM method: Cyanide in Waters etc	Determination of Free Cyanide by steam distillation/colorimetry	Yes		Dry
TP048	MEWAM method: Cyanide in Waters etc	Determination of total cyanide by steam distillation/colorimetry.	Yes	Yes	Wet
TP049	MEWAM method: Cyanide in Waters etc	Determination of complex cyanide by calculation	Yes		Dry
TP050	MEWAM method: Determination of Thiocyanate ,1985	Determination of thiocyanate by colorimetry	Yes	Yes	Dry
TP051	USEPA Method 9030B	Determination of acid soluble sulfides by steam distillation/colorimetry.	Yes	Yes	Dry
TP052	BS1881: Part 324, 1988: Testing Concrete	Determination of elemental sulfur by soxhlet extraction and titrimetry.	Yes		Dry
TP067	TNRCC Method 1005: 2001 (modified)	Determination of pentane/acetone extractable petroleum hydrocarbons (C8 - C40) by GC/FID	Yes	Yes	Wet
TP072	In-house documented method	Determination of ammoniacal nitrogen by colorimetry.			Dry

Notes

1. Terra Tek (Birmingham) are MCERTS accredited for clay, sand & loam matrix types only, where they constitute the major component of the sample. Other coarse granular materials, ie gravel, are not accredited where they comprise the major component of the sample.
2. Results are expressed on a dry-weight basis (samples dried at 30°C ± 5°C) except where stated.
3. The laboratory removes any material >2mm prior to analysis. The quantity and nature of any material removed from samples is recorded and the information is available on request.
4. The laboratory records the date of analysis of each parameter. This information is available on request.
5. Where a parameter cannot be determined in house it is our policy to use a UKAS/MCERTS accredited laboratory wherever possible. Terra Tek will assume responsibility for the quality of subcontracted tests and the performance of the subcontractor chosen. Where there is no known UKAS/MCERTS laboratory for a particular parameter, a laboratory listed within the Terra Tek Approved Subcontractors list, which is subject to performance assessment, will be selected.

Originator	Checked & Approved
N/A	N/A

SUMMARY OF IN-HOUSE ANALYTICAL TEST METHODS (SOIL)

Appendix Y

TERRA TEK SITE INVESTIGATION AND LABORATORY SERVICES

Site REDINGTON ROAD

Client Key GeoSolutions Limited

Engineer

Contract No B20218

Method Code	Reference	Description of Method	ISO17025 Accredited	MCERTS Accredited	Wet/Dry Sample Tested
TP073	In-house documented method	Determination of anionic detergent (MBAS) by colorimetry			Dry
TP074	In-house documented method	Determination of water soluble fluoride by ion selective electrode			Dry
TP098	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of acid soluble chloride by titrimetry			Dry
TP099	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of water soluble chloride by titrimetry	Yes	Yes	Dry
TP100	Wisconsin DNR Modified GRO method, Method for Determining Gasoline Range Organics	Determination of Volatile Petroleum Hydrocarbons/GRO.	Yes	Yes	Wet
TP110	USEPA Methods 8082A & 3665A	Determination of Total & Speciated 7 PCB Congeners by GC/MS SIM	Yes	Yes	Wet
TP114	BS1377, Part 3, 1990: Soils for Civil Engineering Purposes.	Determination of carbonate in soil (rapid titration method)			Dry
TP126	TNRCC Method 1006 (modified)	Extracted petroleum hydrocarbons from TP067 split into aromatic and aliphatic fractions. Analysed by GC/FID.	Yes		Wet
TP134	In-house documented method	Determination of water soluble chloride by titrimetry	Yes	Yes	Dry
TP135	USEPA Methods 8100 & 8270D. In-house method TP045	Determination of polyaromatic hydrocarbons extractable in dichloromethane, by GC/MS (with concentration stage)			Dry
TP145	USEPA Methods 3550C & 8270D	Determination of Semi-Volatile Organic Compounds by GC/MS	Yes	Yes	Wet
TP147	USEPA Methods 8082A & 3665A	Determination of total & speciated WHO 12 PCB Congeners by GC/MS SIM.			Wet
TP150	USEPA Methods 8081B & 8141B	Determination of pesticides and herbicides in soil by GC/MS SIM			Dry
TP152	USEPA Method 556	Determination of carbonyls in soil by GC/MS.			Wet
TP154	USEPA Method 5021. Wisconsin DNR modified GRO method	Determination of volatiles in soil by GC/MS headspace	Yes	Selected	Wet
TP158	USEPA Method 1671	Determination of glycols in soil by GC/FID DI			Wet

Notes

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2. Results are expressed on a dry-weight basis (samples dried at 30°C ± 5°C) except where stated.
3. The laboratory removes any material >2mm prior to analysis. The quantity and nature of any material removed from samples is recorded and the information is available on request.
4. The laboratory records the date of analysis of each parameter. This information is available on request.
5. Where a parameter cannot be determined in house it is our policy to use a UKAS/MCERTS accredited laboratory wherever possible. Terra Tek will assume responsibility for the quality of subcontracted tests and the performance of the subcontractor chosen. Where there is no known UKAS/MCERTS laboratory for a particular parameter, a laboratory listed within the Terra Tek Approved Subcontractors list, which is subject to performance assessment, will be selected.

Originator	Checked & Approved	SUMMARY OF IN-HOUSE ANALYTICAL TEST METHODS (SOIL)	Appendix Y
N/A	N/A		Sheet 2 of 2

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