Proposed Development at Advantage Cars, Comet Way, Hatfield

Phase 2 Ground Investigation Report

On behalf of **Comet Way, Hatfield Ltd.**

Project Ref: 47179/3502 | Rev: 00 | Date: August 2020

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00	18.08.20	Site investigation report issued with preliminary monitoring data	C Radbone N Hills	L Truslove G Scott	O Belson

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1 Introduction

1.1 Brief

1.1.1 Stantec UK Ltd. (Stantec) has been commissioned by Comet Way Hatfield Ltd. (the Client) to undertake a Phase 2 Ground Condition Assessment (GCA) to support a planning application for a proposed redevelopment of the Advantage Cars site, Comet Way, Hatfield (the Site).

1.1.2 The proposed development will comprise the construction of flats in a stepped building between four and six storeys in height. In total 116 residential units will be incorporated, with communal roof gardens featured on the lower parts of the block. Undercroft vehicle parking, cycle storage and bin storage is proposed at ground level with residential units from the first floor and upwards. Outside of the building footprint the ground level of the Site will be used for car parking, an electricity substation and limited peripheral soft landscaping.

1.1.3 This report builds upon the findings of the Phase 1 GCA (desk study)[1] completed by Stantec in April 2020. The Phase 1 GCA should be referred to in conjunction with this report.

1.1.4 This report presents an interpretation of the factual information obtained from the preliminary ground investigation undertaken to characterise the underlying ground conditions. It provides a generic quantitative risk assessment of contamination in relation to human health and the environment and provides advice on likely foundation solutions and other ground related aspects.

1.1.5 Attention is drawn to the Guidance Notes included in final the section, which provides advice for the readers of this report.

1.2 Objectives

1.2.1 The overall objectives of the investigation were to:

1. Report the findings of the Ground Investigation (GI) work and the associated geotechnical and geoenvironmental laboratory analyses in order to define the ground conditions.

2. Refine the Conceptual Model (CM) developed in the Phase 1 GCA using the actual ground conditions encountered.

3. Present contamination and ground gas risk assessments and identify associated significant potential contamination risks that might require management (further assessment, remediation or mitigation). Where required, provide outline recommendations for further investigation or remediation.

4. Confirm or modify the preliminary understanding of the geotechnical conditions across the area of the proposed development and, where possible, determine the depth and condition of groundwater.

5. Identify geotechnical issues, assess likely constraints and provide parameters suitable for design.

6. Provide outline recommendations for foundation design, road design and drainage solutions.

[1] Stantec, April 2020, Ground Conditions Assessment (Phase 1), Proposed Development at Beadles Volkswagen Van Centre, Comet Way, Hatfield).

1.3 Outline Scope of Work

1.3.1 The GI comprised a combined geotechnical and Phase 2 geoenvironmental investigation with the site works completed in March 2020. In summary the site work consisted of:

- The drilling of three Cable Percussion (CP) boreholes (designated CP01 to CP03) to a maximum depth of 30m.
- The drilling of eight Windowless Sample (WS) boreholes (designated WS01 to WS08) to a maximum depth of 5m.
- Construction of groundwater/ground gas monitoring installations in two of the completed CP boreholes (CP01 and CP02) and five of the DS boreholes (WS01, WS02, WS04, WS05 & WS06).
- Geoenvironmental laboratory analysis of recovered soil samples.
- Field geotechnical testing on soil samples and laboratory geotechnical analysis on recovered soil samples.

1.3.2 Each exploratory hole location was subject to a buried services scan using electromagnetic and ground penetrating radar techniques. Inspection pits were excavated by hand at each exploratory location to a depth of 1.2m.

1.3.3 Coring of concrete or macadam hardstanding was used in areas of hardstanding surface followed by a hand-excavated inspection pit to 1.2m.

1.3.4 A more detailed description of the ground investigation works undertaken is provided in **Section 3**, below.

2 The Site

2.1 Site Location and Description

2.1.1 The Site occupies an area of approximately 0.50 hectares (ha) and comprises a van dealership and an asphalt surfaced forecourt/parking area.

2.1.2 The Site is located at approximate National Grid Reference TL 21655 08780 (**Figure 1**), immediately west of Comet Way in Hatfield.

2.1.3 The site is currently used as a car dealership comprising a showroom, offices, limited active workshop facilities, restricted to an active MOT bay, with the workshop area currently utilised for storage of vehicles only. A car valeting area is present to the rear of the main dealership building. A substation is located in the north of the main forecourt area. Eight identified Underground Storage Tanks (UST) were present to the immediate east of the workshop/office building. Further tanks are considered likely to still be present based on information supplied by the Petroleum Officer. A more detailed description of the Site is provided in the Phase 1 GCA.

2.1.4 The Site is bound to the south by a pedestrian underpass and Jetliner Way, to the west by Goldsmith Way and to the north by an electricity substation and the car park of an adjacent restaurant. The A1(m) is present at depth within the Hatfield tunnel approximately 30m east of the Site.

2.2 Geology

2.2.1 The geology of the Site has been determined via reference to online resources (www.bgs.ac.uk) and the 1:50,000 scale Geological Survey map of Hertford, Sheet 239, Soil and Drift (BGS, 1978). The site is situated upon Quaternary deposits of Lowestoft Formation (Diamicton) and Kesgrave Catchment Subgroup (Sand and Gravel), overlying the Cretaceous age Lewes Nodular and Seaford Chalk Formation (Undifferentiated).

2.2.2 These formations are described by the British Geological Survey (BGS) as:

- Diamicton (Boulder Clay) of the Lowestoft Formation – "*chalky till, together with outwash sands and gravels, silts and clays. The till is characterised by its chalk and flint content".* The BGS state that this unit is of variable thickness of up to 60m.
- Kesgrave Catchment Subgroup (Sand and Gravel) – "*cross-bedded and massive, moderately sorted sand and gravel*".
- Lewes Nodular Chalk Formation and Seaford Chalk Formation (undifferentiated) – "*Chalk with flints. With discrete marl seams, nodular chalk, sponge-rich and flint seams throughout".*

2.2.3 The BGS borehole archive holds records of numerous boreholes within the vicinity of the Site boundary, however, it is noted that none of these boreholes were completed to a depth that proves the Chalk interface. A summary of the closest boreholes, with relevance to the Site in terms of encountered geology, ground level and presence of the Chalk are detailed in the table below.

Table 2.1 BGS Historical Borehole Records

Borehole, Distance from site	Interpreted Lithology	From (m bgl)	To (m bgl)	Thickness (m)
TL20NW408	Topsoil	0.0	1.2	1.2

Borehole, Distance from site	Interpreted Lithology	From (m bgl)	To (m bgl)	Thickness (m)
(120m north)	Glacial Deposits	1.2	21.4	20.2
	Chalk	21.4	26.0	>4.6
TL20NW430 (175m north-east)	Fill	0.0	3.0	3.0
	Glacial Deposits	3.0	20.0	17.0
	Chalk	20.0	30.0	>10.0
TL20NW184 (290m south-west)	Fill	0.0	0.2	0.2
	Glacial Deposits	0.2	22.6	22.4
	Chalk	22.6	30.5	>7.9

2.2.4 The Phase 1 GCA concluded that the Site has a **Moderately High** risk of the occurrence of Natural Cavities associated with solution features due to dissolution of the chalk bedrock.

2.2.5 The desk study concluded that the potential for past chalk mining at the Site is considered to be **Low**.

2.3 Site History

2.3.1 A detailed Site history is presented in the Phase 1 GCA and is summarised below.

2.3.2 The Site remained as open undeveloped land until the construction of a horseshoe shaped structure in the 1930s, later recorded as a 'Garage'.

2.3.3 Few changes are recorded until the 1970s when a new garage structure was constructed in the east of the Site between the existing garage and the eastern Site boundary.

2.3.4 Various alterations occurred to the original horseshoe shaped garage and the 1970s garage during the late 1980s/early 1990s, a new rectangular garage building was constructed in the centre of the Site. and an electricity substation was constructed adjacent to the northern corner of the garage.

2.3.5 Up to 22 single skinned steel underground storage tanks are or have been present at the Site during its use as a garage and filling station. Installed between 1961 and 1989 and all subsequently infilled or decommissioned by 2005.

2.3.6 By 2005 the existing Site layout had been established.

3 Ground Investigation

3.1 Scope of Investigation

3.1.1 Boreholes CP01, WS01 and WS02 were proposed to identify potential presence of contamination due to the garage work area and cleaning facilities and the potential impact on deep groundwater within the chalk.

3.1.2 WS05 was proposed to understand any contamination caused by above ground oil storage tanks.

3.1.3 CP02 and WS08 were located to highlight potential historical contamination from when the area housed a garage structure for the De Haviland Aerodrome site as highlighted in the historical land uses within the Phase 1 GCA.

3.1.4 WS06 and WS07 were targeted to investigate the presence of contamination associated with a group of disused USTS that were indicated in the Petroleum Officer report to be present beneath the forecourt.

3.1.5 Remaining holes CP03 and WS03 positioned to investigate the remaining extent of the site.

3.1.6 The exploratory hole locations are presented on **Figure 2.**

Constraints

3.1.7 At the time of the GI, the Site was in active use as a car sales showroom. Exploratory positions were not advanced within the footprint of the existing buildings and were constrained in the forecourt areas by ongoing Site activities.

3.1.8 Across the external areas of the Site, the locations of the exploratory positions were chosen to avoid obstructions and existing infrastructure above and below ground including USTs, fuel distribution pipework and other services identified on plans and through survey work.

3.1.9 Boreholes were adopted in preference to machine-excavated trial pits to minimise disturbance at the Site to site activities.

Cable Percussion Boreholes

3.1.10 Three boreholes of nominal 150mm diameter were sunk using conventional light cable percussion techniques (CP01, CP02 and CP03). Disturbed small and bulk samples were taken and standard penetration tests (SPTs) were carried out using both the split spoon sampler and cone. The SPTs were carried out every 1m to 5m bgl, then every 1.5m from then on with disturbed samples being taken from the split-spoon sampler when in cohesive strata. CP01 and CP02 were completed to their target depths. CP03 was terminated at 1.00m bgl on reinforced concrete.

3.1.11 On completion, 50mm diameter groundwater and ground gas monitoring wells were constructed in CP01 and CP02. Standpipe piezometers were installed and sealed with plain section within the Made Ground to prevent downwards migration of any perched water to lower natural strata. The remaining slotted section pipework was encased in a gravel filter pack. The installation was completed with a rubber bung and gas tap and a flush mounted daisy cover concreted in place. CP03 was backfilled with arisings and sealed with concrete flush with the surrounding surface.

3.1.12 The cable percussion borehole records with engineer descriptions are included in **Appendix A.**

Dynamic Sampling/ Windowless Sampler Boreholes

3.1.13 Dynamic sampling techniques were used to construct WS boreholes at eight locations within the Site (WS01, WS02, WS03, WS04, WS05, WS06, WS07 & WS08) to a target depth of 5.0m bgl.

3.1.14 Continuous soil cores were recovered from the windowless sampler boreholes in PVC liners, which were split to enable detailed logging of all exploratory locations by the Site Engineer in accordance with BS 5930:2015 and BS EN ISO 14688. The hand dug pits were also logged by inspection of the in-situ pit sides and disturbed arisings.

3.1.15 On completion, WS boreholes WS01, WS02, WS04, WS05 and WS06 were installed with nominal 50mm diameter groundwater and ground gas monitoring pipework. The response zones of each installation were located within the Lowestoft Formation and sealed above to prevent downwards migration of any perched water within the Made Ground. The pipework was encased in a gravel filter pack and sealed from ground level using one metre of bentonite pellets and a flush cover concreted in place. The remaining windowless sampler boreholes were backfilled with arisings upon completion.

3.1.16 Records of the WS boreholes are included in **Appendix A.**

3.2 Soil Sampling

3.2.1 Representative disturbed soil samples were recovered during the GI and transported with a completed chain of custody form to the selected accredited laboratory.

3.2.2 Samples of the soils were recovered for geoenvironmental laboratory analysis. Disposable nitrile gloves and clean sampling tools were used during handling of the recovered soils. To prevent cross contamination, all sampling jars and equipment were transported in clean plastic containers and stored separately from the retained samples. Samples were stored in laboratory provided coolboxes with frozen ice packs and couriered to the chosen laboratory following completion of the fieldwork.

3.2.3 Small disturbed soil samples were collected every half metre, placed in clean food grade plastic bags and allowed to rest for approximately 15 minutes prior to monitoring for the presence of total Volatile Organic Compounds (VOCs) using a MiniRAE 2000 Photo-Ionisation Detector (PID) to provide a qualitative indication of the presence of VOCs within soils beneath the Site.

3.3 Laboratory Analysis

Geoenvironmental Laboratory Analysis

3.3.1 Chemtest Laboratories, who hold UKAS accreditation (Laboratory No 2183) and MCERTS accreditation, were commissioned by Stantec to undertake the required geoenvironmental laboratory analysis. The analytical suite adopted was designed on the basis of the potential sources of contamination (notably hydrocarbons and metals resulting from the Site's former fuel filling station use) identified during the Phase 1 GCA.

3.3.2 A summary of the scheduled geoenvironmental soil analysis undertaken is presented in the Table below. The selected potential contaminants of concern is based on the current and historical use of the Site.

Table 3.1 Summary of Scheduled Geoenvironmental Laboratory Analysis (Soils)

Description	Number of Tests
Asbestos	11

Description	Number of Tests
(Screening and identification and quantification if present)	
Metals Suite	11
Volatile Organic Compound (VOCs)	3
Speciated Total Petroleum Hydrocarbons (TPH CWG)	14
Speciated Polycyclic Aromatic Hydrocarbons (16 PAH)	14
pH	5
PCBs	2

3.3.3 The geoenvironmental laboratory analysis certificates for soils are presented in **Appendix B**.

Geotechnical Laboratory Analysis

3.3.4 Geotechnical laboratory analysis was undertaken by Soil Property Testing Ltd, who hold UKAS accreditation Laboratory No 0998, for general classification properties. The geotechnical laboratory analysis certificates are included in **Appendix C**.

3.4 Post-fieldwork Monitoring & Sampling

Groundwater Monitoring

3.4.1 Groundwater levels were recorded during the four post-completion monitoring visits undertaken between 20/03/2020 and 21/07/2020.

Groundwater Sampling

3.4.2 Groundwater samples were collected from CP01 and CP02 during monitoring on the 7th July 2020 and were submitted to Derwent Environmental Testing Services (DETS) for analysis.

3.4.3 The samples were analysed for the suite identified in Table 3.2 below, designed on the basis of the potential sources of contamination (notably hydrocarbons and metals resulting from the Site's former fuel filling station use) identified during the Phase 1 GCA:

Table 3.2 Summary of Scheduled Geoenvironmental Laboratory Analysis (Waters)

Description
Metals Suite
Speciated Total Petroleum Hydrocarbons (TPH CWG)
BTEX MTBE
Speciated Polyaromatic Hydrocarbons (16 PAH)
pH

3.4.4 The groundwater laboratory analysis certificates are presented in **Appendix B**.

Ground Gas Monitoring

3.4.5 Ground gas monitoring visits were carried out between 20th of March 2020 and 21st July 2017 using a Gas Data GFM 436 landfill gas analyser and/or a Geotech GA5000 landfill gas analyser.

3.4.6 The ground gas monitoring results are included in **Appendix D** and the initial findings discussed further below in **Section 5.5**.

4 Ground Conditions Summary

4.1 Stratigraphy

4.1.1 The ground conditions encountered during the ground investigation were found to be as anticipated based on the desk study review of the geology of the area and are summarised in Table 4.1 below.

Table 4.1 Summary of Encountered Stratigraphy

Formation	Top Depth Range (bgl)	Base Depth Range (bgl)	Base Elevation Range (OD)
Made Ground	Ground Level	0.25m - 1.70m*	75.8m to 74.7m
Lowestoft Formation	0.25m - 1.70m	16.10m – 16.40m	59.83m to 59.73m
Kesgrave Catchment Group	16.10m – 16.40m	19.20m – 21.80m	56.73m to 54.33m
Lewes Nodular Chalk Formation	19.20m – 21.80m	Proved to 30.0m	Not proved

*Where the full thickness of Made Ground was proved, the maximum thickness was 1.70m, however the base was not proved in all boreholes due to the presence of near-surface obstructions.

Made Ground

4.1.2 The Made Ground was found to comprise a layer of asphalt or concrete surfacing between 0.1m and 0.2m thick, overlying either sand gravelly clay or granular materials with varying fines content. The exceptions were in CP03 and WS07 where the holes were terminated due to refusal in concrete at 1.0m and 0.7m bgl respectively.

4.1.3 Buried asphalt layers and buried concrete were recorded in the Made Ground as follows:

- WS01 recorded at 0.33m thick buried former asphalt surfacing layer at 0.7m bgl;
- WS06 recorded a 0.1m thick concrete slab at 0.7m bgl; and,
- WS07 recorded concrete at 0.7m bgl which could have been a former pavement layer or possibly a former foundation.

4.1.4 Locally, a plastic membrane was present beneath both the current concrete surface (WS02 & WS07) and beneath the buried historical asphalt surface (WS01).

4.1.5 The granular materials varied from sandy gravels of brick and flint, locally with asphalt and concrete cobbles, to clayey sandy flint and chalk gravels. The cohesive materials were described as either ‘soft’ or ‘firm’ clays with varying sand and gravel contents with cobbles locally recorded. The granular fraction was typically brick or flint occasionally with concrete and asphalt.

4.1.6 Two SPT N_{60} values (i.e. field SPT N values corrected for SPT hammer efficiency in accordance with BS EN ISO 22476-3:2005+A1:2011) were recorded in Made Ground. An N_{60} value of 14 in ‘firm’ sandy gravelly clay was recorded at 1m bgl in WS03 and an N_{60} of 8 at 1m bgl in ‘soft’ clay in WS06.

Lowestoft Formation

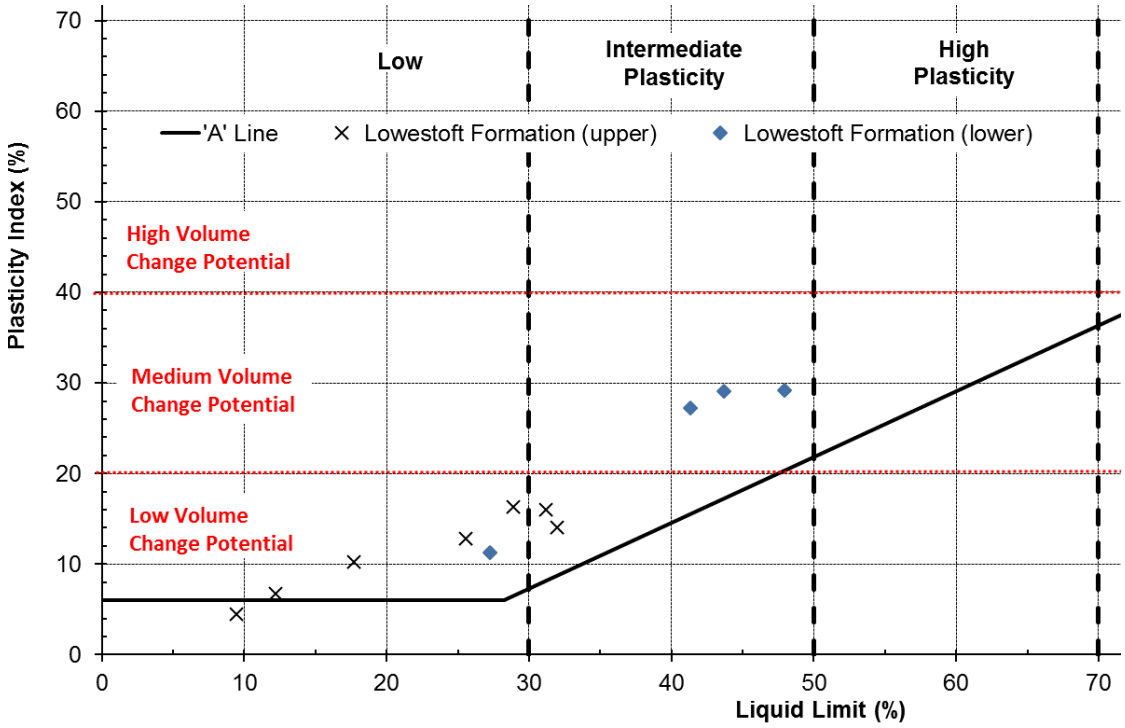
4.1.7 The Lowestoft Formation was found to comprise three distinct groups of substrata, as follows:

- Upper cohesive strata to between 1.9m to 2.6m bgl (74m to 73.4m OD), overlying;
- Granular strata to between 8.8m to 9.3m bgl (67.3m to 66.6m OD), overlying;
- Lower cohesive strata to between 16.1m to 16.4m bgl (59.8m to 59.7m OD).

4.1.8 **Upper cohesive strata** These typically comprise yellowish brown slightly sandy slightly gravelly clay, locally with thin granular strata. The deposit varied in thickness between 0.75m (WS06) and 2.25m (WS04). Consistency is described variously as 'soft', 'soft to firm', 'firm' and locally 'stiff'. The gravel fraction typically comprises flint and chalk.

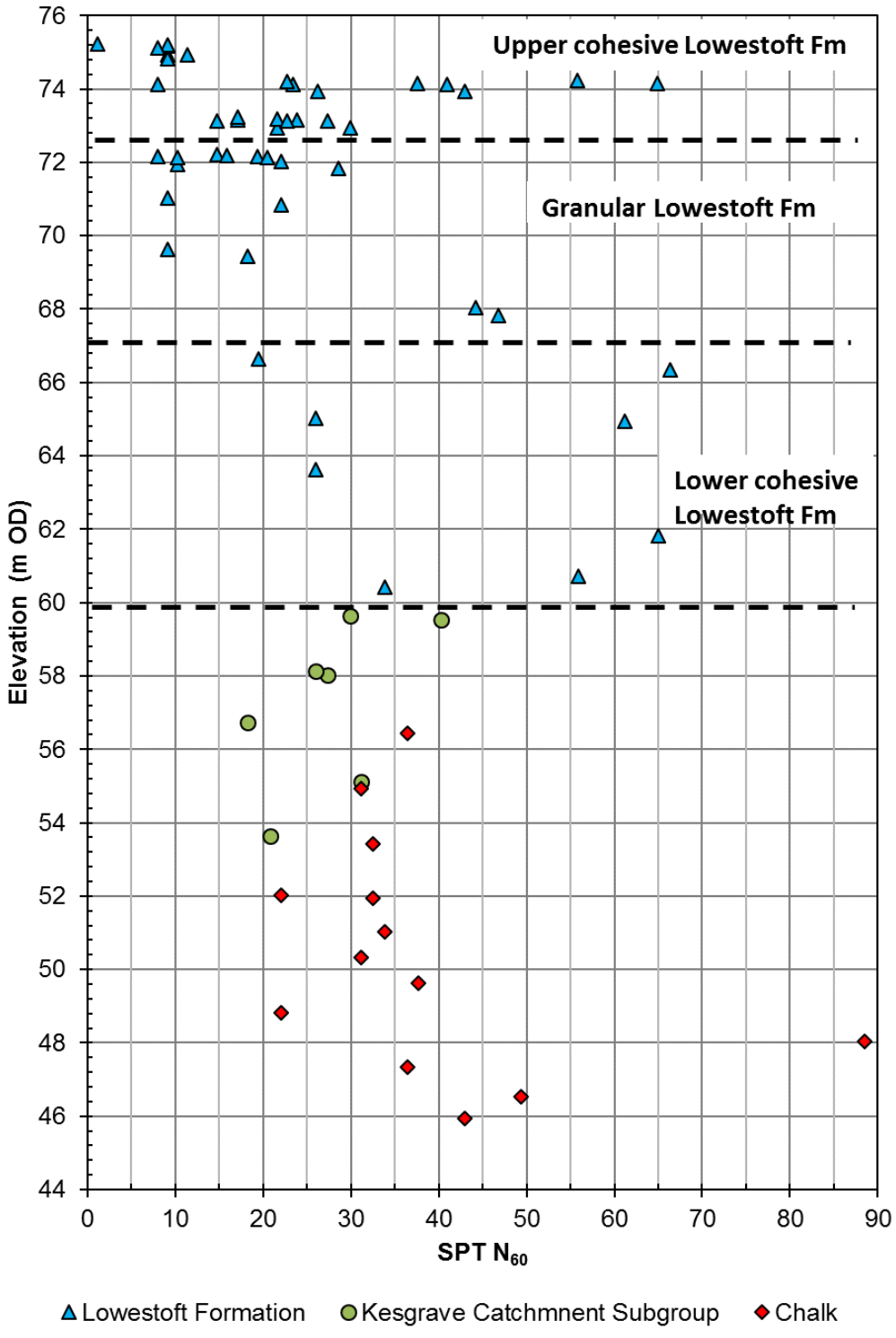
4.1.9 The results of classification tests are presented on a plasticity chart below, with measured values of plasticity index (corrected for coarse material content) of between 5 and 16% (mean of 12%). These values indicate the material ranges between low and intermediate plasticity and is of low volume change potential according to BRE Digest 240.

Figure 4.1 - Lowestoft Formation Plasticity Chart



4.1.10 SPT N_{60} values ranged between 1 and 56 with a mean of 22 (see **Figure 4.2** below).

Figure 4.2 - SPT N vs Elevation Plot



4.1.11 **Granular strata** These typically comprise yellow to reddish brown variably gravelly clayey sands or very sandy slightly silty subrounded to rounded gravel locally with thin gravelly clay strata. The full thickness of the granular material was recorded in CP01 and CP02 only, recorded as 6.5m and 7.4m thick respectively.

4.1.12 SPT N_{60} values (see **Figure 4.2**) range between 8 and 47 (with a mean of 22) indicating the granular materials to exist in a loose to dense state.

4.1.13 **Lower cohesive strata** These were recorded in CP01 and CP02 only where they were 7.6m and 6.8m thick respectively. The deposit is recorded as stiff dark grey slightly gravelly slightly sandy silty clay. Consistency is described 'stiff'. The gravel fraction typically comprises flint and chalk.

4.1.14 The results of classification tests are presented in **Figure 4.1** above, with measured values of plasticity index (corrected for coarse material content) of between 11 and 24% (mean of 24%). These values indicate the material ranges between low and intermediate plasticity and is typically of medium high volume-change potential according to BRE Digest 240.

4.1.15 SPT N_{60} values ranged widely between 19 and 66 with a mean of 44 (see **Figure 4.2** above).

4.1.16 Two undrained triaxial tests recorded undrained shear strengths of 312 and 287kN/m^2 indicating a very stiff material. The same tests recorded bulk density values of 21.2 and 21.9kN/m^3.

Kesgrave Catchment Subgroup – Kesgrave Sands and Gravels

4.1.17 The Lowestoft Formation is directly underlain by the Kesgrave Catchment Subgroup which was recorded as comprising orange brown variably clayey sands and gravels that were recorded to be 5.4m and 3.1m thick in CP01 and CP02 respectively.

4.1.18 SPT N_{60} values (see **Figure 4.2**) ranged between 21 and 40 (with a mean of 28) indicating the granular materials to exist in a medium dense to dense state.

Lewes Nodular Chalk Formation

4.1.19 Chalk underlies the Kesgrave Catchment Subgroup and was recorded in CP01 and CP02 only at depths of 21.80 and 19.20m bgl respectively. This variability in depth suggests erosion into the top of the deposit at the time of deposition of the Kesgrave Catchment Subgroup.

4.1.20 The Chalk was recovered from the boreholes as a white structureless chalk composed of silty subangular to subrounded chalk fragments with some flint. This appearance of the recovered chalk as structureless is due to the cable percussion drilling techniques. SPT N_{60} values (see **Figure 4.2**) ranged between 22 and 88 (with a mean of 38). The data suggests an increase in N value with depth as would be normally anticipated.

4.1.21 As a general rule chalk is considered to be structured when SPT N_{60} values exceed 25 and therefore the SPT data indicates that generally structured chalk was encountered by the deep boreholes, with localised horizons of weaker, structureless chalk.

4.2 Obstructions

4.2.1 Reinforced concrete was identified below the macadam surfacing to a depth of 1.0m bgl in the location of CP03, positioned to provide ground condition information in this part of the site and to provide groundwater monitoring coverage. Owing to the depth and the strength of the concrete encountered it was not possible to advance this location. The concrete is likely associated with the decommissioned USTs identified in the petroleum officer report in the Phase 1 GCA report.

4.2.2 Reinforced concrete was also encountered below the macadam surfacing and made ground at a depth of 0.7m bgl in location WS07, again this is likely associated with USTs identified as being decommissioned in the petroleum officer report in the Phase 1 GCA report.

4.3 Visual and Olfactory Evidence of Contamination

4.3.1 Visual and olfactory evidence of hydrocarbon contamination was identified within CP01, WS02 and WS06 with the presence of green staining within clay arisings, indicative of hydrocarbons presence.

4.3.2 A “hydrocarbon odour” was noted at 1.0m bgl in WS02, located in the western corner of the Site, not near the recorded locations of any known historical or existing Underground Storage Tanks (USTs), but near two existing areas of oil drum storage, the vehicle valeting area and the MOT test bay. A “strong hydrocarbon odour” was noted at 0.75m bgl in WS06, located in the centre of the Site and near the locations of several former (decommissioned) USTs.

4.3.3 Samples of these materials were taken from these layers of potential contamination recovered and were scheduled for geoenvironmental laboratory analysis. The results discussed in Section 5, below and the laboratory certificates are presented in **Appendix B**.

4.3.4 Measurements of VOCs were obtained at approximately 0.5m intervals in each borehole. These were typically below 5.0 parts per million (ppm), with the following exceptions:

- WS02 at 2.0m depth – 46.6ppm
- WS04 at 2.0m depth – 18.9ppm
- WS06 at 2.0m depth – 58.0ppm
- WS06 at 2.5m depth – 5.7ppm
- WS08 at 3.0m depth – 17.7ppm

4.3.5 The elevated readings in WS02 and WS06 correspond to the locations of odours detected during the GI, though occur at a deeper depth, suggesting that the more mobile, volatile contaminants have migrated downwards. The readings detected in WS04 and WS08 do not correspond with other visual/olfactory indicators of contamination.

4.3.6 Potential Asbestos Containing Materials (ACMs) were not visually noted within any of the exploratory holes.

4.4 Groundwater

4.4.1 Groundwater strikes were not recorded in the WS boreholes, sunk to 5m depth through the Made Ground and into the upper part of the Lowestoft Formation.

4.4.2 Groundwater strikes were recorded during drilling in CP01 (16.4m bgl, rising to 16.2m bgl over a 20-minute period) and CP02 (16.1m bgl, rising to 15.6m over a 20-minute period).

4.4.3 During subsequent groundwater monitoring visits (20/03/2020, 07/07/2020, 14/07/2020 and 20/07/2020) boreholes WS01, WS02, WS04 and WS06 have remained dry, WS05 has recorded water at 4.95m bgl during each visit, however this is likely to be water remaining within the end cap of the installed standpipe and not representative of groundwater.

4.4.4 Groundwater levels in CP01 have been recorded between of 13.59m bgl (62.54mAOD) and 15.64mbgl (60.49mAOD). Groundwater levels in CP02 have been recorded between 15.23m bgl (60.70mAOD) and 15.64m bgl (60.29mAOD). On the basis of the monitoring undertaken, a groundwater table appears to be present at approximately 15.6m bgl.

4.4.5 It is considered that the groundwater levels recorded indicate the presence of a sub-artesian groundwater table within the Kesgrave Subcatchment Group, where groundwater is confined from rising upwards by the presence of the cohesive clay layer at the base of the Lowestoft Formation.

5 Tier 2 Environmental Data Review and Risk Assessment

5.1 Approach

5.1.1 In accordance with the Stantec Methodology for the Assessment of Potentially Contaminated Land (**Appendix E**), the measured concentrations of potential contaminants determined as part of the ground investigation have been compared with published criteria for a defined end-use. If concentrations are below the screening criterion for a specified end-use, the parameter is deemed not to be a potential hazard and is not considered further. A concentration above the screening criterion identifies the parameter is considered as a possible hazard and indicates that either further assessment or risk management is required.

5.2 Assessment Criteria

Soil

5.2.1 The Stantec rationale for the selection of Generic Assessment Criteria (GAC) has been used for this assessment and is presented in **Appendix F**.

5.2.2 The assessment criteria for a residential end-use without plant uptake (growing of home grown produce) have been used as it is considered that this is the most appropriate for the proposed redevelopment.

5.2.3 Where the criterion for a parameter is dependent on the Soil Organic Matter (SOM) content, the vales for SOM of 1% has been used. This is considered to provide a conservative assessment in the absence of SOM analysis.

Groundwater

5.2.4 The Stantec Rationale for the Selection of Generic Assessment Criteria (GAC) has been used for this assessment and is presented in **Appendix E**.

5.2.5 The nearest surface water receptor to the Site, as identified by the Phase 1 GCA is the Ellenbrook, located approximately 900m west of the Site. The Site is located within Zone 2 of a groundwater Source Protection Zone (SPZ) likely to be associated with a groundwater abstraction borehole located approximately 1km to the south of the Site. In addition, the Site is located within a Drinking Water Safeguard Zone (DWSZ) for groundwater.

5.2.6 Given the absence of a nearby surface water receptor, and the presence of both an SPZ and a DWSG the assessment criteria for protection of Human Health (the Drinking Water Standards) have been used.

5.3 Review of Soil Chemical Testing Data

5.3.1 The laboratory certificates for the soil analyses are presented in **Appendix B** along with as table comparison to the selected criteria.

5.3.2 In summary, one sample (WS07 at 0.5m bgl) contained an elevated concentration of lead at the criteria threshold for residential end use (without home produce). In addition, a single positive identification of asbestos was found in the soils scheduled for analysis at WS06.

5.3.3 Remaining analyses did not identify any other potential contaminants above the relevant assessment criteria.

5.3.4 Of the eleven soil samples analysed, one(WS07 at 0.5m), recorded the presence of amosite asbestos. The laboratory described the recorded asbestos as 'board' and the laboratory gravimetric analysis stated that the asbestos represented 0.005% of the sample by weight.

5.3.5 Hydrocarbon odours were recorded at 1.0m depth in WS02. The samples from WS02 (recovered at 0.8m and 2.00m depth) recorded concentrations of hydrocarbons (both TPHs and PAHs) below the laboratory Limit of Detection (LOD). Similarly, hydrocarbon odours were recorded at 0.75m depth in WS06. The samples from WS06 (recovered at 0.7m and 1.9m depth) recorded concentrations of both TPHs and PAHs either less than, or only marginally excess of, the laboratory LOD.

Hydrocarbon Hazard Index

5.3.6 As described in the Stantec Methodology (**Appendix E**), calculation of the hydrocarbon Hazard Index (HI) has been undertaken. The calculated HI was well below unity (1) for a residential without home-grown produce end-use for all soil samples tested, indicating that the measured hydrocarbons as a combination do not present a significant risk of harm to human health.

5.4 Review of Groundwater Data

5.4.1 The certificates for the geoenvironmental laboratory analysis undertaken on the samples of groundwater during routine monitoring on 07/07/2020 from CP01 and CP02 are **Appendix B** and compared against the Drinking Water Standards in the Table 5.2 below.

Table 5.2 Groundwater Geoenvironmental Laboratory Analysis Summary

Determinand	Minimum Concentration	Maximum Concentration	Pass/Fail (number exceeding Drinking Water Standard)
Total Cyanide	<5	<5	PASS
Arsenic (dissolved)	<5	<5	PASS
Cadmium (dissolved)	<0.4	<0.4	PASS
Chromium (dissolved)	<5	8	PASS
Copper (dissolved)	<5	<5	PASS
Lead (dissolved)	<5	<5	PASS
Mercury (dissolved)	<0.05	0.13	PASS
Nickel (dissolved)	<5	<5	PASS
Selenium (dissolved)	<5	<5	PASS
Zinc (dissolved)	<2	<2	PASS
Total Phenols (monohydric)	<10	<10	PASS
PAHs (USEPA16 Total)[1]	<0.01	<0.01	PASS
Total TPH[2]	<140	<140	PASS
Benzene	<1	<1	PASS
Toluene	<3	<3	PASS

Determinand	Minimum Concentration	Maximum Concentration	Pass/Fail (number exceeding Drinking Water Standard)
Ethylbenzene	<5	<5	PASS
Xylenes	<10	<10	PASS
MTBE	<10	<10	PASS

1) The concentration of each individual of the USEPA16 PAHs was less than the laboratory limit of detection of 0.01µg/l.
2) The concentration of each TPHCWG band, for both aliphatic and aromatic hydrocarbons, was less than the laboratory limit of detection of 10.0µg/l.

5.4.2 As is evident from the table above, the concentrations of all CoPC were found to be below the adopted GAC for the relevant end-use.

5.4.3 It is notable that dissolved phase concentrations of hydrocarbons (either TPH or PAH) in excess of the laboratory limit of detection have not been recorded.

5.5 Review of Ground Gas Data

5.5.1 Ground gas spot monitoring has been carried out on four occasions, as described in **Section 3.4.5** above, with some monitoring events particularly targeted to correspond with low and falling atmospheric pressure conditions. Falling atmospheric pressure is associated with gas migration potential as it causes gas to expand and come out of the ground. However, this is only likely to occur where there are open pathways in the ground and not for soils with low permeability (Card et al, 2019a). Monitoring has been undertaken on the following occasions:

- 20/03/2020 – 1009 millibar (mb), wider trend of static pressure
- 07/07/2020 – 1001 mb, wider trend of falling pressure
- 14/07/2020 – 998 mb, wider trend of static pressure
- 21/07/2020 – 1023mb, wider trend of falling pressure

5.5.2 Given the data above, and considering the potential for ground gas generation and lack of relevant sources in proximity to the Site, it is considered that the gas monitoring carried out to date is sufficient to enable a suitable assessment of the ground gas regime at the Site and the requirements for mitigation measures for the proposed development. It is worth noting that no sources of organic matter were observed in the exploratory hole arisings during the ground investigation.

5.5.3 Negative gas flow rates were recorded in boreholes WS01 and WS02. Negative gas flow rates are often associated with pressures in the ground being below that of atmospheric pressure (typical for ground with limited permeability and negligible gas generation) resulting in a flow into the borehole and a negative gas flow rate.

5.5.4 The steady-state concentrations of ground gases and ground gas flow rates measured in the gas monitoring wells installed in the boreholes are summarised in the following table.

Table 5.2 Summary of Ground Gas Monitoring Information

Exploratory Hole	Flow (l/hr)	Carbon Dioxide* (%v/v)	Oxygen** (%v/v)	Methane* (%v/v)
CP01	<0.1	3.2	12.2	<0.1
CP02	<0.1	3.7	13.8	<0.1
WS01	-0.4 to 0.1	2.7	15.5	<0.1
WS02	-0.4 to 0.1	2.0	16.2	<0.1
WS04	<0.1	3.9	14.3	<0.1
WS05	<0.1	1.3	16.8	<0.1
WS06	<0.1	1.9	15.6	<0.1

** Maximum measured steady-state value.*
*** Minimum measured steady-state value.*

Calculation of Gas Screening Values

5.5.5 Using the procedure for classifying gassing sites proposed by BS 8485:2015 + A1:2019, Gas Screening Values (GSVs) have been calculated for both carbon dioxide and methane for each monitoring visit to each borehole.

5.5.6 For the purposes of the assessment below, a gas concentration of less than the LOD of the monitoring instrument is treated as 100 per cent of the LOD (i.e. 0.1%v/v).

5.5.7 Negligible steady-state gas flow rates have been recorded during the monitoring visits. For the purposes of the assessment below, a flow rate of less than the LOD is treated as 100 per cent of the LOD (i.e. 0.1 L/hr). As described in BS8484:2015 + A1:2019 where a negative flow rate has been recorded, it has been assessed as a positive flow rate of the same magnitude.

5.5.8 The calculated GSVs range from 0.0001 to 0.0039 L/hr for carbon dioxide and from 0.0001 to 0.0004 L/hr for methane. These GSVs correspond to a very low hazard potential and a site classification of Characteristic Situation (CS) 1 as per Table 2 of BS 8485. The GSV limit between CS 1 and CS 2 is 0.07 L/hr.

5.5.9 As advocated by BS8485, further assessment has been undertaken using the highest flow rates and gas concentrations recorded within each borehole whereon the calculated GSVs range from 0.0001 to 0.0108 L/hr (CS1) for carbon dioxide and from 0.0001 to 0.0004 L/hr (CS1) for methane (CS1).

5.5.10 Finally, as also advocated by BS8485, a ‘worst-case’ check has been undertaken using the highest flow rates and gas concentrations recorded across all monitoring visits combined and in any borehole across all monitoring visits combined. The calculated GSVs are 0.0156 L/hr (CS1) for carbon dioxide and 0.0004 L/hr (CS1) for methane (CS1).

5.5.11 On the basis of the above, it is concluded that a classification of CS1 is appropriate and ground gas protection measures are therefore not required.

5.5.12 It should be noted that the ground floor of the development is proposed to be undercroft parking, further negating the risk presented by the potential ingress of ground gases and vapours.

6 Tier 2 Generic Quantitative Risk Assessment

6.1 Hazard Classification

6.1.1 Using Stantec's Methodology (**Appendix E**), the historical context of the Site as described in the Phase 1 GCA, the ground conditions encountered during the GI, and the results of the associated laboratory analyses, the potential for significant contamination to be present at the Site has been assessed to be **Low** (2). As described in Table 1 of the Methodology, a classification of **Low** describes a Site with the potential for "locally slightly elevated concentrations".

6.1.2 Whilst it is recognised that the GI did not reveal the presence of elevated concentrations of potential contaminants, it is also recognised that there are numerous USTs and fuel distribution pipework at the Site which it has not been possible to investigate and therefore there is potential for contamination associated with USTs to be present. Contamination may also be present beneath the existing buildings which have likewise not been investigated due to the ongoing use of the Site as a van dealership.

6.2 Potential Receptors & Sensitivity Score

6.2.1 As described in the Phase 1 GCA, the receptors considered as part of this land contamination assessment are summarised in the table below. Sensitivity scores are allocated in accordance with the Stantec Methodology (**Appendix E**) with a score of 5 being the highest, most sensitive category and a score of 1 being the lowest. The sensitivity score informs the consequence element of the risk estimation process.

Table 6.1 Potential Receptors and Sensitivity Score

Receptor Type	Comment	Sensitivity Score
Human Health – On-site Current Users	Staff and customers of van dealership	4
Human Health – On-site future Users	Residents of proposed buildings	5
Human Health –Construction	Anticipated construction workers, future maintenance workers	4
Human Health - Neighbours	Residents of nearby residential properties	5
Groundwater	Superficial Deposits - Secondary Undifferentiated Aquifer Chalk Bedrock – Principal Aquifer in SPZ 2	1 4
Surface Water	Eliminated – Surface water features in the vicinity of the Site have not been identified	Eliminated
Property - Buildings	Existing van dealership, Proposed multi-storey residential structures with basement.	1
Property - Animal or Crop Effect	Receptor not identified	Eliminated
Ecological Systems	Designated sites are not present in the vicinity of the Site.	Eliminated

6.3 Potential Exposure Pathways

6.3.1 The Stantec methodology (**Appendix E**) Table 2 describes possible exposure pathways for each receptor type. Each of these possible pathways is then identified as viable or not when assessing the probability of the source of contamination causing a consequence to a defined receptor.

6.4 Risk Estimation

6.4.1 When there is a pollutant linkage (and therefore some measure of risk) it is necessary to determine whether the risk is significant and therefore whether further action is required.

6.4.2 Risk estimation involves predicting the likely consequence (what degree of harm might result) and the probability that the consequences will arise (how likely the outcome is).

6.4.3 Based on the information available, the estimated risks have been designated with further comments in the sections below.

6.4.4 A summary of the estimated risks is presented in the table below.

Table 6.2 Worst-Case Risk Estimation

Receptor	Risk Estimation
Human Health (On-site Current Users)	Very Low
Human Health (On-site Future Users)	Low
Human Health –Construction	Low
Human Health - Neighbours	Very Low
Groundwater – Shallow superficial aquifer	Very Low
Groundwater – Deep bedrock aquifer	Low
Surface Water	Eliminated
Property - Buildings	Very Low
Property (Animal/Crop)	Eliminated
Ecological Systems	Eliminated

6.5 Risk Evaluation

6.5.1 Possible pollutant linkages are determined using professional judgement. If a linkage is considered plausible with some associated risk, even if estimated to be Low, it is considered that this represents a potentially 'unacceptable risk' and therefore requires further consideration. Risk reduction can be achieved through implementation of remediation or mitigation measures or through further tiers of assessment following collection of Site-specific data.

6.5.2 In absence of any mitigation, possible pollutant linkages have been identified for human health, controlled water and building, albeit the level of risk from on-Site sources is **Very Low** to **Low**.

6.6 Data Gaps and Uncertainty

6.6.1 There are numerous USTs and areas of fuel distribution pipework which it has not been possible to investigate and therefore there is potential for contamination associated with this infrastructure to be present.

6.6.2 Contamination may also be present beneath the existing buildings which have likewise not been investigated due to the ongoing use of the Site as a van dealership.

7 Outline Remediation Strategy

7.1 Introduction

7.1.1 The technical options for risk management include one or more of the following: -

- Modification of the source – remediation as treatment of soil and/or groundwater or removal of point sources such as USTs;
- Modification of the exposure pathway – referred to as mitigation measures; and,
- Modification of the receptor – changes to the nature or location of the end-use.

7.1.2 The preferred option is therefore to manage exposure pathways. It should be noted that changes to the nature of the end use and layout of the development could affect the approaches in the outline remedial strategy.

7.2 Removal of USTs

7.2.1 Whilst the management of exposure pathways is typically preferred, it will be necessary to remove the USTs at the Site to facilitate the construction of the proposed development.

7.2.2 At the same time as the tank removal it will also be necessary to remove any associated fuel lines or off-set fill points associated with the distribution infrastructure. Care should be taken to ensure these fuel lines do not contain any residual fuel that could result in spillage when they are removed.

7.2.3 The removal of sludges, liquids and gases should be undertaken in-situ if possible and in a manner to minimize the potential for spillage during tank emptying. Any movement of the tank prior to emptying must be undertaken in a manner which does not compromise the integrity of the tank and to prevent uncontrolled release during removal and transit. Removed tanks/distribution lines should be stored in a bunded area pending testing and off-site disposal to a licenced waste management facility

7.2.4 Any concrete or foam used to fill the tanks should also be removed by the breaking open of the tanks and this should be disposed of by a licensed haulier in a controlled manner; it is likely that these material wills be contaminated, so any on-site stockpiling of these materials should be avoided. It is preferential to have these contaminated materials immediately removed from the Site.

7.2.5 Once the tanks and any fill materials have been removed the concrete tank cradles should be broken out and removed so that any residual contamination in the resultant excavation can be inspected and assessed.

7.2.6 The excavation perimeter should be surveyed or measured in to known on-site benchmarks and recorded on a site plan.

7.2.7 Prior to backfilling of the excavation, validation sampling will be required to ensure that any contaminated soils surrounding the tanks and distribution pipework have been removed.

7.2.8 Excavations shall only be backfilled where they are free from water and other liquids and following removal of free phase hydrocarbon impacted soils.

7.3 Unexpected Ground Conditions

7.3.1 If any unusual solid materials or liquids are encountered during the construction works in previously unidentified areas of potential contamination, they will be dealt with in line with an agreed protocol.

7.3.2 Soil will either be sampled in-situ in the ground by a suitably experienced geoenvironmental engineer (and left undisturbed while the samples are tested and the results interpreted) or excavated and stockpiled in an appropriate manner while verification testing for potential contamination is carried out. The storage area will be designed to ensure that contamination does not migrate and affect other areas of the Site. Where remediation of unidentified sources of contamination is required, a remediation/mitigation strategy and verification plan will be prepared and agreed with the Local Planning Authority before implementation.

7.4 Legislative Compliance and Permits/Licenses

7.4.1 The Principal Contractor (PC) will have responsibility for ensuring legislative compliance and obtaining all permits/licenses as required. The following are highlighted but should not be considered the only aspects to addressed.

Control of Asbestos Regulations (CAR) 2012

7.4.2 The PC will undertake a risk assessment to determine whether or not the works are required to comply with CAR.

Soil Excavation – Re-Use and Disposal

7.4.3 If it is intended to re-use excavated arisings then the PC will need to undertake an assessment regarding suitability and demonstrate that the material is not a waste using the Definition of Waste: Development Industry Code of Practice (CL:AIRE, 2011). The Code of Practice sets out good practice for the development industry to use when assessing whether excavated materials are classified as waste or not. It also allows the determination, on a Site-specific basis, when treated excavated waste can cease to be waste for a particular use. Further it describes an auditable system to demonstrate that this Code of Practice has been adhered to.

7.4.4 Off-Site disposal of arisings will require compliance with the Waste Duty of Care Code of Practice March 2016 which requires the following:

- Prevent unauthorised or harmful deposit, treatment or disposal of waste.
- Prevent a breach (failure) by any other person to meet the requirement to have an environmental permit, or a breach of a permit condition.
- Prevent the escape of waste from your control.
- Ensure that any person you transfer the waste to has the correct authorisation, and
- Provide an accurate written description of the waste when it is transferred to another person. For controlled waste that is classified as ‘non-hazardous’ this will require a waste transfer note and for waste classified as ‘hazardous’ this will require a consignment note. In both cases the record will require a waste code and classification.

7.4.5 Failure to comply with the duty of care requirements is a criminal offence and could lead to prosecution.

7.5 Protection of Human Health – End User

Ingestion

7.5.1 Reference will be required to be made to the relevant water company to assess whether the water supply pipework is required to be provided via barrier pipe, suitable to prevent ingress of hydrocarbons, following identification of the route of the pipework and completion of relevant testing along the route.

Direct Contact / Inhalation (Asbestos)

7.5.2 Areas of external landscaping will have a minimum of 600mm of suitable imported soil overlying a suitable geotextile no-dig membrane to prevent potential release of asbestos fibres.

7.5.3 The implementation of these mitigation measures will reduce the risk to future residents and to future maintenance workers to **Very Low**.

7.6 Protection of Human Health – Construction/Maintenance Worker

7.6.1 During the construction phase, mitigation measures to limit the risk to site workers from any potential contaminants in the ground will be implemented. Specification of appropriate measures will be the responsibility of the Principle Contractor.

7.6.2 There are considered to be readily available solutions for the management of the exposure pathways including: -

- Informing the site workers of potential contamination on the Site and the potential health effects from exposure through site induction and 'tool box talks';
- Methods of dust control and selection of appropriate methods of working to limit the potential for air-borne dust to arise associated with the excavation and disturbance of the soils present on the Site
- Operational good practice (PPE, hygiene facilities, safe methods of work).

7.6.3 Service trenches will have a marker membrane beneath to identify the presence of contaminated ground below.

7.6.4 The implementation of these mitigation measures will reduce the risk to construction workers to **Very Low**.

7.7 Protection of Property – Buildings

7.7.1 The design will incorporate specification of construction materials to mitigate aggressive ground conditions. For mobile groundwater conditions, the values correspond to Design Sulphate Class DS-1 and ACEC Class AC-1 as defined by BRE (2005). The recommendations of BRE (2005) should be followed in the design of mixes for buried concrete for the classifications given. Section 8 below provides further details in this regard.

7.7.2 See **Section 7.5.1** regarding the type of material for the water supply pipes.

7.8 Protection of Controlled Waters

7.8.1 USTs and associated contaminated soil and groundwater will be removed from the Site as discussed in Section 7.2 above.

7.8.2 In addition, pile design will need to minimise the potential for creation of preferential pathways and will likely require a Piling Risk Assessment to be approved by the Environment Agency.

7.8.3 The implementation of these mitigation measures will reduce the risk to construction workers to Very Low.

8 Geotechnical Engineering Assessment

8.1 Proposed Development

8.1.1 The proposed development of the Site entails the construction of residential units in a single building of between two and six storeys high with undercroft parking and associated infrastructure.

8.1.2 The conclusions and recommendations of this assessment should be reviewed upon receipt of the remainder of the groundwater monitoring data.

8.2 Potential for Natural Solution Feature Hazards

8.2.1 The surface level of the chalk appears to vary from about 54.33m OD (CP01) to 56.73m OD (CP02) and this has the potential to vary by several metres in level depending upon the severity of past glacial erosion which can include channelling into the surface. However, comparison of these chalk levels with the typical karstic Lambeth Group/Chalk interface level locally (within a kilometre or so) suggests that below the Site the chalk has been deeply eroded to circa 40m or so below the former interface level. On this basis it would be expected that typical karstic features like dissolution pipes will have been removed by the glacial erosion process. Consequently, the potential for dissolution features in the chalk surface to exist below the Site is now considered to be a **Low hazard**.

8.2.2 However, glacial meltwater can be rich in CO_2 making it aggressive and able to dissolve the chalk as it drains through the stratum along bedding and joint planes thereby increasing the potential for solution cavities to be formed at depth within the chalk rockhead. For this reason, it is considered that such features pose a **Moderate** hazard to foundations (e.g. piles) reliant upon the stable support of the chalk.

8.3 Geotechnical Design Parameters

8.3.1 Recommended characteristic values of parameters for geotechnical design, as determined from consideration of the results of in-situ and laboratory geotechnical testing carried out on soil samples recovered during the ground investigation and consideration of published data and correlations with index properties, are discussed in Section 4 of this report and are summarised in the following table.

Table 8.1 Summary of Recommended Characteristic Values

Formation	Bulk Unit Weight (kN/m^3)	Undrained Shear Strength (kPa)	Effective Friction Angle (degrees)
Made Ground Cohesive Made Ground Granular	18 17	45 -	28 34
Lowestoft Formation Upper cohesive	18	45	28
Lowestoft Formation Granular	18	-	34
Lowestoft Formation Lower cohesive	19 at 67m OD increasing linearly to 21 at 60m OD	100 at 67m OD increasing linearly to 175 at 60m OD	25
Kesgrave Catchment Subgroup Granular	19	-	34
Lewes Nodular Chalk Formation	19	-	33

8.3.2 Bulk unit weight for the cohesive soils is based on the soil description and the recommendations of BS8004 (2015).

8.3.3 Bulk unit weight for the cohesive soils is based on the soil description and relative density (from SPT N_{60}) values and the recommendations of BS8004 (2015).

8.3.4 Bulk unit weight of the chalk is based on the soil description and published data from C574.

8.3.5 The undrained cohesion (C_u) for the Lowestoft Formation upper cohesive soils is conservative and reflects the variability of the deposit in terms of its described consistency and SPT N_{60} values.

8.3.6 The undrained cohesion (C_u) for the Lowestoft Formation lower cohesive soils was derived from SPT N_{60} values using the method proposed by Stroud (1974). In this case $C_u = N_1 \times N_{60}$. Where $N_1 = 5$, based on the mean soil plasticity of 24%. The values recommended are conservative and used the lower bound SPT N_{60} values.

8.3.7 Effective friction angle in the cohesive soils were derived from consideration of the correlation with plasticity index (BS 8004, 2015) and the visual description of the material.

8.3.8 Effective friction angle in the granular soil were derived from the SPT N_{60} values, soil grading and particle angularity and the recommendations of BS 8004 (2015).

8.3.9 Effective friction angle from the chalk is based on published data from CIRIA C574.

8.3.10 Effective cohesion c' is recommended to be zero in all strata.

8.4 Site Preparation

Excavation Works

8.4.1 The near-surface soils typically comprise cohesive and granular Made Ground overlying natural clays and natural sands. Excavation though these materials should generally be possible with conventional earth moving plant, however, breakers are likely to be required to excavate through the foundations and concrete slabs present at depth in the Made Ground locally.

Stability of Excavations

8.4.2 The ground investigation has recorded soft to firm clay and granular Made Ground overlying soft to firm natural clays soil over natural loose to medium dense granular soils. Shallow groundwater was not encountered. Unsupported shallow excavations may remain stable for short periods and deeper excavations are likely to require full side support to remain stable.

Groundwater Control

8.4.3 Sump pumping techniques will likely be suitable to control any perched groundwater that is encountered above the water table in the shallow Made Ground or natural soils.

8.4.4 Deep excavations below the water table (if required) will likely require groundwater control and full side support. Any excavations at depth below the water table on this urban Site should be engineer designed because ground movements around the excavation due to stress relief or groundwater lowering could damage surrounding structures.

8.5 Foundations

8.5.1 A piled foundation solution is considered to be the most appropriate for the ground conditions and the building proposed. This is due to the load that will be imposed on the ground from the

up to 6 storey building and the presence of Made Ground up to 1.7m thick and the relatively low undrained shears strength of the near surface Lowestoft Formation.

8.5.2 Other foundations solutions such as vibro stone columns or vibro concrete columns are unlikely to be appropriate at this Site due to the potential for the vibrations during column construction to cause structural damage to nearby off-site structures.

8.5.3 The clays of the Lowestoft Formation should provide stable strata in which friction piles could be employed. The granular strata of the Lowestoft Formation and the Kesgrave Catchment Subgroup would also be suitable but would provide lower shaft resistance than cohesive soils. The chalk at depth would also provide a good stratum to provide shaft resistance for friction piles.

8.5.4 Given the ground conditions present and the urban setting, in which vibration and noise may be constraints, it is likely that a bored pile solution may be most suitable. Pile design may be based on the characteristic parameters given in **Table 8.1** and should take account of the recommendations of BS8004:2015 generally and CIRIA reports C754 (2002) and PR86 (2003) where the piles penetrate the chalk. As noted in C574, where there is potential for solution cavities to exist at depth in the chalk, the load carrying capacity of the pile should be designed to be supported entirely by the shaft friction, ignoring end-bearing support in case of upward void migration from depth in the chalk.

8.5.5 The actual resistance of a pile will be dependent on pile type and the method of installation used as well as ground conditions. Specialist piling contractors should be contacted to determine the sizes and types of pile they recommend for the ground conditions, foundation loadings and structural and settlement tolerances appropriate to the building. If groups of piles are required the minimum spacing between the centres of the piles in a group should not be less than three pile diameters. Pile integrity and load testing should be carried out to confirm the design and workmanship.

8.5.6 Potential constraints to piling will be the in-ground structures such as tanks and the buried foundations or slabs that prevented progress of some of the exploratory holes.

8.5.7 The design of piled foundations may be based on the following ground model:

- Made Ground to 74.75m AOD.
- Lowestoft Formation (upper cohesive) to 73.5m AOD.
- Lowestoft Formation (granular) to 66.5m AOD.
- Groundwater at 62.5m AOD.
- Lowestoft Formation (lower cohesive) to 60.0m AOD.
- Kesgrave Catchment Subgroup (granular) to 54.0m AOD.
- Chalk from 54.0m AOD.

8.5.8 Pile design in chalk is based on the overburden pressure and SPT N_{60} values. The following SPT N_{60} profile may be used for pile design in the chalk:

- Constant SPT N of 25 to 49.0m AOD.
- SPT N increasing from 25 at 59.0m AOD linearly to 40 at 46.0m AOD.

8.5.9 The recommended N_{60} values are conservative to take account of the variability in the recorded N values (see **Figure 4.2**).

8.5.10 Potential constraints to the use of piled foundations will be in-ground obstructions as follows:

- Foundations and floor slabs of the existing and former buildings remining after demolition of the Site;
- Underground fuel storage tanks (refer to Phase 1 desk study for location plans); and,
- Drainage runs and fuel tank delivery pipework.

8.5.11 These will need to be carefully removed and the resultant voids backfilled before piling commences.

8.6 Pavement Design

8.6.1 The ground investigation indicates that pavements are likely to be founded on Made Ground or natural cohesive strata.

8.6.2 For natural cohesive soil at subgrade level the California Bearing Ratio (CBR) value used for preliminary design may be derived from plasticity index testing of soil samples (DMRB, 2009 - Table 5.1). For preliminary design purposes the measured mean plasticity indices of the near surface cohesive Lowestoft Formation soils present would equate to an equilibrium CBR value of 4%, assuming a thick pavement construction.

8.6.3 A CBR of <2% may be assumed for the Made Ground.

8.6.4 Pavements carried on a suitable depth of capping/sub-base should prove adequate provided the exposed deposits are compacted by a heavy smooth wheeled roller and any soft or degradable materials removed and replaced with compacted granular fill.

8.6.5 Potential constraints to the performance of completed pavements will be hard spots such as foundations or slabs remaining in the ground near surface or deep areas of Made Ground.

8.6.6 All formations will likely deteriorate rapidly in inclement weather conditions and appropriate construction practice should be adopted with all formations exposed only for the minimum time period.

8.7 Aggressiveness of the Ground

Chemical Attack on Buried Concrete

8.7.1 pH values recorded in the natural soils range from 6.9 to 7.2 and concentrations of water soluble sulphate ranged from <0.01 to 0.28g/l. These results suggest no elevated levels of sulphate and equate to a Design Sulphate Class of DS1 and ACEC Class of AC-1^{d} (assuming mobile groundwater) according to Table C1 of BRE SD1.

9 Conclusions

9.1 Ground Conditions

9.1.1 The ground conditions encountered beneath the Site are summarised as follows:

Formation	Description	Base Depth Range (bgl)	Thickness (m)
Made Ground	Asphalt or concrete surfacing between 0.1m and 0.2m thick, overlying either sand gravelly clay or granular materials with varying fines contents	0.25m to 1.70m	0.25 to 1.70
Lowestoft Formation	Upper layer of soft to firm yellowish brown slightly sandy slightly gravelly clay	1.90m to 2.60m	0.75 to 2.10
	Central layer of yellow to reddish brown variably gravelly clayey sands or very sandy slightly silty subrounded to rounded gravel	8.80m to 9.30m	
	Lower layer of stiff dark grey slightly gravelly slightly sandy silty clay.	16.10m to 16.40m	
Kesgrave Catchment Group	Orangish brown variably clayey sands and gravels	19.20m to 21.80m	3.10 to 5.40
Lewes Nodular Chalk Formation	White chalk	Proved to 30.0m	Proved to 10.8

9.1.2 Groundwater has been recorded at depth resting within the clay layer of the Lowestoft Formation, however it considered that the groundwater levels recorded indicate the presence of a sub-artesian groundwater table within the Kesgrave Subcatchment Group immediately beneath the Lowestoft Formation, where it is confined from rising upwards by the presence of the cohesive clay layer at the base of the Lowestoft Formation.

9.1.3 The potential for dissolution features in the chalk surface to exist below the Site is considered to be a Low hazard.

9.1.4 The potential for solution cavities to be formed at depth within the chalk rockhead is considered to be a Moderately High hazard to foundations (e.g. piles) that are reliant upon the stable support of the chalk.

9.1.5 Shallow foundations bearing in the upper cohesive Lowestoft Formation can be expected to achieve a presumed bearing value of 75 kN/m^2.

9.1.6 Shallow foundations bearing in the granular Lowestoft Formation can be expected to achieve a presumed bearing value of 120 kN/m^2 when a 1m wide foundation is employed.

9.1.7 The ground conditions are suitable for the use of piled foundations, however, in-ground structures such as former foundations, floor slabs and tanks etc. will need to be completely removed to prevent obstructions to piling. The potential presence of unrecorded in-ground features should not be ruled out.

9.1.8 There is a potential for solution cavities to exist at depth in the chalk and therefore it is recommended that the load carrying capacity of the piles should be designed to be supported entirely by the shaft friction, ignoring end-bearing support in case of upward void migration from depth in the chalk.

9.2 Geoenvironmental Conditions

9.2.1 Hydrocarbon odours were noted at shallow depth in two locations, one of which was located in the vicinity of the existing USTs. Only marginally elevated total VOC readings were encountered in the arisings as measured in the field using a PID.

9.2.2 Concentrations of Contaminants of Potential Concern (CoPC) have not been recorded in excess of the adopted Generic Assessment Criteria for a residential end-use without private gardens (soils) or drinking water (groundwater).

9.2.3 Potential Asbestos Containing Materials (ACMs) were not visually noted within any of the exploratory holes, however amosite asbestos board was recorded by the laboratory within one sample.

9.2.4 The Site remained as an active dealership at the time of the ground investigation and as such it has only been possible to fully investigate the external or the internal areas of the Site. This being the case, there remains potential for contamination to be present beneath these areas, and also in the immediate vicinity of the USTs and fuel distribution pipework.

9.3 Tier 2 Geoenvironmental Risk Assessment

9.3.1 The Conceptual Site Model derived for the Site in the Phase 1 GCA has been refined using the findings of the recent ground investigation and a Tier 2 geoenvironmental risk assessment has been undertaken.

9.3.2 Potential pollutant linkages have been identified and the potential for Site-wide contamination to be present on-Site based on its past and present use has been assessed as being **Low**. On this basis, the estimated risks to human health and groundwater without implementation of appropriate remediation or mitigation are assessed as **Very Low** to **Low**.

9.3.3 It is considered unlikely that the Site would be designated statutory contaminated land under Part 2A of the Environmental Protection Act 1990.

9.4 Ground Gas Risk Assessment

9.4.1 Four ground gas monitoring visits have been undertaken and are considered to provide a representative view of the ground gas regime at the Site considering the lack of potential sources of ground gas in the vicinity of the Site.

9.4.2 A ground gas risk assessment has been undertaken and the Site has been classified as Characteristic Situation 1, meaning that ground gas protection measures are not required. The proposed construction of undercroft parking at ground floor level further negates potential risk associated with ground gases or vapours.

9.5 Outline Remediation Strategy

9.5.1 An outline remediation strategy has been prepared and comprises the following:

- Removal of USTs and fuel distribution pipework
- An outline protocol for the management of unexpected contamination

- Legislative compliance and permits/licences in relation to the Control of Asbestos Regulations 2012 and to re-use and disposal of soils

- The protection of human health by the use of a 600mm thick clean-cover system in landscaped areas, the use of barrier pipe for water supply and the incorporation of protective measures for future construction workers

- Protection of buildings by the use of appropriate construction materials where aggressive ground conditions may be present

- The protection of controlled waters through the removal of USTs and fuel distribution pipework, and through the use of appropriate pile design to minimise the potential for creation of preferential pathways to the deep Kesgrave/Chalk aquifers

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11 Essential Guidance for Report Readers

This report has been prepared within an agreed timeframe and to an agreed budget that will necessarily apply some constraints on its content and usage. The remarks below are presented to assist the reader in understanding the context of this report and any general limitations or constraints. If there are any specific limitations and constraints, they are described in the report text.

The opinions and recommendations expressed in this report are based on statute, guidance, and best practice current at the time of its publication. Stantec UK Ltd (Stantec) does not accept any liability whatsoever for the consequences of any future legislative changes or the release of subsequent guidance documentation, etc. Such changes may render some of the opinions and advice in this report inappropriate or incorrect and the report should be returned to us and reassessed if required for re-use after one year from date of publication. Following delivery of the report, Stantec has no obligation to advise the Client or any other party of such changes or their repercussions.

Some of the conclusions in this report may be based on third-party data. No guarantee can be given for the accuracy or completeness of any of the third-party data used.

Historical maps and aerial photographs provide a “snapshot” in time about conditions or activities at the site and cannot be relied upon as indicators of any events or activities that may have taken place at other times. It is possible for developments to have occurred between surveys that are not shown or for the map record to have been censored for military security.

The absence of cavity records in the Stantec natural and mining cavities (non-coal) databases is not considered as conclusive as to the absence of these features and we do not warranty that the data is complete or error free.

The conclusions and recommendations made in this report and the opinions expressed are based on the information reviewed and/or the ground conditions encountered in exploratory holes and the results of any field or laboratory testing undertaken. There may be ground conditions at the site that have not been disclosed by the information reviewed or by the investigative work undertaken. Such undisclosed conditions cannot be considered in any analysis and reporting.

It should be noted that this report is a land condition assessment and does not purport to be an ecological, flood risk or archaeological survey and additional specific surveys may be required.

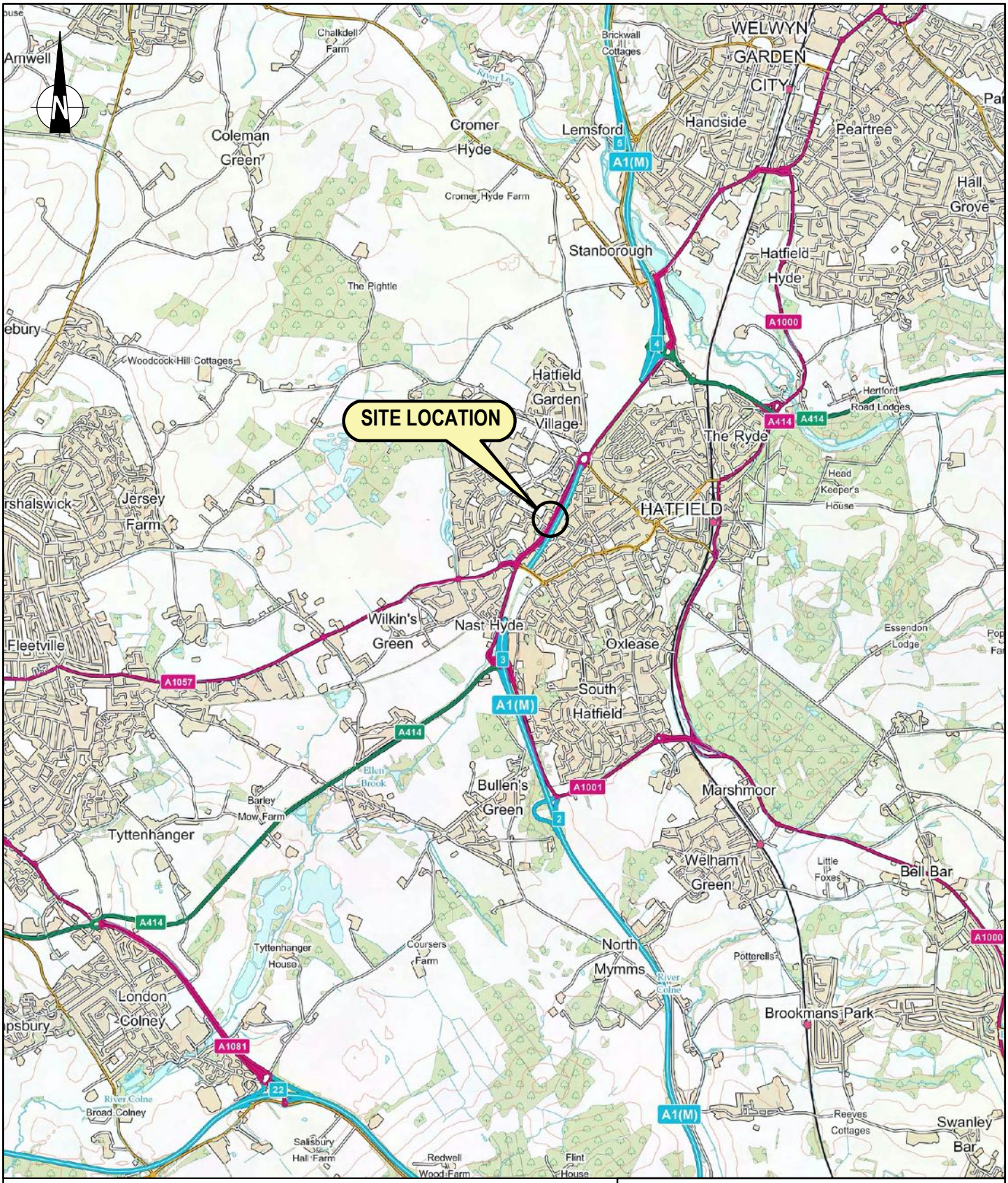
The identification of invasive and/or noxious plants such as Japanese Knotweed is outside the remit of our appointment.

This report has been written for the sole use of the Client stated at the front of the report in relation to a specific development or scheme. The conclusions and recommendations presented herein are only relevant to the scheme or the phase of project under consideration. This report shall not be relied upon or transferred to any other party without the expressed written authorisation of Stantec. Any such party relies upon the report at its own risk.

The interpretation carried out in this report is based on scientific and engineering appraisal carried out by suitably experienced and qualified technical consultants based on the scope of our engagement. We have not considered the perceptions of, for example, banks, insurers, other funders, lay people, etc., unless the report has been prepared specifically for that purpose. Advice from other specialists may be required such as the legal, planning and architecture professions, whether specifically recommended in our report or not.

Public or legal consultations or enquiries, or consultation with any Regulatory Bodies (such as the Environment Agency, Natural England or Local Authority) have taken place only as part of this work where specifically stated.

Figures



0 1000 2000

metres

Site Grid Ref: TL 216 087

COMET WAY, HATFIELD

SITE LAYOUT PLAN

Client

COMET WAY HATFIELD LIMITED

Date of 1st Issue: 16.03.2020	Drawn by: davco
A4 Scale: 1:500	Checked by: CR
Figure Number: 1	

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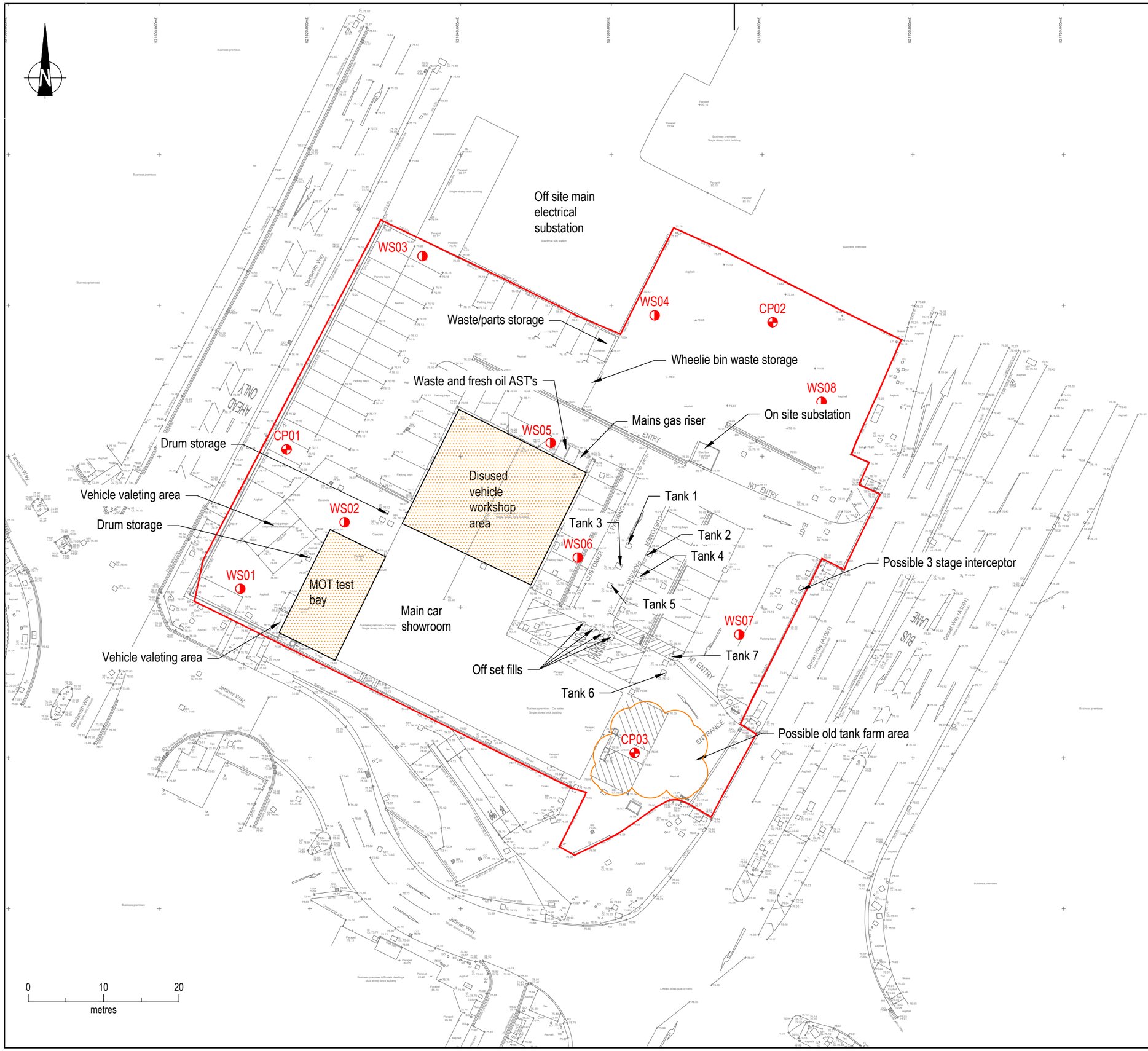

LEGEND

- APPROXIMATE SITE BOUNDARY
- BOREHOLE LOCATION
- WINDOW SAMPLE LOCATION

Note:
CP03 and WS07 were terminated early due to concrete obstruction.

COMET WAY, HATFIELD

BOREHOLE LOCATION AND SITE LAYOUT

Client
COMET WAY HATFIELD LIMITED

Date of 1st Issue	Drawn by
05.03.2020	davco
A3 Scale	Checked by
1:500	CR
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2	

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Appendix A Exploratory Hole Records

Project Name	Project No:		BOREHOLE
Comet Way, Hatfield	**47179**	Stantec	**CP01**
Client	Start Date / End Date		
Comet Way Hatfield Ltd	**09/03/2020** **09/03/2020**		
Contractor	Ground Level		
A Wescott	**76.13m OD**		
Method/Plant	Coordinates	Logged By: **CR**	Sheet 1 of 3
Dando 2000	**521617 E** **208781 N**	Checked By:	Scale 1:50

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
						(0.10)	76.03	Macadam	
						0.10			
						(0.20)		[MADE GROUND]	
						0.30	75.83	Dark brown clayey very gravelly SAND. Gravel is sub angular brick, concrete, asphalt and flint with regular cobbles.	
	0.50	PID	0 ppmv					[MADE GROUND]	
	0.60	D1							
1	1.00	PID	0 ppmv					Soft to firm brown very sandy slightly gravelly CLAY becoming firmer and increasing gravel content with depth.	
	1.20	S	N=7						
		B2				(2.00)			
	1.50	PID	0 ppmv					[LOWESTOFT FORMATION]	
2	2.00	C	N=18						
		PID	0 ppmv						
	2.10	D3				2.30	73.83		
	2.30	B4				(0.30)		Medium dense grey silty clayey GRAVEL. Gravel is sub rounded flint and chalk.	
	2.50	PID	1 ppmv			2.60	73.53	[LOWESTOFT FORMATION]	
3	3.00	C	N=21					Medium dense brown SAND AND GRAVELS of flint becoming denser at depth.	
		PID	0 ppmv					[LOWESTOFT FORMATION]	
	3.10	B5							
						(2.10)			
4	4.10	C	N=17						
	4.30	D6							
						4.70	71.43	Loose brown SAND AND GRAVELS of subrounded flint.	
5	5.10	C	N=7						
	5.20	D7							
6	6.10	D8				(2.80)			
	6.50	C	N=7						
7	7.00	B9							
						7.50	68.63	Medium dense brown SAND AND GRAVELS of flint becoming denser at depth.	
8	8.10	C	N=34			(1.30)			
	8.30	D10							
						8.80	67.33	Firm grey blue very sandy clayey SILT with traces of flint and chalk gravel.	
9	9.00	D11						[LOWESTOFT FORMATION]	
	9.50	S	N=15						
	9.70	B12							
10									

General Remarks

Scanned and cleared of services by EDI prior to drilling. Location cored and broken out. Hand pits dug to 1.2m. Hole drilled to 30m. Groundwater encountered at 16.1m. Monitoring well installed to 20m with gas bung and flush cover.

Boring Progress			Water Strike			Chiselling		
Date/Time	Depth	Cas. Depth	Strike	Time (mins)	Rose To	From	To	Duration
			16.40	20	16.20			

Project Name	Project No:		BOREHOLE
Comet Way, Hatfield	**47179**	Stantec	**CP01**
Client	Start Date / End Date		
Comet Way Hatfield Ltd	**09/03/2020** **09/03/2020**		
Contractor	Ground Level		
A Wescott	**76.13m OD**		
Method/Plant	Coordinates	Logged By: **CR**	Sheet 2 of 3
Dando 2000	**521617 E** **208781 N**	Checked By:	Scale 1:50

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
								Firm grey blue very sandy clayey SILT with traces of flint and chalk gravel. [LOWESTOFT FORMATION]	
11	11.10	S	N=20						
	11.40	D13				(4.50)			
12	12.10	D14							
	12.50	S	N=20						
13						13.30	62.83		
	13.50	D15						Stiff grey silty gravelly CLAY. Gravel is rounded Chalk. [LOWESTOFT FORMATION]	
	13.90	U16	Ublow=46						
14	14.40	D17				(2.60)			
15	15.10	D18							
	15.40	S	N=43						
	15.50	B19							
						15.90	60.23		
16	16.20	D20		▼		(0.50)		Firm brown silty gravelly CLAY. Gravel is rounded Chalk. [LOWESTOFT FORMATION]	
				▽		16.40	59.73		
	16.60	C	N=31					Medium dense to dense flint GRAVEL and coarse SAND. [KESGRAVE SUBCATCHMENT GROUP]	
	16.80	B21							
17									
18	18.10	C	N=21			(5.40)			
	18.30	D22							
19									
	19.40	C	N=14						
	19.50	D23							
20									

General Remarks

Scanned and cleared of services by EDI prior to drilling. Location cored and broken out. Hand pits dug to 1.2m. Hole drilled to 30m. Groundwater encountered at 16.1m. Monitoring well installed to 20m with gas bung and flush cover.

Boring Progress			Water Strike			Chiselling		
Date/Time	Depth	Cas. Depth	Strike	Time (mins)	Rose To	From	To	Duration
			16.40	20	16.20			

Project Name	Project No:		BOREHOLE
Comet Way, Hatfield	**47179**	Stantec	**CP01**
Client	Start Date / End Date		
Comet Way Hatfield Ltd	**09/03/2020** **09/03/2020**		
Contractor	Ground Level		
A Wescott	**76.13m OD**		
Method/Plant	Coordinates	Logged By: **CR**	Sheet 3 of 3
Dando 2000	**521617 E** **208781 N**	Checked By:	Scale 1:50

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
21	21.00	C	N=24					Medium dense to dense flint GRAVEL and coarse SAND. [KESGRAVE SUBCATCHMENT GROUP]	
	21.10	B24							
						21.80	54.33		
22	22.00	D25						Structureless CHALK composed of silty subangular to subrounded GRAVEL with some flint. Gravel is medium to low density, creamy white. [Grade Dc] [LEWES NODULAR CHALK FORMATION]	
	22.50	C	N=16						
	22.60	B26							
23									
24	24.10	C	N=17						
25	25.10	C	N=26						
	25.30	D27							
						(8.20)			
26	26.10	D28							
	26.50	C	N=29						
27									
	27.50	B29							
28	28.10	C	N=68						
29									
	29.60	C	N=38						
	29.80	D30							
30						30.00	46.13	End of Borehole at 30.00m	

General Remarks

Scanned and cleared of services by EDI prior to drilling. Location cored and broken out. Hand pits dug to 1.2m. Hole drilled to 30m. Groundwater encountered at 16.1m. Monitoring well installed to 20m with gas bung and flush cover.

Boring Progress			Water Strike			Chiselling		
Date/Time	Depth	Cas. Depth	Strike	Time (mins)	Rose To	From	To	Duration
			16.40	20	16.20			

Project Name	Project No:		BOREHOLE
Comet Way, Hatfield	**47179**	Stantec	**CP02**
Client	Start Date / End Date		
Comet Way Hatfield Ltd	**09/03/2020** **11/03/2020**		
Contractor	Ground Level		
A Wescott	**75.93m OD**		
Method/Plant	Coordinates	Logged By: **CR**	Sheet 1 of 3
Dando 2000	**521681 E** **208798 N**	Checked By:	Scale 1:50

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
						0.10 (0.25)	75.83	Macadam [MADE GROUND]	
	0.40	D1				0.35	75.58	Soft orange brown mottled grey slightly sandy ravelly CLAY. Gravel is sub rounded flint and asphalt. [MADE GROUND]	
	0.50	PID	0 ppmv						
	0.60	B2							
1	1.00	PID	0 ppmv					Soft brown very sandy gravelly CLAY. [LOWESTOFT FORMATION]	
	1.10	S	N=7			(1.55)			
	1.50	PID	0 ppmv						
	1.60	D3							
2	2.00	C	N=33			1.90	74.03	Medium dense to dense brown clayey gravelly SAND. [LOWESTOFT FORMATION]	
		PID	0 ppmv						
	2.10	B4				(0.90)			
	2.50	PID	0 ppmv						
						2.80	73.13	Medium dense brown SAND AND GRAVELS with increasing cobble content with depth. [LOWESTOFT FORMATION]	
3	3.00	C	N=23						
		PID	0 ppmv						
	3.10	B5							
4	4.10	C	N=22						
	4.30	D6							
5	5.10	C	N=17						
	5.20	D7							
6						(6.50)			
	6.50	C	N=14						
	6.60	D8							
7									
8	8.10	C	N=36						
	8.20	B9							
9									
						9.30	66.63	Stiff dark grey silty gravelly CLAY with some sand lenses. Gravel is rounded Chalk. [LOWESTOFT FORMATION]	
	9.40	U10	Ublow=58						
	9.50	D11							
	9.60	C	N=51						
	9.80	B12							
10									

General Remarks

Scanned and cleared of services by EDI prior to drilling. Location cored and broken out. Hand pits dug to 1.2m. Hole drilled to 30m. Groundwater encountered at 16.1m. Monitoring well installed to 20m with gas bung and flush cover.

Boring Progress			Water Strike			Chiselling		
Date/Time	Depth	Cas. Depth	Strike	Time (mins)	Rose To	From	To	Duration
			16.10	20	15.60			

Project Name	Project No:		BOREHOLE
Comet Way, Hatfield	**47179**	Stantec	**CP02**
Client	Start Date / End Date		
Comet Way Hatfield Ltd	**09/03/2020** **11/03/2020**		
Contractor	Ground Level		
A Wescott	**75.93m OD**		
Method/Plant	Coordinates	Logged By: **CR**	Sheet 2 of 3
Dando 2000	**521681 E** **208798 N**	Checked By:	Scale 1:50

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
								Stiff dark grey silty gravelly CLAY with some sand lenses. Gravel is rounded Chalk. [LOWESTOFT FORMATION]	
11	11.00	C	N=47						
	11.20	D13							
12									
	12.50	U14	Ublow=50			(6.10)			
13	13.00	D15							
14	14.10	C	N=50						
	14.20	B16							
15	15.10	D17							
	15.50	C	N=26			15.40	60.53		
	15.70	D18				(0.70)		Firm brown sandy slightly gravelly CLAY. Gravel is subrounded flint. [LOWESTOFT FORMATION]	
16						16.10	59.83		
	16.50	C	N=23					Medium dense flint GRAVEL. [KESGRAVE SUBCATCHMENT GROUP]	
	16.60	B19				(1.40)			
17						17.50	58.43		
								Medium dense brown SAND AND GRAVELS. [KESGRAVE SUBCATCHMENT GROUP]	
18	18.00	C	N=20						
	18.20	D20				(1.70)			
19						19.20	56.73		
	19.50	C	N=28					Structureless CHALK composed of silty subangular to subrounded GRAVEL with some flint. Gravel is medium to low density, creamy white. [Grade Dc] [LEWES NODULAR CHALK FORMATION]	
	19.70	B21							
20									

General Remarks

Scanned and cleared of services by EDI prior to drilling. Location cored and broken out. Hand pits dug to 1.2m. Hole drilled to 30m. Groundwater encountered at 16.1m. Monitoring well installed to 20m with gas bung and flush cover.

Boring Progress			Water Strike			Chiselling		
Date/Time	Depth	Cas. Depth	Strike	Time (mins)	Rose To	From	To	Duration
			16.10	20	15.60			

Project Name	Project No:		BOREHOLE
Comet Way, Hatfield	**47179**	Stantec	**CP02**
Client	Start Date / End Date		
Comet Way Hatfield Ltd	**09/03/2020** **11/03/2020**		
Contractor	Ground Level		
A Wescott	**75.93m OD**		
Method/Plant	Coordinates	Logged By: **CR**	Sheet 3 of 3
Dando 2000	**521681 E** **208798 N**	Checked By:	Scale 1:50

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
								Structureless CHALK composed of silty subangular to subrounded GRAVEL with some flint. Gravel is medium to low density, creamy white. [Grade Dc] [LEWES NODULAR CHALK FORMATION]	
21	21.00	C	N=24						
22									
	22.50	C	N=25						
	22.70	D22							
23									
24	24.00	C	N=25						
	24.10	B23							
25						(10.80)			
	25.60	C	N=24						
26	26.00	D24							
27	27.10	C	N=17						
28									
	28.60	C	N=28						
	28.70	B25							
29									
30	30.00	C	N=33			30.00	45.93	End of Borehole at 30.00m	
		D26							

General Remarks

Scanned and cleared of services by EDI prior to drilling. Location cored and broken out. Hand pits dug to 1.2m. Hole drilled to 30m. Groundwater encountered at 16.1m. Monitoring well installed to 20m with gas bung and flush cover.

Boring Progress			Water Strike			Chiselling		
Date/Time	Depth	Cas. Depth	Strike	Time (mins)	Rose To	From	To	Duration
			16.10	20	15.60			

Project Name	Project No:		BOREHOLE
Comet Way, Hatfield	**47179**	Stantec	**CP03**
Client	Start Date / End Date		
Comet Way Hatfield Ltd	**09/03/2020** **09/03/2020**		
Contractor	Ground Level		
A Wescott	**76.05m OD**		
Method/Plant	Coordinates	Logged By: **CR**	Sheet 1 of 1
Dando 2000	**521663 E** **208741 N**	Checked By:	Scale 1:50

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
						(0.10) 0.10	75.95	Macadam [MADE GROUND]	
						(0.20) 0.30	75.75	Creamy white concrete with rebar at 0.30. [MADE GROUND]	
	0.50	PID	0 ppmv			(0.50)			
						0.80 (0.20)	75.25	Concrete, not reinforced. [MADE GROUND]	
1						1.00	75.05	Hard concrete (probably reinforced). [MADE GROUND]	
								End of Borehole at 1.00m	
2									
3									
4									
5									
6									
7									
8									
9									
10									

General Remarks

Scanned and cleared of services by EDI prior to drilling. Location cored and broken out. Hole terminated at 1m due to hitting reinforced concrete. Hole backfilled with arisings and reinstated with Macadam.

Boring Progress			Water Strike			Chiselling		
Date/Time	Depth	Cas. Depth	Strike	Time (mins)	Rose To	From	To	Duration

Project Name	Project No:		WINDOW SAMPLE
Comet Way, Hatfield	**47179**	Stantec	
Client	Start Date / End Date		**WS01**
Comet Way Hatfield Ltd	**09/03/2020** / **09/03/2020**		
Contractor	Ground Level		
A F Howlands	**76.16m OD**		
Method/Plant	Coordinates	Logged By: **CR**	Sheet 1 of 1
Dando Terrier	**521611 E** **208762 N**	Checked By:	Scale 1:40

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
						(0.10) 0.10	76.06	Macadam [MADE GROUND]	
						(0.40)		Reddish brown clayey gravelly SAND. Gravel is subrounded brick and flint. [MADE GROUND]	
	0.50	PID	5 ppmv			(0.47) 0.50	75.66		
						(0.33) 0.97	75.59	Macadam. [MADE GROUND]	
						0.90	75.26	*Membrane*	
1	1.00	S D1	N=8					Reddish brown clayey sandy GRAVEL. Gravel is subrounded brick and flint with occasional cobbles and timber. [MADE GROUND]	
		PID	0 ppmv			(0.90)			
	1.50	PID	0 ppmv					Soft orange brown sightly gravelly CLAY. Gravel is subrounded flint. [LOWESTOFT FORMATION]	
						1.80	74.36		
2	2.00	S D2	N=57					Stiff yellow brown gravelly CLAY. Gravel is subrounded flint. [LOWESTOFT FORMATION]	
		PID	0 ppmv			(0.80)			
	2.50	PID	0 ppmv						
						2.60	73.56	Medium dense yellow brown clayey very gravelly SAND. Gravel is subrounded flint. [LOWESTOFT FORMATION]	
						(0.50)			
3	3.00	S D3	N=15			(0.10) 3.10	73.06		
		PID	0 ppmv			3.20	72.96	Medium dense yellow brown clayey gravelly SAND. Gravel is subrounded flint. [LOWESTOFT FORMATION]	
						(0.40)		*Damp arisings*	
	3.50	PID	0 ppmv			3.60	72.56		
						(0.20) 3.80	72.36	Medium dense yellow brown dense to very dense clayey very gravelly SAND. Gravel is subrounded flint. [LOWESTOFT FORMATION]	
4	4.00	S D4	N=7					Loose yellow brown clayey gravelly SAND. [LOWESTOFT FORMATION]	
		PID	0 ppmv			(1.20)		Loose dark reddish brown slightly clayey slightly gravelly fine to medium SAND. [LOWESTOFT FORMATION]	
	4.50	PID	0 ppmv						
5	5.00	PID	0 ppmv			5.00	71.16	End of Window Sample at 5.00m	
6									
7									
8									

General Remarks

Scanned and cleared of services by EDI prior to drilling. Location cored and broken out. Hand pits dug to 1.2m. Drilled to 5m. Arisings recorded as damp between 3.1 and 3.2m. Installed with a monitoring well to 5m. Installed with gas bung and flush cover.

Water Strike			Window Sample Run			
Strike	Time (mins)	Rose to	Start	End	Dia. (mm)	Rec. %
			1.20	2.00		100
			2.00	3.00		100
			3.00	4.00		100
			4.00	5.00		100

Project Name	Project No:		WINDOW SAMPLE
Comet Way, Hatfield	**47179**	Stantec	**WS02**
Client	Start Date / End Date		
Comet Way Hatfield Ltd	**09/03/2020** / **09/03/2020**		
Contractor	Ground Level		
A F Howlands	**76.22m OD**		
Method/Plant	Coordinates	Logged By: **CR**	Sheet 1 of 1
Dando Terrier	**521625 E** **208771 N**	Checked By:	Scale 1:40

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
						(0.20)		Concrete with rebar at 0.15m.	
						0.20	76.02	[MADE GROUND]	
	0.50	PID	0 ppmv			(0.90)		Soft brown sandy gravelly CLAY. Gravel is brick and concrete with cobbles of flint and brick. [MADE GROUND] *Membrane*	
1	1.00	S D1 PID	N=1 0 ppmv			1.10	75.12	Firm to stiff greenish grey slightly gravelly CLAY. Gravel is subrounded flint. [LOWESTOFT FORMATION]	
	1.50	PID	0 ppmv			(1.10)		*Hydrocarbon smell*	
2	2.00	S D2 PID	N=49 47 ppmv			2.20	74.02		
						(0.25)		Firm greenish grey very sandy very gravelly CLAY. Gravel is subrounded flint. [LOWESTOFT FORMATION]	
	2.50	PID	0 ppmv			2.45	73.77	Medium dense yellow brown gravelly SAND. Gravel is subrounded flint. [LOWESTOFT FORMATION]	
						(0.55)			
3	3.00	S D3 PID	N=15 0 ppmv			3.00	73.22	Medium dense yellow brown clayey gravelly fine to medium SAND. Gravel is subrounded flint. [LOWESTOFT FORMATION]	
						(0.50)			
	3.50	PID	0 ppmv			3.50	72.72		
						(0.95)	72.67	Medium dense orange brown slightly clayey gravelly SAND. Gravel is subrounded flint. [LOWESTOFT FORMATION]	
4	4.00	S D4 PID	N=13 0 ppmv			(0.90)		Medium dense orange brown slightly gravelly fine to medium SAND. Gravel is subrounded flint. [LOWESTOFT FORMATION]	
	4.50	PID	0 ppmv			4.45	71.77		
						(0.25)		Medium dense dark reddish brown fine to medium SAND. [LOWESTOFT FORMATION]	
						4.70	71.52		
						(0.30)		Medium dense yellow brown fine to medium SAND. [LOWESTOFT FORMATION]	
5	5.00	PID				5.00	71.22	End of Window Sample at 5.00m	
6									
7									
8									

General Remarks

Scanned and cleared of services by EDI prior to drilling. Location cored and broken out. Hand pits dug to 1.2m. Drilled to 5m. Installed with a monitoring well to 5m. Installed with gas bung and flush cover.

Water Strike			Window Sample Run			
Strike	Time (mins)	Rose to	Start	End	Dia. (mm)	Rec. %
			1.20	2.00		100
			2.00	3.00		100
			3.00	4.00		100
			4.00	5.00		100

Project Name	Project No:		WINDOW SAMPLE
Comet Way, Hatfield	**47179**	Stantec	**WS03**
Client	Start Date / End Date		
Comet Way Hatfield Ltd	**09/03/2020** **09/03/2020**		
Contractor	Ground Level		
A F Howlands	**76.16m OD**		
Method/Plant	Coordinates	Logged By: **CR**	Sheet 1 of 1
Dando Terrier	**521635 E** **208807 N**	Checked By:	Scale 1:40

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
						(0.20)		Macadam	
						0.20	75.96	[MADE GROUND]	
	0.50	ES				(0.50)		Medium dense reddish brown clayey gravelly SAND. Gravel is subrounded brick and flint. [MADE GROUND]	
		ESES1							
		PID	0 ppmv			0.70	75.46		
						(0.20)		Medium dense reddish grey clayey slightly gravelly SAND. Gravel is subrounded flint and brick. [MADE GROUND]	
1	1.00	S	N=14			0.90	75.26		
		D1				(0.30)		Medium dense yellow medium SAND. [MADE GROUND]	
		PID	0 ppmv			1.20	74.96		
						(0.25)		Firm yellow and red very sandy gravelly CLAY. Gravel is subrounded brick. [MADE GROUND]	
	1.50	PID	0 ppmv			1.45	74.71		
						(0.35)		*Concrete slab fragment*	
						1.80	74.36	Medium dense yellow clayey very gravelly SAND. Gravel is subrounded flint.	
2	2.00	S	N=33			(0.75)		Firm yellow brown sandy gravelly CLAY. Gravel is subrounded flint.	
		D2							
		PID	0 ppmv						
	2.50	PID	0 ppmv			2.55	73.61		
						(0.20)		Medium dense yellow gravelly fine to medium SAND. Gravel is subrounded flint.	
						2.75	73.41		
						(0.60)		Firm yellow brown sandy gravelly CLAY. Gravel is subrounded flint.	
						3.35	73.36		
3	3.00	S	N=21			(0.50)		Medium dense yellow gravelly fine to medium SAND. Gravel is subrounded flint.	
		D3							
		PID	0 ppmv			3.30	72.86		
						(0.50)		Medium dense orange slightly clayey slightly gravelly SAND. Gravel is subrounded flint.	
	3.50	PID	0 ppmv			3.80	72.36		
								Medium dense yellowish brown fine to medium SAND.	
4	4.00	S	N=17						
		D4							
		PID	0 ppmv						
						(1.20)			
	4.50	PID	0 ppmv						
5	5.00	PID	0 ppmv			5.00	71.16	End of Window Sample at 5.00m	
6									
7									
8									

General Remarks

Scanned and cleared of services by EDI prior to drilling. Location cored and broken out. Hand pits dug to 1.2m. Hole drilled to 5m. Hole backfilled with arisings and reinstated with Macadam.

Water Strike			Window Sample Run			
Strike	Time (mins)	Rose to	Start	End	Dia. (mm)	Rec. %
			1.20	2.00		60
			2.00	3.00		100
			3.00	4.00		90
			4.00	5.00		100

Project Name	Project No:		WINDOW SAMPLE
Comet Way, Hatfield	**47179**	Stantec	**WS04**
Client	Start Date / End Date		
Comet Way Hatfield Ltd	**09/03/2020** / **09/03/2020**		
Contractor	Ground Level		
A F Howlands	**75.93m OD**		
Method/Plant	Coordinates	Logged By: **CR**	Sheet 1 of 1
Dando Terrier	**521666 E** **208799 N**	Checked By:	Scale 1:40

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
						(0.15)	75.78	Macadam	
						0.15		[MADE GROUND]	
						(0.10)	75.68	Firm grey mottled orange slightly sandy gravelly CLAY.	
						0.25		[MADE GROUND]	
	0.50	PID	0 ppmv					Soft orange brown slightly sandy sightly gravelly CLAY. Gravel is subrounded flint.	
1	1.00	S D1	N=10			(1.75)			
		PID	0 ppmv						
	1.50	PID	0 ppmv						
2	2.00	S D2	N=23			2.00	73.93	Firm to stiff yellow brown sandy gravelly CLAY. Becoming very sandy at depth.	
		PID	19 ppmv			(0.50)			
	2.50	PID	0 ppmv			2.50	73.43	Medium dense yellow brown clayey very gravelly SAND.	
						(0.60)			
3	3.00	S D3	N=19			3.10	72.83	Firm yellow brown very sandy gravelly CLAY. Gravel is subrounded flint.	
		PID	0 ppmv			(0.30)			
						3.40	72.53	[LOWESTOFT FORMATION]	
	3.50	PID	0 ppmv					Loose yellow slightly clayey slightly gravelly fine to medium SAND. Gravel is subrounded flint.	
						(0.80)		[LOWESTOFT FORMATION]	
4	4.00	S D4	N=9						
		PID	0 ppmv			4.20	71.73	Loose orangish yellow slightly clayey gravelly SAND. Gravel is subrounded flint.	
						(0.25)			
	4.50	PID	0 ppmv			4.45	71.48	[LOWESTOFT FORMATION]	
						(0.55)		Loose orange slightly clayey very gravelly SAND. Gravel is subrounded flint.	
5	5.00	PID	0 ppmv			5.00	70.93	[LOWESTOFT FORMATION]	
								End of Window Sample at 5.00m	
6									
7									
8									

General Remarks

Scanned and cleared of services by EDI prior to drilling. Location cored and broken out. Hand pits dug to 1.2m. Drilled to 5m. Installed with a monitoring well to 5m. Installed with gas bung and flush cover.

Water Strike			Window Sample Run			
Strike	Time (mins)	Rose to	Start	End	Dia. (mm)	Rec. %
			1.20	2.00		100
			2.00	3.00		80
			3.00	4.00		80
			4.00	5.00		75

Project Name	Project No:		WINDOW SAMPLE
Comet Way, Hatfield	**47179**	Stantec	**WS05**
Client	Start Date / End Date		
Comet Way Hatfield Ltd	**09/03/2020** / **09/03/2020**		
Contractor	Ground Level		
A F Howlands	**76.19m OD**		
Method/Plant	Coordinates	Logged By: **CR**	Sheet 1 of 1
Dando Terrier	**521652 E** **208782 N**	Checked By:	Scale 1:40

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
						(0.20)		Macadam	
						0.20	75.99	[MADE GROUND]	
						(0.30)		Orange brown clayey sandy GRAVEL. Gravel is subrounded flint and chalk.	
	0.50	ES				0.50	75.69	[MADE GROUND]	
		ESES1				(0.30)		Soft black sandy gravelly CLAY with brick cobbles. Gravel is subrounded to angular brick, flint and asphalt.	
		PID	0 ppmv			0.80	75.39	[MADE GROUND]	
						(0.20)			
1	1.00	S	N=8			1.00	75.19	Soft orange, stained black, slightly gravelly CLAY. Gravel is subrounded flint and asphalt.	
		D1						[MADE GROUND]	
		PID	0 ppmv					Firm to stiff orange brown slightly sandy sightly gravelly CLAY. Gravel is subrounded flint.	
	1.50	PID	0 ppmv					[LOWESTOFT FORMATION]	
						(1.50)			
2	2.00	S	N=20						
		D2							
		PID	0 ppmv						
	2.50	PID	0 ppmv			2.50	73.69	Medium dense light brown very clayey gravelly SAND.	
						(0.40)		[LOWESTOFT FORMATION]	
						2.90	73.29		
3	3.00	S	N=19					Medium dense yellow slightly clayey slightly gravelly fine to medium SAND. Gravel is subrounded flint.	
		D3				(0.50)		[LOWESTOFT FORMATION]	
		PID	0 ppmv						
						3.40	72.79		
	3.50	PID	0 ppmv					Medium dense yellow orange brown slightly clayey gravelly SAND. Gravel is subrounded flint.	
						(0.90)		[LOWESTOFT FORMATION]	
4	4.00	S	N=14						
		D4							
		PID	0 ppmv						
						4.30	71.89		
	4.50	PID	0 ppmv					Medium dense orange slightly clayey fine to medium SAND	
						(0.70)		[LOWESTOFT FORMATION]	
5	5.00	PID	0 ppmv			5.00	71.19		
								End of Window Sample at 5.00m	
6									
7									
8									

General Remarks

Scanned and cleared of services by EDI prior to drilling. Location cored and broken out. Hand pits dug to 1.2m. Drilled to 5m. Installed with a monitoring well to 5m. Installed with gas bung and flush cover.

Water Strike			Window Sample Run			
Strike	Time (mins)	Rose to	Start	End	Dia. (mm)	Rec. %
			1.20	2.00		100
			2.00	3.00		80
			3.00	4.00		80
			4.00	5.00		80

Project Name	Project No:		WINDOW SAMPLE
Comet Way, Hatfield	**47179**	Stantec	**WS06**
Client	Start Date / End Date		
Comet Way Hatfield Ltd	**09/03/2020** / **09/03/2020**		
Contractor	Ground Level		
A F Howlands	**76.13m OD**		
Method/Plant	Coordinates	Logged By: **CR**	Sheet 1 of 1
Dando Terrier	**521656 E** **208767 N**	Checked By:	Scale 1:40

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
						(0.10)	76.03	Macadam	
						0.10			
						(0.10)			
						0.20	75.93	[MADE GROUND]	
						(0.25)		Firm yellow brown very sandy very gravelly CLAY. Gravel is subrounded flint.	
	0.50	PID	0 ppmv			0.45	75.68	[MADE GROUND]	
						(0.25)			
	0.70	ES				0.70	75.43	Firm dark brown very sandy very gravelly CLAY with occasional brick fragments and cobbles.	
		ESES1				(0.10)		[MADE GROUND]	
						0.80	75.33	Concrete.	
1	1.00	S	N=8					[MADE GROUND]	
		D1						Soft dark brown slightly sandy slightly gravelly CLAY.	
		PID	0 ppmv			(0.90)		[MADE GROUND]	
	1.50	PID	4 ppmv					Soft orange brown slightly sandy slightly CLAY with regualr brick fragments	
						1.70	74.43	[MADE GROUND]	
	1.90	ES						Soft greenish grey slightly gravelly CLAY.	
2		ESES2				(0.75)		[LOWESTOFT FORMATION]	
	2.00	S	N=7					*Strong hydrocarbon smell*	
		D2							
		PID	58 ppmv			2.45	73.68	Medium dense grey very clayey gravelly SAND. Gravel is subrounded flint.	
	2.50	PID	6 ppmv			(0.45)		[LOWESTOFT FORMATION]	
						2.90	73.23	Medium dense yellowish clayey gravelly SAND. Gravel is subrounded flint.	
3	3.00	S	N=20			(0.30)		[LOWESTOFT FORMATION]	
		D3				3.20	72.93	Firm yellow very sandy gravelly CLAY. Gravel is subrounded flint.	
		PID	0 ppmv			(0.30)		[LOWESTOFT FORMATION]	
	3.50	PID	0 ppmv			3.50	72.63	Medium dense orange clayey gravelly SAND. Gravel is subrounded flint.	
						(0.80)		[LOWESTOFT FORMATION]	
4	4.00	S	N=18						
		D4							
		PID	0 ppmv			4.30	71.83	Medium dense yellow clayey very gravelly SAND. Gravel is subrounded flint.	
	4.50	PID	0 ppmv			(0.30)		[LOWESTOFT FORMATION]	
						4.60	71.53	Medium dense dark brown clayey gravelly SAND. Gravel is subrounded flint.	
						(0.10)		[LOWESTOFT FORMATION]	
						4.70	71.43	Medium dense orange clayey gravelly SAND. Gravel is subrounded flint.	
						(0.30)		[LOWESTOFT FORMATION]	
5						5.00	71.13	End of Window Sample at 5.00m	
6									
7									
8									

General Remarks

Scanned and cleared of services by EDI prior to drilling. Location cored and broken out. Hand pits dug to 1.2m. Drilled to 5m. Installed with a monitoring well to 5m. Installed with gas bung and flush cover.

Water Strike			Window Sample Run			
Strike	Time (mins)	Rose to	Start	End	Dia. (mm)	Rec. %
			1.20	2.00		100
			2.00	3.00		80
			3.00	4.00		60
			4.00	5.00		60

Project Name	Project No:		WINDOW SAMPLE
Comet Way, Hatfield	**47179**	Stantec	**WS07**
Client	Start Date / End Date		
Comet Way Hatfield Ltd	**09/03/2020** / **09/03/2020**		
Contractor	Ground Level		
A F Howlands	**76.21m OD**		
Method/Plant	Coordinates	Logged By: **CR**	Sheet 1 of 1
Dando Terrier	**512677 E** **208756 N**	Checked By:	Scale 1:40

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
						(0.03)	76.18	Macadam	
						(0.18)		[MADE GROUND]	
						0.21	76.00	Yellowish concrete with rebar at 0.15m	
								[MADE GROUND]	
	0.50	ES ESES1 PID	0 ppmv			(0.49)		Reddish brown clayey sandy GRAVEL. Gravel is subangular to subrounded flint and brick with regular brick cobbles.	
						(0.70)	75.51	[MADE GROUND]	
						0.70	75.50	Concrete	
								[MADE GROUND]	
								End of Window Sample at 0.70m	
1									
2									
3									
4									
5									
6									
7									
8									

General Remarks

Scanned and cleared of services by EDI prior to drilling. Location cored and broken out. Hole terminated at 0.7m due to hitting reinforced concrete. Hole backfilled with arisings and reinstated with Macadam.

Water Strike			Window Sample Run			
Strike	Time (mins)	Rose to	Start	End	Dia. (mm)	Rec. %

Project Name	Project No:		WINDOW SAMPLE
Comet Way, Hatfield	**47179**	Stantec	
Client	Start Date / End Date		**WS08**
Comet Way Hatfield Ltd	**09/03/2020** / **09/03/2020**		
Contractor	Ground Level		
A F Howlands	**76.13m OD**		
Method/Plant	Coordinates	Logged By: **CR**	Sheet 1 of 1
Dando Terrier	**521688 E** **208787 N**	Checked By:	Scale 1:40

(m)	Samples and Insitu Tests			Water	Legend	Depth (Thickness)	Level (m OD)	Stratum Description	Instrumentation /Backfill
	Depth	Type	Results						
						(0.15)		Macadam	
						0.15	75.98	[MADE GROUND]	
						(0.25)			
	0.50	PID	0 ppmv			0.40	75.73	Firm grey mottled orange slightly sandy gravelly CLAY. Gravel is subrounded to subangular flint, concrete and brick. [MADE GROUND]	
1	1.00	S D1 PID	N=7 0 ppmv			(1.50)		Firm orange brown silty slightly gravelly CLAY. Gravel is subrounded flint. [LOWESTOFT FORMATION]	
	1.50	PID	0 ppmv						
						1.90	74.23		
2	2.00	S D2 PID	N=36 0 ppmv			(0.60)		Firm to stiff light orange brown sandy gravelly CLAY. Gravel is subrounded flint. [LOWESTOFT FORMATION]	
	2.50	PID	3 ppmv			2.50	73.63	Medium dense yellow gravelly fine to medium SAND. Gravel is subrounded flint. [LOWESTOFT FORMATION]	
						(0.60)			
3	3.00	S D3 PID	N=13 18 ppmv			3.10	73.03	Medium dense orange brown very clayey gravelly SAND. Gravel is subrounded flint. [LOWESTOFT FORMATION]	
						(0.30)			
	3.50	PID	0 ppmv			3.40	72.73	Loose orange yellow gravelly fine to medium SAND. [LOWESTOFT FORMATION]	
						(0.80)			
4	4.00	S D4 PID	N=9 0 ppmv			4.20	71.93	Loose orange brown slightly clayey slightly gravelly fine to medium SAND. Gravel is subrounded flint. [LOWESTOFT FORMATION]	
	4.50	PID	0 ppmv			(0.80)			
5	5.00	PID	0 ppmv			5.00	71.13	End of Window Sample at 5.00m	
6									
7									
8									

General Remarks

Scanned and cleared of services by EDI prior to drilling. Location cored and broken out. Hand pits dug to 1.2m. Hole drilled to 5m. Hole backfilled with arisings and reinstated with Macadam.

Water Strike			Window Sample Run			
Strike	Time (mins)	Rose to	Start	End	Dia. (mm)	Rec. %
			1.20	2.00		100
			2.00	3.00		100
			3.00	4.00		55
			4.00	5.00		60

Appendix B Geochemical Laboratory Analysis Results

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

Final Report

Report No.:	20-08170-1
Initial Date of Issue:	24-Mar-2020
Client	Stantec UK Limited
Client Address:	3rd Floor 50-60 Station Road Cambridge Cambridgeshire CB1 2JH
Contact(s):	Oliver Belson Christopher Radbone
Project	47179 Comet Way, Hatfield

Quotation No.:		**Date Received:**	13-Mar-2020
Order No.:	32280	**Date Instructed:**	18-Mar-2020
No. of Samples:	7		
Turnaround (Wkdays):	5	**Results Due:**	24-Mar-2020
Date Approved:	24-Mar-2020		

Approved By:

[redacted]

Details: Glynn Harvey, Technical Manager

Chemtest
The right chemistry to deliver results

Results - Soil

Project: 47179 Comet Way, Hatfield

Client: Stantec UK Limited		**Chemtest Job No.:**			20-08170	20-08170	20-08170	20-08170	20-08170	20-08170	20-08170
Quotation No.:		**Chemtest Sample ID.:**			985727	985729	985730	985732	985733	985734	985736
		Client Sample ID.:			ES1	ES3	ES1	ES1	ES2	ES1	ES1
		Sample Location:			CP01	CP01	CP02	WS01	WS02	WS04	WS08
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.25	2.50	0.35	0.40	0.80	0.20	0.25
		Date Sampled:			09-Mar-2020	11-Mar-2020	09-Mar-2020	09-Mar-2020	10-Mar-2020	10-Mar-2020	10-Mar-2020
		Asbestos Lab:			COVENTRY		COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
ACM Type	U	2192		N/A	-		-	-	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected		No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-		-	-	-	-	-
Moisture	N	2030	%	0.020	7.5	12	13	9.3	14	12	15
Natural Moisture Content	N	2030	%	0.020	8.1	13	15	10	17	13	17
Soil Colour	N	2040		N/A	Brown,	Brown,	Brown,	Brown,	Brown,	Brown,	Brown,
Other Material	N	2040		N/A	Stones,	Stones,	Stones,	Stones,	Stones,	Stones,	Stones,
Soil Texture	N	2040		N/A	Sand,	Clay,	Clay,	Sand,	Clay,	Clay,	Clay,
Chromatogram (TPH)	N			N/A	See Attached	See Attached	See Attached	See Attached	See Attached	See Attached	See Attached
pH	M	2010		4.0			8.8	10.0		8.2	
Arsenic	M	2450	mg/kg	1.0	22		10	22	8.4	10	11
Cadmium	M	2450	mg/kg	0.10	0.18		0.29	0.21	< 0.10	0.48	0.49
Chromium	M	2450	mg/kg	1.0	23		24	25	22	28	22
Copper	U	2450	mg/kg	0.50	19		17	13	11	30	35
Mercury	M	2450	mg/kg	0.10	< 0.10		< 0.10	< 0.10	< 0.10	0.12	0.24
Nickel	M	2450	mg/kg	0.50	24		23	25	18	26	21
Lead	M	2450	mg/kg	0.50	34		32	32	14	47	110
Selenium	M	2450	mg/kg	0.20	< 0.20		0.21	< 0.20	0.34	0.27	0.25
Zinc	U	2450	mg/kg	0.50	79		61	68	43	100	91
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50		< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	92	< 1.0	< 1.0	8.3	< 1.0	39	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	92	< 5.0	< 5.0	8.3	< 5.0	39	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	290	< 1.0	< 1.0	380	< 1.0	73	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

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Results - Soil

Project: 47179 Comet Way, Hatfield

Client: Stantec UK Limited		**Chemtest Job No.:**			20-08170	20-08170	20-08170	20-08170	20-08170	20-08170	20-08170
Quotation No.:		**Chemtest Sample ID.:**			985727	985729	985730	985732	985733	985734	985736
		Client Sample ID.:			ES1	ES3	ES1	ES1	ES2	ES1	ES1
		Sample Location:			CP01	CP01	CP02	WS01	WS02	WS04	WS08
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.25	2.50	0.35	0.40	0.80	0.20	0.25
		Date Sampled:			09-Mar-2020	11-Mar-2020	09-Mar-2020	09-Mar-2020	10-Mar-2020	10-Mar-2020	10-Mar-2020
		Asbestos Lab:			COVENTRY		COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	290	< 5.0	< 5.0	380	< 5.0	73	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	380	< 10	< 10	390	< 10	110	< 10
Dichlorodifluoromethane	U	2760	µg/kg	1.0		< 1.0					
Chloromethane	M	2760	µg/kg	1.0		< 1.0					
Vinyl Chloride	M	2760	µg/kg	1.0		< 1.0					
Bromomethane	M	2760	µg/kg	20		< 20					
Chloroethane	U	2760	µg/kg	2.0		< 2.0					
Trichlorofluoromethane	M	2760	µg/kg	1.0		< 1.0					
1,1-Dichloroethene	M	2760	mg/kg	1.0		< 1.0					
Trans 1,2-Dichloroethene	M	2760	mg/kg	1.0		< 1.0					
1,1-Dichloroethane	M	2760	µg/kg	1.0		< 1.0					
cis 1,2-Dichloroethene	M	2760	µg/kg	1.0		< 1.0					
Bromochloromethane	U	2760	µg/kg	5.0		< 5.0					
Trichloromethane	M	2760	µg/kg	1.0		< 1.0					
1,1,1-Trichloroethane	M	2760	µg/kg	1.0		< 1.0					
Tetrachloromethane	M	2760	µg/kg	1.0		< 1.0					
1,1-Dichloropropene	U	2760	µg/kg	1.0		< 1.0					
Benzene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	M	2760	µg/kg	2.0		< 2.0					
Trichloroethene	N	2760	µg/kg	1.0		< 1.0					
1,2-Dichloropropane	M	2760	µg/kg	1.0		< 1.0					
Dibromomethane	M	2760	µg/kg	1.0		< 1.0					
Bromodichloromethane	M	2760	µg/kg	5.0		< 5.0					
cis-1,3-Dichloropropene	N	2760	µg/kg	10		< 10					
Toluene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	N	2760	µg/kg	10		< 10					
1,1,2-Trichloroethane	M	2760	µg/kg	10		< 10					
Tetrachloroethene	M	2760	µg/kg	1.0		< 1.0					
1,3-Dichloropropane	U	2760	µg/kg	2.0		< 2.0					
Dibromochloromethane	U	2760	µg/kg	10		< 10					
1,2-Dibromoethane	M	2760	µg/kg	5.0		< 5.0					
Chlorobenzene	M	2760	µg/kg	1.0		< 1.0					
1,1,1,2-Tetrachloroethane	M	2760	µg/kg	2.0		< 2.0					
Ethylbenzene	M	2760	µg/kg	1.0	< 1.0	6.6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	M	2760	µg/kg	1.0	< 1.0	4.8	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	M	2760	µg/kg	1.0	< 1.0	1.6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Styrene	M	2760	µg/kg	1.0		< 1.0					
Tribromomethane	U	2760	µg/kg	1.0		< 1.0					

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Results - Soil

Project: 47179 Comet Way, Hatfield

Client: Stantec UK Limited		**Chemtest Job No.:**			20-08170	20-08170	20-08170	20-08170	20-08170	20-08170	20-08170
Quotation No.:		**Chemtest Sample ID.:**			985727	985729	985730	985732	985733	985734	985736
		Client Sample ID.:			ES1	ES3	ES1	ES1	ES2	ES1	ES1
		Sample Location:			CP01	CP01	CP02	WS01	WS02	WS04	WS08
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.25	2.50	0.35	0.40	0.80	0.20	0.25
		Date Sampled:			09-Mar-2020	11-Mar-2020	09-Mar-2020	09-Mar-2020	10-Mar-2020	10-Mar-2020	10-Mar-2020
		Asbestos Lab:			COVENTRY		COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
Isopropylbenzene	M	2760	µg/kg	1.0		2.3					
Bromobenzene	M	2760	µg/kg	1.0		< 1.0					
1,2,3-Trichloropropane	N	2760	µg/kg	50		< 50					
N-Propylbenzene	U	2760	µg/kg	1.0		6.7					
2-Chlorotoluene	M	2760	µg/kg	1.0		< 1.0					
1,3,5-Trimethylbenzene	M	2760	µg/kg	1.0		6.8					
4-Chlorotoluene	U	2760	µg/kg	1.0		< 1.0					
Tert-Butylbenzene	U	2760	µg/kg	1.0		< 1.0					
1,2,4-Trimethylbenzene	M	2760	µg/kg	1.0		21					
Sec-Butylbenzene	U	2760	µg/kg	1.0		< 1.0					
1,3-Dichlorobenzene	M	2760	µg/kg	1.0		< 1.0					
4-Isopropyltoluene	U	2760	µg/kg	1.0		< 1.0					
1,4-Dichlorobenzene	M	2760	µg/kg	1.0		< 1.0					
N-Butylbenzene	U	2760	µg/kg	1.0		5.4					
1,2-Dichlorobenzene	M	2760	µg/kg	1.0		< 1.0					
1,2-Dibromo-3-Chloropropane	U	2760	µg/kg	50		< 50					
1,2,4-Trichlorobenzene	M	2760	µg/kg	1.0		< 1.0					
Hexachlorobutadiene	U	2760	µg/kg	1.0		< 1.0					
1,2,3-Trichlorobenzene	U	2760	µg/kg	2.0		< 2.0					
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Naphthalene	N	2800	mg/kg	0.010	0.060	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Acenaphthylene	N	2800	mg/kg	0.010	0.080	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Acenaphthene	N	2800	mg/kg	0.010	0.10	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Fluorene	N	2800	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Phenanthrene	N	2800	mg/kg	0.010	0.76	< 0.010	0.26	0.14	< 0.010	0.75	< 0.010
Anthracene	N	2800	mg/kg	0.010	0.23	< 0.010	0.050	0.030	< 0.010	0.20	< 0.010
Fluoranthene	N	2800	mg/kg	0.010	1.8	0.10	1.1	0.37	< 0.010	1.7	0.83
Pyrene	N	2800	mg/kg	0.010	1.5	0.15	0.98	0.36	< 0.010	1.5	0.69
Benzo[a]anthracene	N	2800	mg/kg	0.010	0.71	< 0.010	0.49	< 0.010	< 0.010	0.58	0.44
Chrysene	N	2800	mg/kg	0.010	0.59	< 0.010	0.37	< 0.010	< 0.010	0.50	0.33
Benzo[b]fluoranthene	N	2800	mg/kg	0.010	1.2	< 0.010	0.87	< 0.010	< 0.010	0.86	0.65
Benzo[k]fluoranthene	N	2800	mg/kg	0.010	0.36	< 0.010	0.18	< 0.010	< 0.010	0.17	0.22
Benzo[a]pyrene	N	2800	mg/kg	0.010	1.4	< 0.010	0.81	< 0.010	< 0.010	0.66	0.65
Indeno(1,2,3-c,d)Pyrene	N	2800	mg/kg	0.010	0.98	< 0.010	0.44	< 0.010	< 0.010	0.40	0.53
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.010	0.18	< 0.010	0.040	< 0.010	< 0.010	0.060	0.040
Benzo[g,h,i]perylene	N	2800	mg/kg	0.010	0.71	< 0.010	0.34	< 0.010	< 0.010	0.49	0.47
Total Of 16 PAH's	N	2800	mg/kg	0.20	11	0.25	5.9	0.90	< 0.20	7.9	4.9
PCB 28	U	2815	mg/kg	0.010						< 0.010	< 0.010

Chemtest
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Results - Soil

Project: 47179 Comet Way, Hatfield

Client: Stantec UK Limited			**Chemtest Job No.:**		20-08170	20-08170	20-08170	20-08170	20-08170	20-08170	20-08170
Quotation No.:			**Chemtest Sample ID.:**		985727	985729	985730	985732	985733	985734	985736
			Client Sample ID.:		ES1	ES3	ES1	ES1	ES2	ES1	ES1
			Sample Location:		CP01	CP01	CP02	WS01	WS02	WS04	WS08
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		0.25	2.50	0.35	0.40	0.80	0.20	0.25
			Date Sampled:		09-Mar-2020	11-Mar-2020	09-Mar-2020	09-Mar-2020	10-Mar-2020	10-Mar-2020	10-Mar-2020
			Asbestos Lab:		COVENTRY		COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
PCB 52	U	2815	mg/kg	0.010						< 0.010	< 0.010
PCB 90+101	U	2815	mg/kg	0.010						< 0.010	< 0.010
PCB 118	U	2815	mg/kg	0.010						< 0.010	< 0.010
PCB 153	U	2815	mg/kg	0.010						< 0.010	< 0.010
PCB 138	U	2815	mg/kg	0.010						< 0.010	< 0.010
PCB 180	U	2815	mg/kg	0.010						< 0.010	< 0.010
Total PCBs (7 Congeners)	U	2815	mg/kg	0.10						< 0.10	< 0.10
VOC TIC	N	2760	µg/kg	N/A		None Detected					

TPH Chromatogram on Soil Sample: 985727

<Sample Information>

Sample Name : 985727 20-08170
Data Filename : 19 March 2020_19032020_985727 20-08170_101.gcd
Method Filename : TPH 12m Fast OSv2.gcm
Sample # : 51
Date Acquired : 19/03/2020 23:40:35
Date Processed : 19/03/2020

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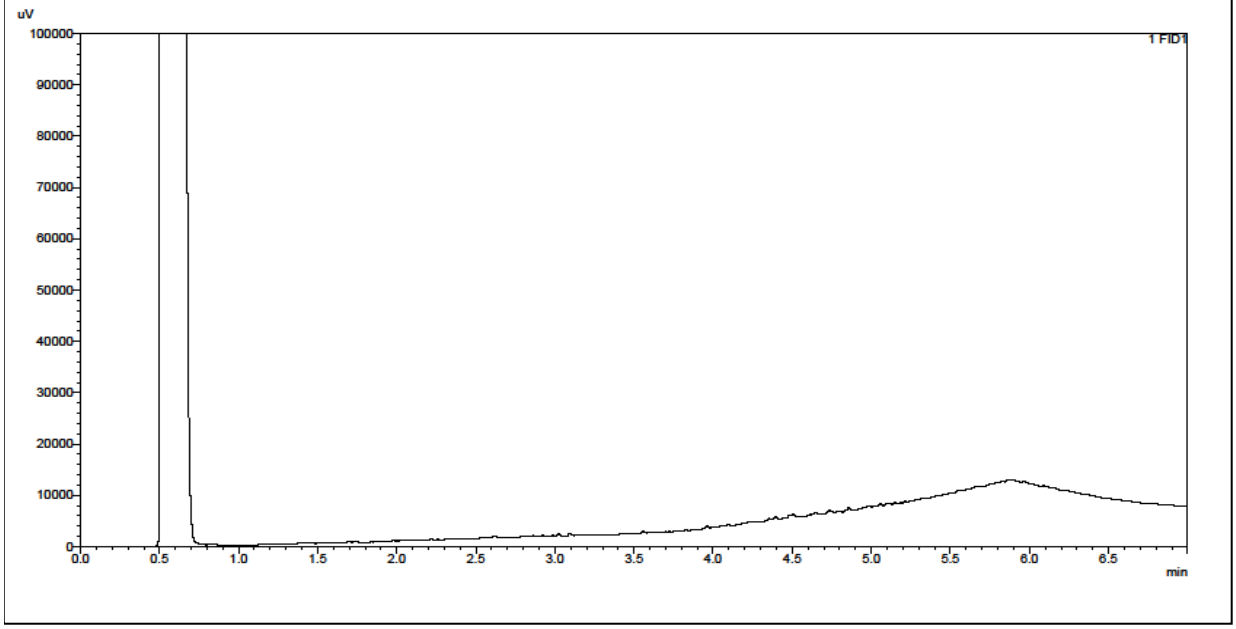
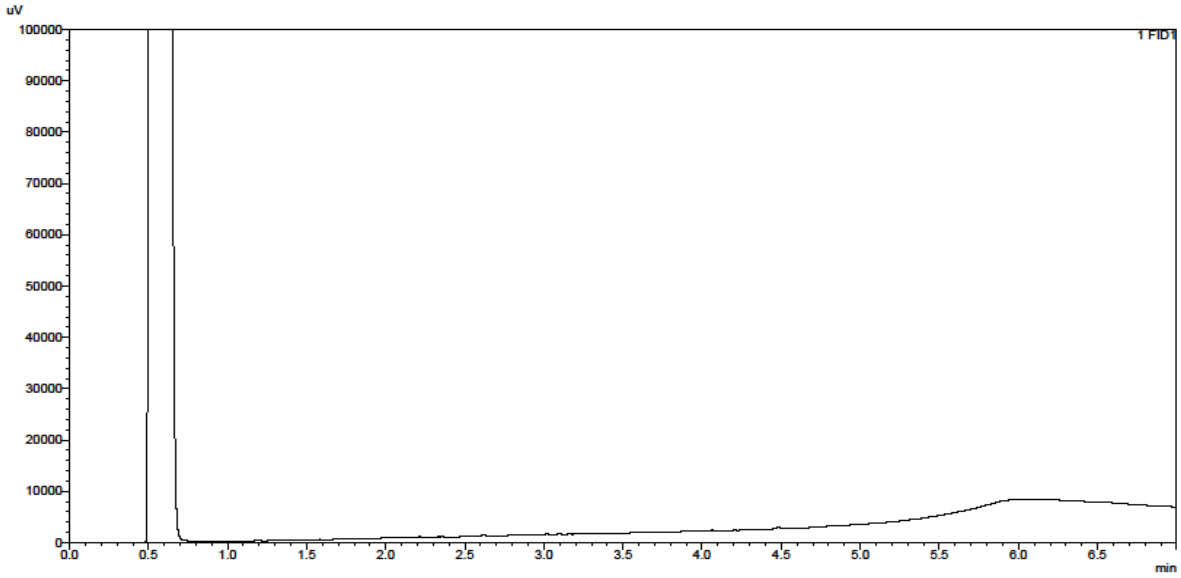


TPH Chromatogram on Soil Sample: 985729

<Sample Information>

Sample Name : 985729 20-08170
Data Filename : 19 March 2020_19032020_985729 20-08170_103.gcd
Method Filename : TPH 12m Fast OSv2.gcm
Sample # : 52
Date Acquired : 19/03/2020 23:53:25
Date Processed : 20/03/2020

<Chromatogram>

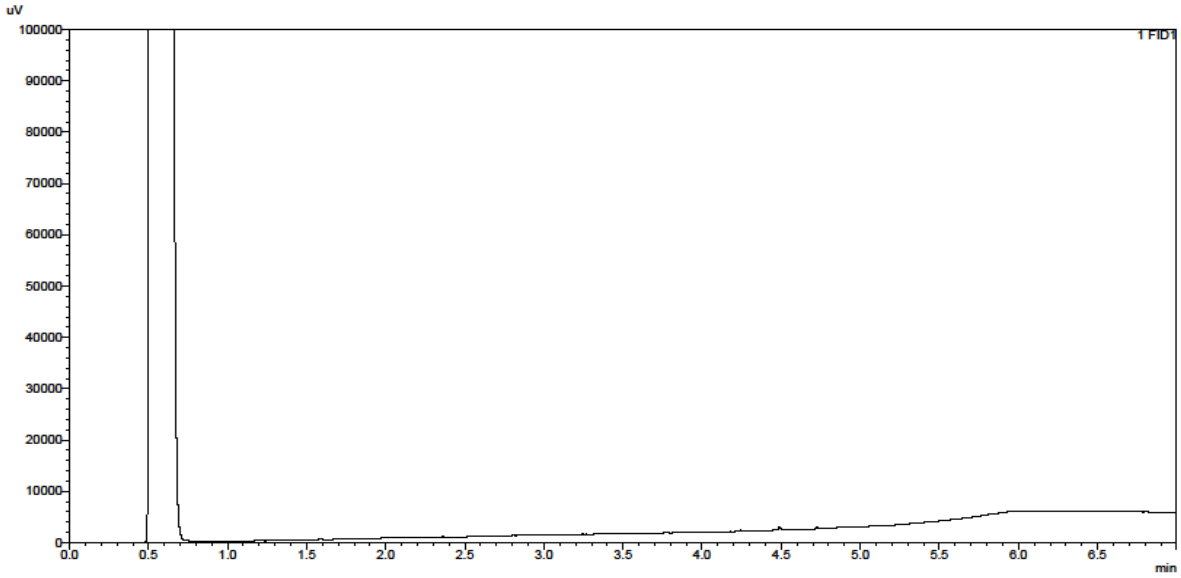


TPH Chromatogram on Soil Sample: 985730

<Sample Information>

Sample Name : 985730 20-08170
Data Filename : 19 March 2020_19032020_985730 20-08170_105.gcd
Method Filename : TPH 12m Fast OSv2.gcm
Sample # : 53
Date Acquired : 20/03/2020 00:06:11
Date Processed : 20/03/2020

<Chromatogram>



TPH Chromatogram on Soil Sample: 985732

<Sample Information>

Sample Name : 985732 20-08170
Data Filename : 19 March 2020_19032020_985732 20-08170_107.gcd
Method Filename : TPH 12m Fast OSv2.gcm
Sample # : 54
Date Acquired : 20/03/2020 00:18:52
Date Processed : 20/03/2020

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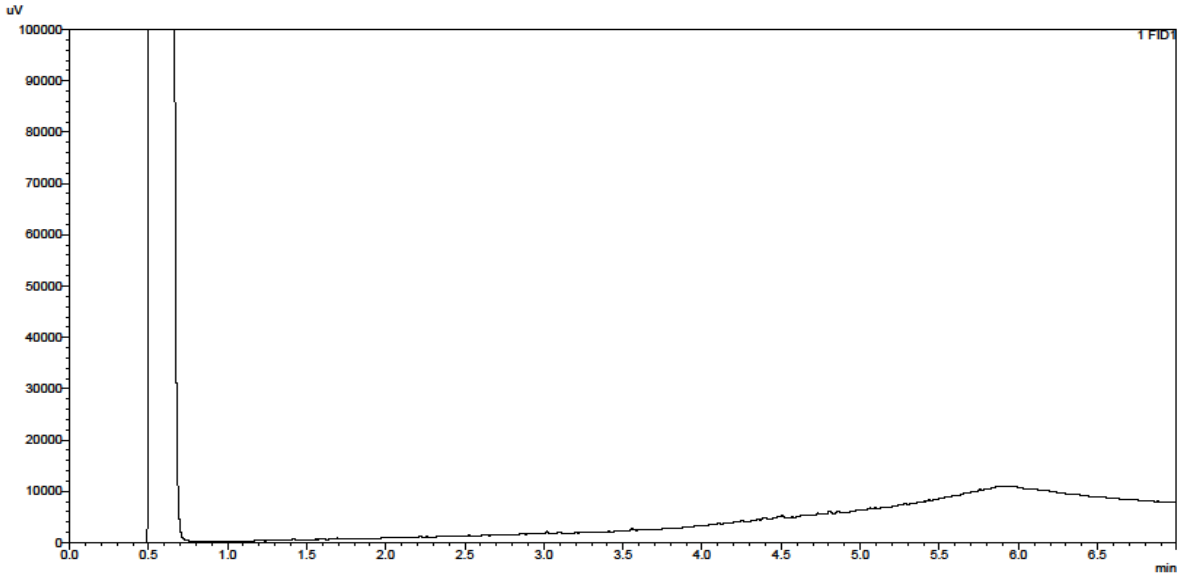

TPH Chromatogram on Soil Sample: 985733

<Sample Information>

Sample Name : 985733 20-08170
Data Filename : 19 March 2020_19032020_985733 20-08170_109.gcd
Method Filename : TPH 12m Fast OSv2.gcm
Sample # : 55
Date Acquired : 20/03/2020 00:31:32
Date Processed : 20/03/2020

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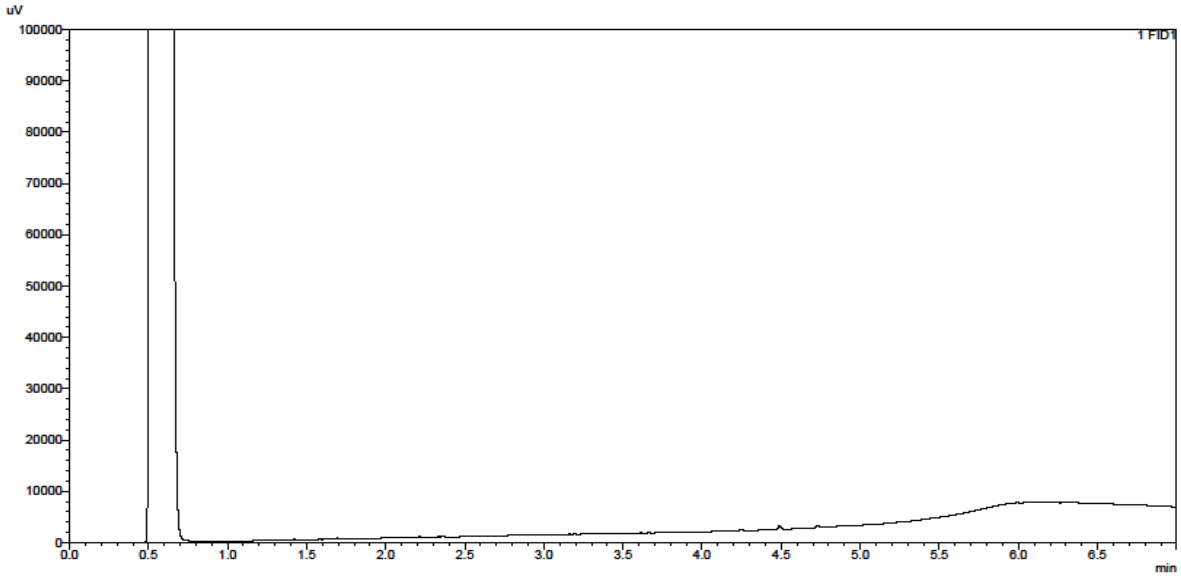

TPH Chromatogram on Soil Sample: 985734

<Sample Information>

Sample Name : 985734 20-08170
Data Filename : 19 March 2020_19032020_985734 20-08170_111.gcd
Method Filename : TPH 12m Fast OSv2.gcm
Sample # : 56
Date Acquired : 20/03/2020 00:44:18
Date Processed : 20/03/2020

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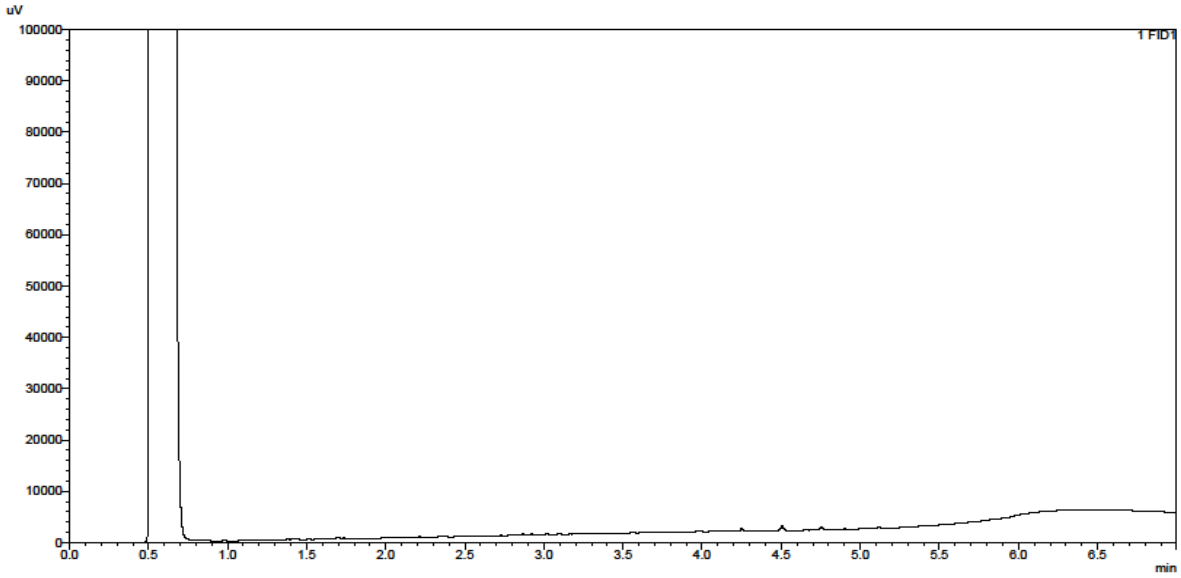
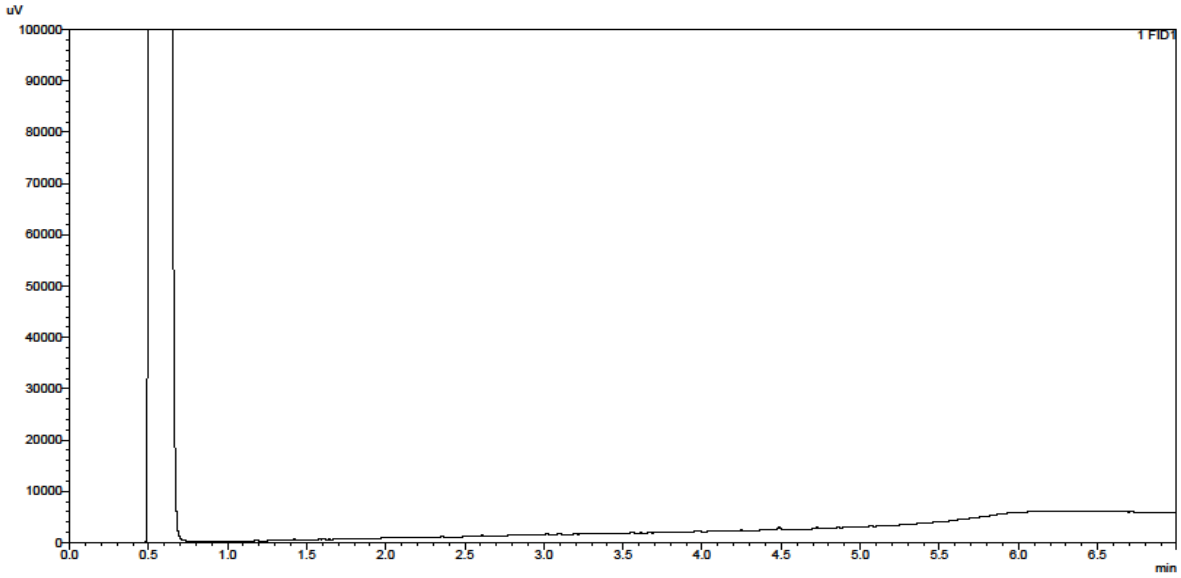


TPH Chromatogram on Soil Sample: 985736

<Sample Information>

Sample Name : 985736 20-08170
Data Filename : 19 March 2020_19032020_985736 20-08170_113.gcd
Method Filename : TPH 12m Fast OSv2.gcm
Sample # : 57
Date Acquired : 20/03/2020 00:57:13
Date Processed : 20/03/2020

<Chromatogram>



Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS

Report Information

Key

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

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

Sample Deviation Codes

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

Sample Retention and Disposal

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

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

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

Final Report

Report No.:	20-08295-1
Initial Date of Issue:	23-Mar-2020
Client	Stantec UK Limited
Client Address:	3rd Floor 50-60 Station Road Cambridge Cambridgeshire CB1 2JH
Contact(s):	Oliver Belson
Project	47179 Comet Way, Hatfield

Quotation No.:		**Date Received:**	16-Mar-2020
Order No.:	32280	**Date Instructed:**	18-Mar-2020
No. of Samples:	5		
Turnaround (Wkdays):	5	**Results Due:**	24-Mar-2020
Date Approved:	23-Mar-2020		

Approved By:

[redacted]

Details: Glynn Harvey, Technical Manager

Chemtest
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Results - Soil

Project: 47179 Comet Way, Hatfield

Client: Stantec UK Limited		**Chemtest Job No.:**			20-08295	20-08295	20-08295	20-08295	20-08295
Quotation No.:		**Chemtest Sample ID.:**			986363	986365	986366	986367	986369
		Client Sample ID.:			ES1	ES1	ES1	ES2	ES1
		Sample Location:			WS03	WS05	WS06	WS06	WS07
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.5	0.5	0.7	1.9	0.5
		Date Sampled:			10-Mar-2020	10-Mar-2020	09-Mar-2020	12-Mar-2020	09-Mar-2020
		Asbestos Lab:			LIVERPOOL	LIVERPOOL	LIVERPOOL		LIVERPOOL
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
ACM Type	U	2192		N/A	-	-	-		Board
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected		Amosite
ACM Detection Stage	U	2192		N/A	-	-	-		Stereo Microscopy
Moisture	N	2030	%	0.020	9.9	12	13	11	13
Natural Moisture Content	N	2030	%	0.020	11	13	15	12	15
Soil Colour	N	2040		N/A	Brown,	Brown,	Brown,	Brown,	Brown,
Other Material	N	2040		N/A	Stones,	Stones,	Stones,	Stones,	Stones,
Soil Texture	N	2040		N/A	Clay,	Clay,	Clay,	Clay,	Sand,
Chromatogram (TPH)	N			N/A	See Attached	See Attached	See Attached	See Attached	See Attached
pH	M	2010		4.0	9.8		9.3		
Arsenic	M	2450	mg/kg	1.0	27	9.7	17		13
Cadmium	M	2450	mg/kg	0.10	0.26	0.17	0.21		0.24
Chromium	M	2450	mg/kg	1.0	30	17	21		24
Copper	U	2450	mg/kg	0.50	21	22	27		92
Mercury	M	2450	mg/kg	0.10	< 0.10	< 0.10	0.21		0.20
Nickel	M	2450	mg/kg	0.50	28	20	20		27
Lead	M	2450	mg/kg	0.50	54	46	79		310
Selenium	M	2450	mg/kg	0.20	< 0.20	0.20	0.26		< 0.20
Zinc	U	2450	mg/kg	0.50	89	69	60		300
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50		0.52
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	2.9
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	5.1	< 1.0	< 1.0	61
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	5.1	< 5.0	< 5.0	63
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	6.9	3.0	< 1.0	< 1.0	2.4
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	170	190	< 1.0	< 1.0	160

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Results - Soil

Project: 47179 Comet Way, Hatfield

Client: Stantec UK Limited					**Chemtest Job No.:**	20-08295	20-08295	20-08295	20-08295
Quotation No.:					**Chemtest Sample ID.:**	986363	986365	986366	986367	986369
					Client Sample ID.:	ES1	ES1	ES1	ES2	ES1
					Sample Location:	WS03	WS05	WS06	WS06	WS07
					Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	0.5	0.5	0.7	1.9	0.5
					Date Sampled:	10-Mar-2020	10-Mar-2020	09-Mar-2020	12-Mar-2020	09-Mar-2020
					Asbestos Lab:	LIVERPOOL	LIVERPOOL	LIVERPOOL		LIVERPOOL
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0		180	200	< 5.0	< 5.0	170
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0		180	200	< 10	< 10	230
Dichlorodifluoromethane	U	2760	µg/kg	1.0					< 1.0	
Chloromethane	M	2760	µg/kg	1.0					< 1.0	
Vinyl Chloride	M	2760	µg/kg	1.0					< 1.0	
Bromomethane	M	2760	µg/kg	20					< 20	
Chloroethane	U	2760	µg/kg	2.0					< 2.0	
Trichlorofluoromethane	M	2760	µg/kg	1.0					< 1.0	
1,1-Dichloroethene	M	2760	mg/kg	1.0					< 1.0	
Trans 1,2-Dichloroethene	M	2760	mg/kg	1.0					< 1.0	
1,1-Dichloroethane	M	2760	µg/kg	1.0					< 1.0	
cis 1,2-Dichloroethene	M	2760	µg/kg	1.0					< 1.0	
Bromochloromethane	U	2760	µg/kg	5.0					< 5.0	
Trichloromethane	M	2760	µg/kg	1.0					< 1.0	
1,1,1-Trichloroethane	M	2760	µg/kg	1.0					< 1.0	
Tetrachloromethane	M	2760	µg/kg	1.0					< 1.0	
1,1-Dichloropropene	U	2760	µg/kg	1.0					< 1.0	
Benzene	M	2760	µg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	M	2760	µg/kg	2.0					< 2.0	
Trichloroethene	N	2760	µg/kg	1.0					< 1.0	
1,2-Dichloropropane	M	2760	µg/kg	1.0					< 1.0	
Dibromomethane	M	2760	µg/kg	1.0					< 1.0	
Bromodichloromethane	M	2760	µg/kg	5.0					< 5.0	
cis-1,3-Dichloropropene	N	2760	µg/kg	10					< 10	
Toluene	M	2760	µg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	N	2760	µg/kg	10					< 10	
1,1,2-Trichloroethane	M	2760	µg/kg	10					< 10	
Tetrachloroethene	M	2760	µg/kg	1.0					< 1.0	
1,3-Dichloropropane	U	2760	µg/kg	2.0					< 2.0	
Dibromochloromethane	U	2760	µg/kg	10					< 10	
1,2-Dibromoethane	M	2760	µg/kg	5.0					< 5.0	
Chlorobenzene	M	2760	µg/kg	1.0					< 1.0	
1,1,1,2-Tetrachloroethane	M	2760	µg/kg	2.0					< 2.0	
Ethylbenzene	M	2760	µg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	M	2760	µg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	M	2760	µg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Styrene	M	2760	µg/kg	1.0					< 1.0	

Chemtest
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Results - Soil

Project: 47179 Comet Way, Hatfield

Client: Stantec UK Limited			**Chemtest Job No.:**		20-08295	20-08295	20-08295	20-08295	20-08295
Quotation No.:			**Chemtest Sample ID.:**		986363	986365	986366	986367	986369
			Client Sample ID.:		ES1	ES1	ES1	ES2	ES1
			Sample Location:		WS03	WS05	WS06	WS06	WS07
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		0.5	0.5	0.7	1.9	0.5
			Date Sampled:		10-Mar-2020	10-Mar-2020	09-Mar-2020	12-Mar-2020	09-Mar-2020
			Asbestos Lab:		LIVERPOOL	LIVERPOOL	LIVERPOOL		LIVERPOOL
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
Tribromomethane	U	2760	µg/kg	1.0				< 1.0	
Isopropylbenzene	M	2760	µg/kg	1.0				< 1.0	
Bromobenzene	M	2760	µg/kg	1.0				< 1.0	
1,2,3-Trichloropropane	N	2760	µg/kg	50				< 50	
N-Propylbenzene	U	2760	µg/kg	1.0				< 1.0	
2-Chlorotoluene	M	2760	µg/kg	1.0				< 1.0	
1,3,5-Trimethylbenzene	M	2760	µg/kg	1.0				< 1.0	
4-Chlorotoluene	U	2760	µg/kg	1.0				< 1.0	
Tert-Butylbenzene	U	2760	µg/kg	1.0				< 1.0	
1,2,4-Trimethylbenzene	M	2760	µg/kg	1.0				< 1.0	
Sec-Butylbenzene	U	2760	µg/kg	1.0				< 1.0	
1,3-Dichlorobenzene	M	2760	µg/kg	1.0				< 1.0	
4-Isopropyltoluene	U	2760	µg/kg	1.0				< 1.0	
1,4-Dichlorobenzene	M	2760	µg/kg	1.0				< 1.0	
N-Butylbenzene	U	2760	µg/kg	1.0				< 1.0	
1,2-Dichlorobenzene	M	2760	µg/kg	1.0				< 1.0	
1,2-Dibromo-3-Chloropropane	U	2760	µg/kg	50				< 50	
1,2,4-Trichlorobenzene	M	2760	µg/kg	1.0				< 1.0	
Hexachlorobutadiene	U	2760	µg/kg	1.0				< 1.0	
1,2,3-Trichlorobenzene	U	2760	µg/kg	2.0				< 2.0	
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Naphthalene	N	2800	mg/kg	0.010	0.080	0.12	< 0.010	< 0.010	< 0.010
Acenaphthylene	N	2800	mg/kg	0.010	0.17	0.030	< 0.010	< 0.010	0.040
Acenaphthene	N	2800	mg/kg	0.010	0.090	0.050	< 0.010	< 0.010	< 0.010
Fluorene	N	2800	mg/kg	0.010	0.090	0.040	< 0.010	< 0.010	0.020
Phenanthrene	N	2800	mg/kg	0.010	1.1	0.33	< 0.010	< 0.010	0.62
Anthracene	N	2800	mg/kg	0.010	0.46	0.10	< 0.010	< 0.010	0.16
Fluoranthene	N	2800	mg/kg	0.010	2.7	1.4	0.31	< 0.010	1.4
Pyrene	N	2800	mg/kg	0.010	2.4	1.2	0.19	< 0.010	1.2
Benzo[a]anthracene	N	2800	mg/kg	0.010	1.2	0.71	< 0.010	< 0.010	0.72
Chrysene	N	2800	mg/kg	0.010	0.94	0.45	< 0.010	< 0.010	0.60
Benzo[b]fluoranthene	N	2800	mg/kg	0.010	2.2	1.1	< 0.010	< 0.010	1.0
Benzo[k]fluoranthene	N	2800	mg/kg	0.010	0.76	0.26	< 0.010	< 0.010	0.32
Benzo[a]pyrene	N	2800	mg/kg	0.010	2.5	1.2	< 0.010	< 0.010	0.74
Indeno(1,2,3-c,d)Pyrene	N	2800	mg/kg	0.010	1.4	0.55	< 0.010	< 0.010	0.50
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.010	0.22	0.14	< 0.010	< 0.010	0.13
Benzo[g,h,i]perylene	N	2800	mg/kg	0.010	1.5	0.52	< 0.010	< 0.010	0.50
Total Of 16 PAH's	N	2800	mg/kg	0.20	18	8.2	0.50	< 0.20	7.9

Results - Soil

Project: 47179 Comet Way, Hatfield

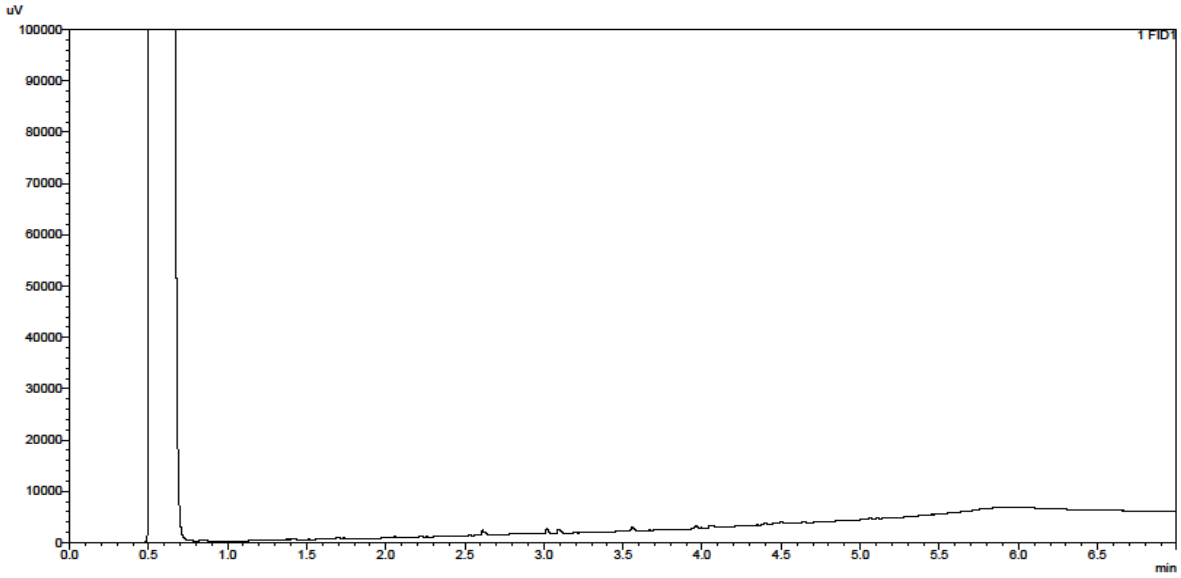
Client: Stantec UK Limited					**Chemtest Job No.:**	20-08295	20-08295	20-08295	20-08295	20-08295
Quotation No.:					**Chemtest Sample ID.:**	986363	986365	986366	986367	986369
					Client Sample ID.:	ES1	ES1	ES1	ES2	ES1
					Sample Location:	WS03	WS05	WS06	WS06	WS07
					Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	0.5	0.5	0.7	1.9	0.5
					Date Sampled:	10-Mar-2020	10-Mar-2020	09-Mar-2020	12-Mar-2020	09-Mar-2020
					Asbestos Lab:	LIVERPOOL	LIVERPOOL	LIVERPOOL		LIVERPOOL
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
VOC TIC	N	2760	µg/kg	N/A					None Detected	

TPH Chromatogram on Soil Sample: 986363

<Sample Information>

Sample Name : 986363 20-08295
Data Filename : 19 March 2020_19032020_986363 20-08295_123.gcd
Method Filename : TPH 12m Fast OSv2.gcm
Sample # : 62
Date Acquired : 20/03/2020 02:00:53
Date Processed : 20/03/2020

<Chromatogram>

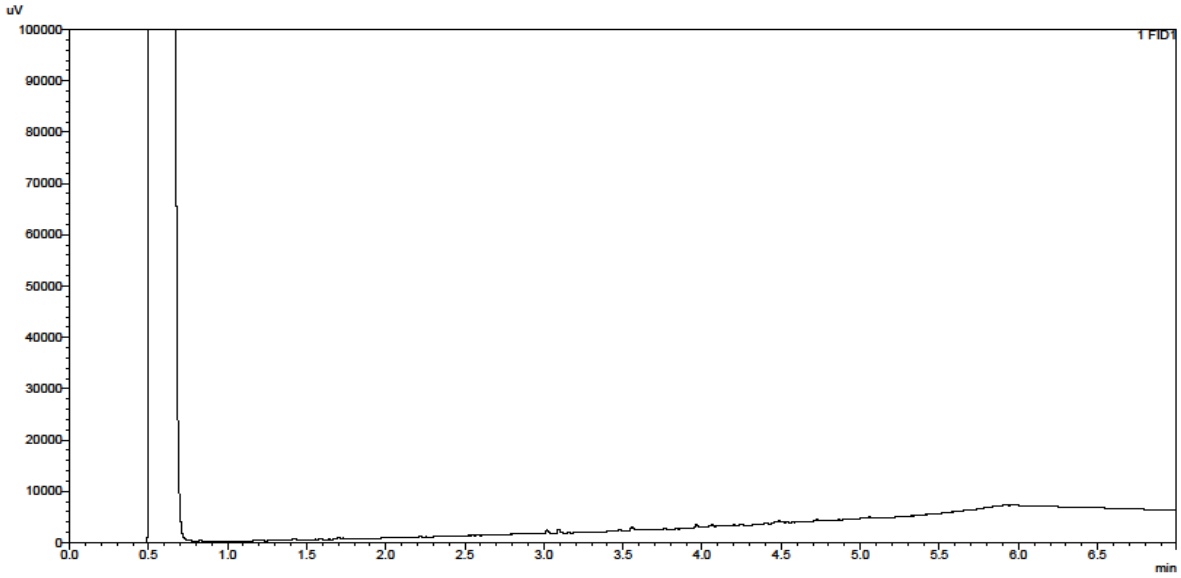


TPH Chromatogram on Soil Sample: 986365

<Sample Information>

Sample Name : 986365 20-08295
Data Filename : 19 March 2020_19032020_986365 20-08295_125.gcd
Method Filename : TPH 12m Fast OSv2.gcm
Sample # : 63
Date Acquired : 20/03/2020 02:13:40
Date Processed : 20/03/2020

<Chromatogram>

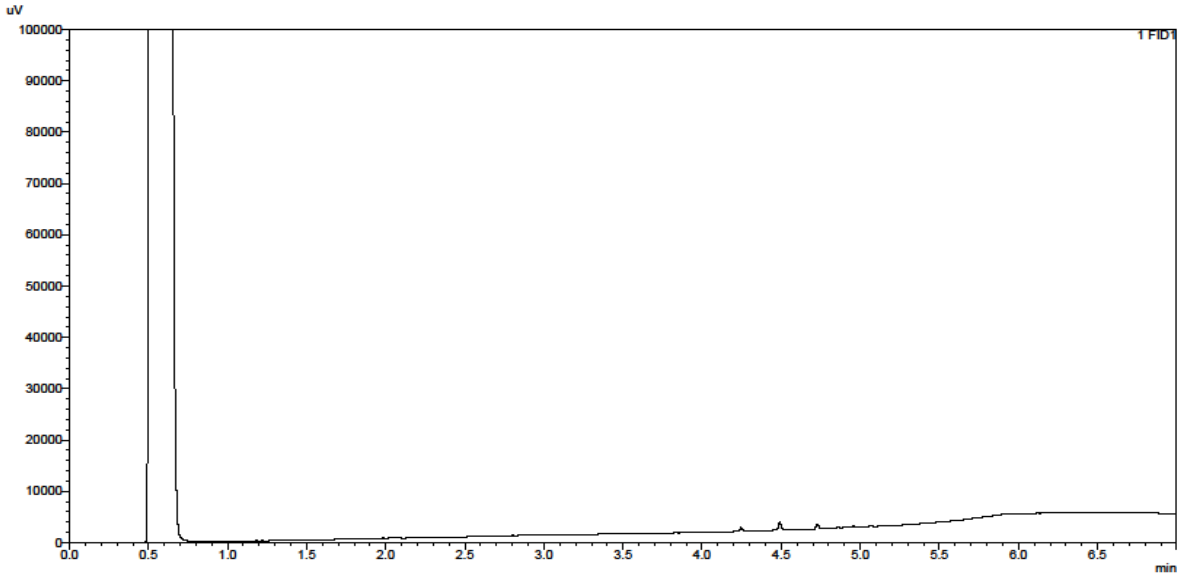


TPH Chromatogram on Soil Sample: 986366

<Sample Information>

Sample Name : 986366 20-08295
Data Filename : 19 March 2020_19032020_986366 20-08295_127.gcd
Method Filename : TPH 12m Fast OSv2.gcm
Sample # : 64
Date Acquired : 20/03/2020 02:26:22
Date Processed : 20/03/2020

<Chromatogram>

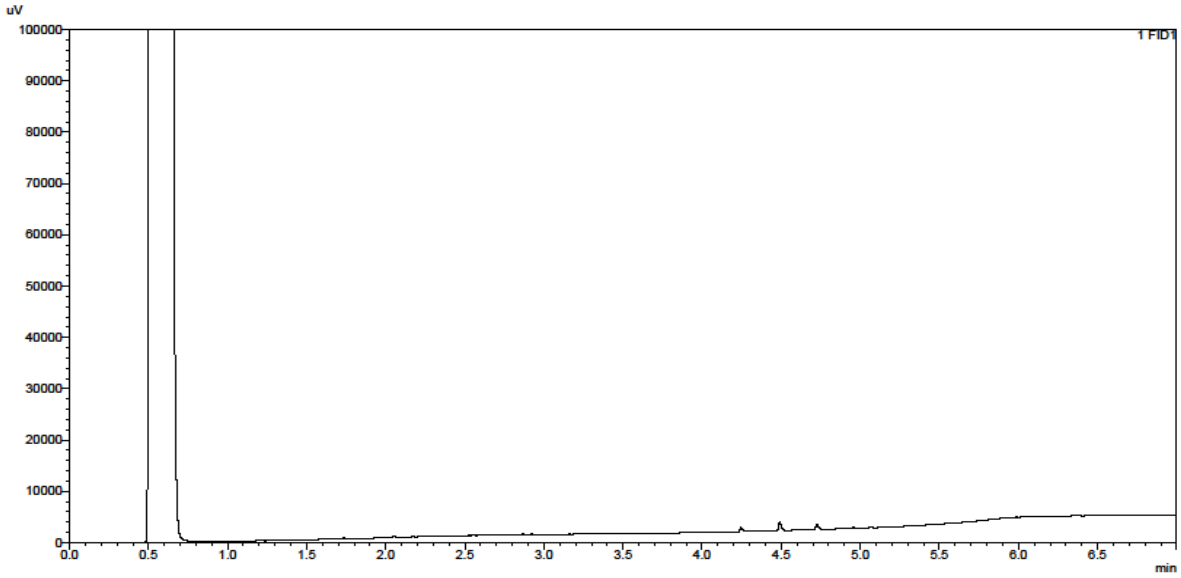


TPH Chromatogram on Soil Sample: 986367

<Sample Information>

Sample Name : 986367 20-08295
Data Filename : 19 March 2020_19032020_986367 20-08295_129.gcd
Method Filename : TPH 12m Fast OSv2.gcm
Sample # : 65
Date Acquired : 20/03/2020 02:39:07
Date Processed : 20/03/2020

<Chromatogram>

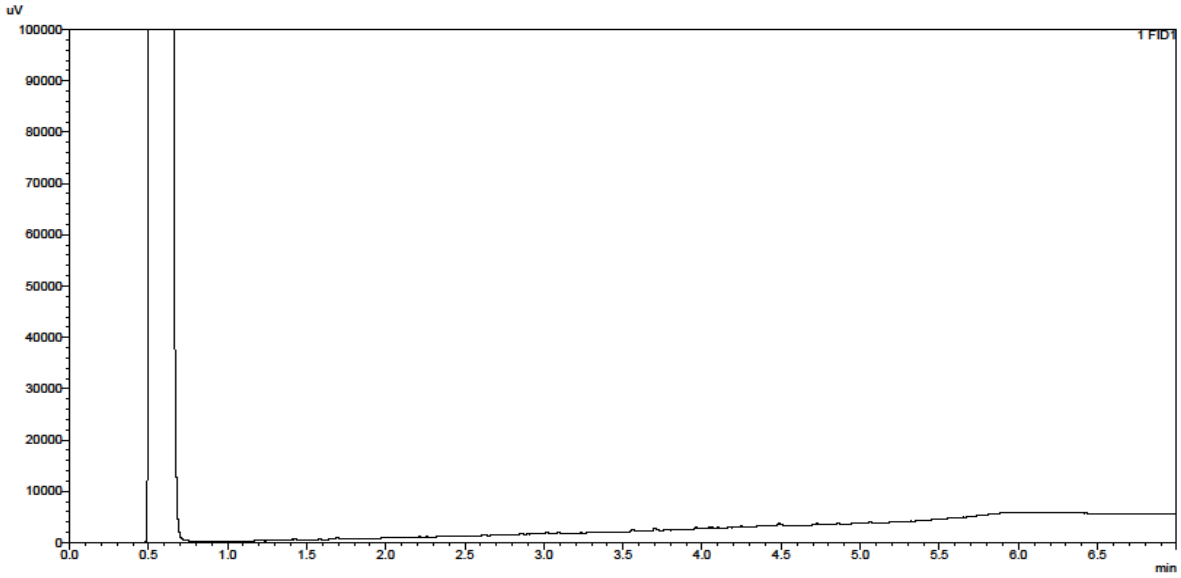


TPH Chromatogram on Soil Sample: 986369

<Sample Information>

Sample Name : 986369 20-08295
Data Filename : 19 March 2020_19032020_986369 20-08295_131.gcd
Method Filename : TPH 12m Fast OSv2.gcm
Sample # : 66
Date Acquired : 20/03/2020 02:51:54
Date Processed : 20/03/2020

<Chromatogram>



Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS

Report Information

Key

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

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

Sample Deviation Codes

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

Sample Retention and Disposal

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

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

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

Amended Report

Report No.:	20-08295-2		
Initial Date of Issue:	23-Mar-2020	**Date of Re-Issue:**	30-Apr-2020
Client	Stantec UK Limited		
Client Address:	3rd Floor 50-60 Station Road Cambridge Cambridgeshire CB1 2JH		
Contact(s):	Oliver Belson		
Project	47179 Comet Way, Hatfield		
Quotation No.:		**Date Received:**	16-Mar-2020
Order No.:	32280	**Date Instructed:**	18-Mar-2020
No. of Samples:	6		
Turnaround (Wkdays):	34	**Results Due:**	06-May-2020
Date Approved:	30-Apr-2020		

Approved By:

[redacted]

Details: Glynn Harvey, Technical Manager

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Results - Soil

Project: 47179 Comet Way, Hatfield

Client: Stantec UK Limited		**Chemtest Job No.:**			20-08295	20-08295	20-08295	20-08295	20-08295
Quotation No.:		**Chemtest Sample ID.:**			986363	986365	986366	986367	986369
		Client Sample ID.:			ES1	ES1	ES1	ES2	ES1
		Sample Location:			WS03	WS05	WS06	WS06	WS07
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.5	0.5	0.7	1.9	0.5
		Date Sampled:			10-Mar-2020	10-Mar-2020	09-Mar-2020	12-Mar-2020	09-Mar-2020
		Asbestos Lab:			LIVERPOOL	LIVERPOOL	LIVERPOOL		LIVERPOOL
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
ACM Type	U	2192		N/A	-	-	-		Board
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected		Amosite
ACM Detection Stage	U	2192		N/A	-	-	-		Stereo Microscopy
Asbestos by Gravimetry	U	2192	%	0.001					0.005
Total Asbestos	N	2192	%	0.001					0.005
Moisture	N	2030	%	0.020	9.9	12	13	11	13
Natural Moisture Content	N	2030	%	0.020	11	13	15	12	15
Soil Colour	N	2040		N/A	Brown,	Brown,	Brown,	Brown,	Brown,
Other Material	N	2040		N/A	Stones,	Stones,	Stones,	Stones,	Stones,
Soil Texture	N	2040		N/A	Clay,	Clay,	Clay,	Clay,	Sand,
Chromatogram (TPH)	N			N/A	See Attached	See Attached	See Attached	See Attached	See Attached
pH	M	2010		4.0	9.8		9.3		
Arsenic	M	2450	mg/kg	1.0	27	9.7	17		13
Cadmium	M	2450	mg/kg	0.10	0.26	0.17	0.21		0.24
Chromium	M	2450	mg/kg	1.0	30	17	21		24
Copper	M	2450	mg/kg	0.50	21	22	27		92
Mercury	M	2450	mg/kg	0.10	< 0.10	< 0.10	0.21		0.20
Nickel	M	2450	mg/kg	0.50	28	20	20		27
Lead	M	2450	mg/kg	0.50	54	46	79		310
Selenium	M	2450	mg/kg	0.20	< 0.20	0.20	0.26		< 0.20
Zinc	M	2450	mg/kg	0.50	89	69	60		300
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50		0.52
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	2.9
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	5.1	< 1.0	< 1.0	61
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	5.1	< 5.0	< 5.0	63
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

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Results - Soil

Project: 47179 Comet Way, Hatfield

Client: Stantec UK Limited		**Chemtest Job No.:**			20-08295	20-08295	20-08295	20-08295	20-08295
Quotation No.:		**Chemtest Sample ID.:**			986363	986365	986366	986367	986369
		Client Sample ID.:			ES1	ES1	ES1	ES2	ES1
		Sample Location:			WS03	WS05	WS06	WS06	WS07
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			0.5	0.5	0.7	1.9	0.5
		Date Sampled:			10-Mar-2020	10-Mar-2020	09-Mar-2020	12-Mar-2020	09-Mar-2020
		Asbestos Lab:			LIVERPOOL	LIVERPOOL	LIVERPOOL		LIVERPOOL
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	6.9	3.0	< 1.0	< 1.0	2.4
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	170	190	< 1.0	< 1.0	160
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	180	200	< 5.0	< 5.0	170
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	180	200	< 10	< 10	230
Dichlorodifluoromethane	U	2760	µg/kg	1.0				< 1.0	
Chloromethane	M	2760	µg/kg	1.0				< 1.0	
Vinyl Chloride	M	2760	µg/kg	1.0				< 1.0	
Bromomethane	M	2760	µg/kg	20				< 20	
Chloroethane	U	2760	µg/kg	2.0				< 2.0	
Trichlorofluoromethane	M	2760	µg/kg	1.0				< 1.0	
1,1-Dichloroethene	M	2760	mg/kg	1.0				< 1.0	
Trans 1,2-Dichloroethene	M	2760	mg/kg	1.0				< 1.0	
1,1-Dichloroethane	M	2760	µg/kg	1.0				< 1.0	
cis 1,2-Dichloroethene	M	2760	µg/kg	1.0				< 1.0	
Bromochloromethane	U	2760	µg/kg	5.0				< 5.0	
Trichloromethane	M	2760	µg/kg	1.0				< 1.0	
1,1,1-Trichloroethane	M	2760	µg/kg	1.0				< 1.0	
Tetrachloromethane	M	2760	µg/kg	1.0				< 1.0	
1,1-Dichloropropene	U	2760	µg/kg	1.0				< 1.0	
Benzene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	M	2760	µg/kg	2.0				< 2.0	
Trichloroethene	N	2760	µg/kg	1.0				< 1.0	
1,2-Dichloropropane	M	2760	µg/kg	1.0				< 1.0	
Dibromomethane	M	2760	µg/kg	1.0				< 1.0	
Bromodichloromethane	M	2760	µg/kg	5.0				< 5.0	
cis-1,3-Dichloropropene	N	2760	µg/kg	10				< 10	
Toluene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	N	2760	µg/kg	10				< 10	
1,1,2-Trichloroethane	M	2760	µg/kg	10				< 10	
Tetrachloroethene	M	2760	µg/kg	1.0				< 1.0	
1,3-Dichloropropane	U	2760	µg/kg	2.0				< 2.0	
Dibromochloromethane	U	2760	µg/kg	10				< 10	
1,2-Dibromoethane	M	2760	µg/kg	5.0				< 5.0	
Chlorobenzene	M	2760	µg/kg	1.0				< 1.0	
1,1,1,2-Tetrachloroethane	M	2760	µg/kg	2.0				< 2.0	
Ethylbenzene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: 47179 Comet Way, Hatfield

Client: Stantec UK Limited					**Chemtest Job No.:**	20-08295	20-08295	20-08295	20-08295
Quotation No.:					**Chemtest Sample ID.:**	986363	986365	986366	986367	986369
					Client Sample ID.:	ES1	ES1	ES1	ES2	ES1
					Sample Location:	WS03	WS05	WS06	WS06	WS07
					Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	0.5	0.5	0.7	1.9	0.5
					Date Sampled:	10-Mar-2020	10-Mar-2020	09-Mar-2020	12-Mar-2020	09-Mar-2020
					Asbestos Lab:	LIVERPOOL	LIVERPOOL	LIVERPOOL		LIVERPOOL
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
o-Xylene	M	2760	µg/kg	1.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Styrene	M	2760	µg/kg	1.0					< 1.0	
Tribromomethane	U	2760	µg/kg	1.0					< 1.0	
Isopropylbenzene	M	2760	µg/kg	1.0					< 1.0	
Bromobenzene	M	2760	µg/kg	1.0					< 1.0	
1,2,3-Trichloropropane	N	2760	µg/kg	50					< 50	
N-Propylbenzene	U	2760	µg/kg	1.0					< 1.0	
2-Chlorotoluene	M	2760	µg/kg	1.0					< 1.0	
1,3,5-Trimethylbenzene	M	2760	µg/kg	1.0					< 1.0	
4-Chlorotoluene	U	2760	µg/kg	1.0					< 1.0	
Tert-Butylbenzene	U	2760	µg/kg	1.0					< 1.0	
1,2,4-Trimethylbenzene	M	2760	µg/kg	1.0					< 1.0	
Sec-Butylbenzene	U	2760	µg/kg	1.0					< 1.0	
1,3-Dichlorobenzene	M	2760	µg/kg	1.0					< 1.0	
4-Isopropyltoluene	U	2760	µg/kg	1.0					< 1.0	
1,4-Dichlorobenzene	M	2760	µg/kg	1.0					< 1.0	
N-Butylbenzene	U	2760	µg/kg	1.0					< 1.0	
1,2-Dichlorobenzene	M	2760	µg/kg	1.0					< 1.0	
1,2-Dibromo-3-Chloropropane	U	2760	µg/kg	50					< 50	
1,2,4-Trichlorobenzene	M	2760	µg/kg	1.0					< 1.0	
Hexachlorobutadiene	U	2760	µg/kg	1.0					< 1.0	
1,2,3-Trichlorobenzene	U	2760	µg/kg	2.0					< 2.0	
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Naphthalene	N	2800	mg/kg	0.010	0.080	0.12	< 0.010	< 0.010	< 0.010
Acenaphthylene	N	2800	mg/kg	0.010	0.17	0.030	< 0.010	< 0.010	0.040
Acenaphthene	N	2800	mg/kg	0.010	0.090	0.050	< 0.010	< 0.010	< 0.010
Fluorene	N	2800	mg/kg	0.010	0.090	0.040	< 0.010	< 0.010	0.020
Phenanthrene	N	2800	mg/kg	0.010	1.1	0.33	< 0.010	< 0.010	0.62
Anthracene	N	2800	mg/kg	0.010	0.46	0.10	< 0.010	< 0.010	0.16
Fluoranthene	N	2800	mg/kg	0.010	2.7	1.4	0.31	< 0.010	1.4
Pyrene	N	2800	mg/kg	0.010	2.4	1.2	0.19	< 0.010	1.2
Benzo[a]anthracene	N	2800	mg/kg	0.010	1.2	0.71	< 0.010	< 0.010	0.72
Chrysene	N	2800	mg/kg	0.010	0.94	0.45	< 0.010	< 0.010	0.60
Benzo[b]fluoranthene	N	2800	mg/kg	0.010	2.2	1.1	< 0.010	< 0.010	1.0
Benzo[k]fluoranthene	N	2800	mg/kg	0.010	0.76	0.26	< 0.010	< 0.010	0.32
Benzo[a]pyrene	N	2800	mg/kg	0.010	2.5	1.2	< 0.010	< 0.010	0.74
Indeno(1,2,3-c,d)Pyrene	N	2800	mg/kg	0.010	1.4	0.55	< 0.010	< 0.010	0.50
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.010	0.22	0.14	< 0.010	< 0.010	0.13

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Results - Soil

Project: 47179 Comet Way, Hatfield

Client: Stantec UK Limited					**Chemtest Job No.:**	20-08295	20-08295	20-08295	20-08295	20-08295
Quotation No.:					**Chemtest Sample ID.:**	986363	986365	986366	986367	986369
					Client Sample ID.:	ES1	ES1	ES1	ES2	ES1
					Sample Location:	WS03	WS05	WS06	WS06	WS07
					Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	0.5	0.5	0.7	1.9	0.5
					Date Sampled:	10-Mar-2020	10-Mar-2020	09-Mar-2020	12-Mar-2020	09-Mar-2020
					Asbestos Lab:	LIVERPOOL	LIVERPOOL	LIVERPOOL		LIVERPOOL
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
Benzo[g,h,i]perylene	N	2800	mg/kg	0.010		1.5	0.52	< 0.010	< 0.010	0.50
Total Of 16 PAH's	N	2800	mg/kg	0.20		18	8.2	0.50	< 0.20	7.9
VOC TIC	N	2760	µg/kg	N/A					None Detected	

TPH Chromatogram on Soil Sample: 986363

<Sample Information>

Sample Name : 986363 20-08295
Data Filename : 19 March 2020_19032020_986363 20-08295_123.gcd
Method Filename : TPH 12m Fast OSv2.gcm
Sample # : 62
Date Acquired : 20/03/2020 02:00:53
Date Processed : 20/03/2020

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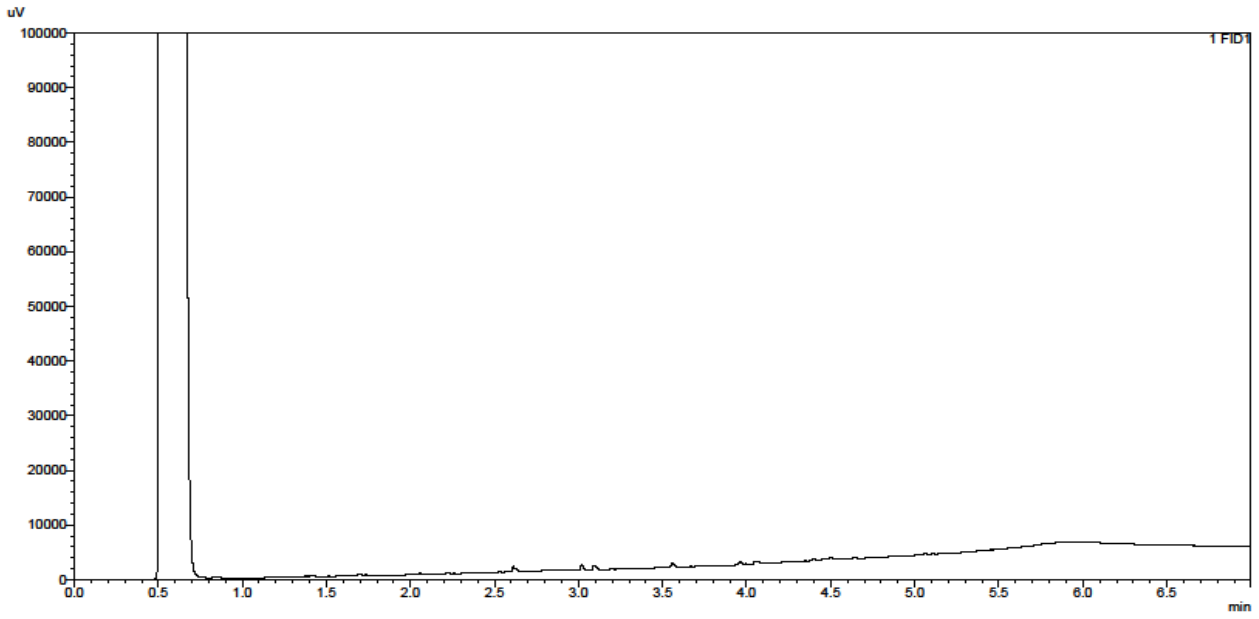
<Chromatogram>

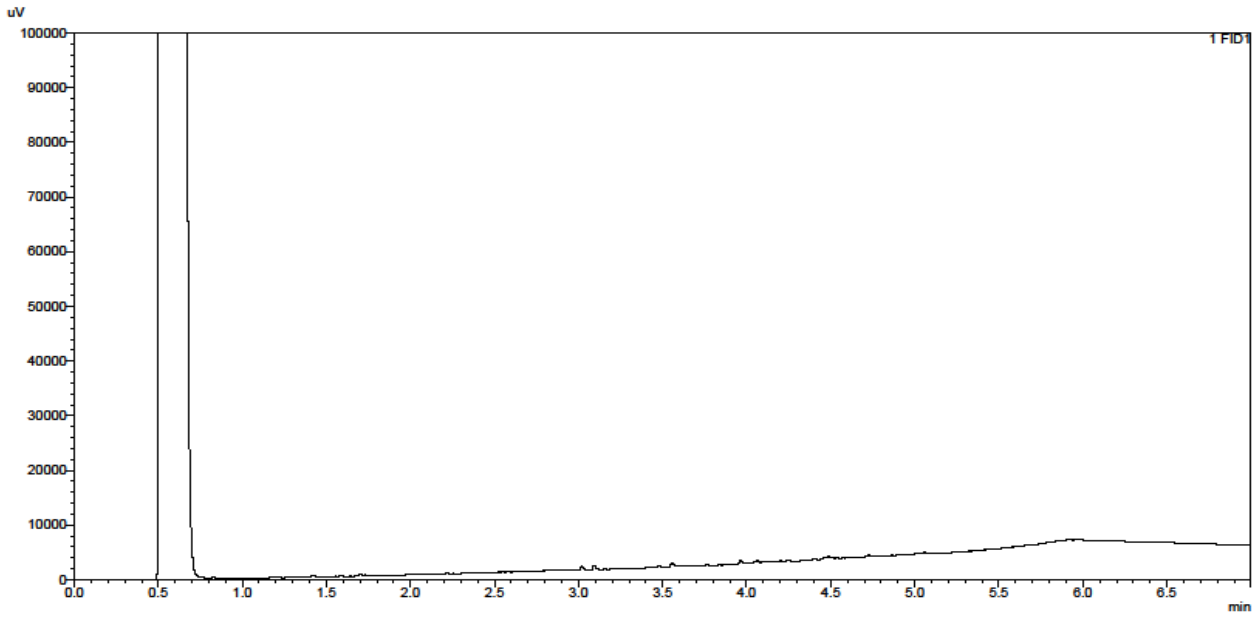


TPH Chromatogram on Soil Sample: 986365

<Sample Information>

Sample Name : 986365 20-08295
Data Filename : 19 March 2020_19032020_986365 20-08295_125.gcd
Method Filename : TPH 12m Fast OSv2.gcm
Sample # : 63
Date Acquired : 20/03/2020 02:13:40
Date Processed : 20/03/2020

<Chromatogram>

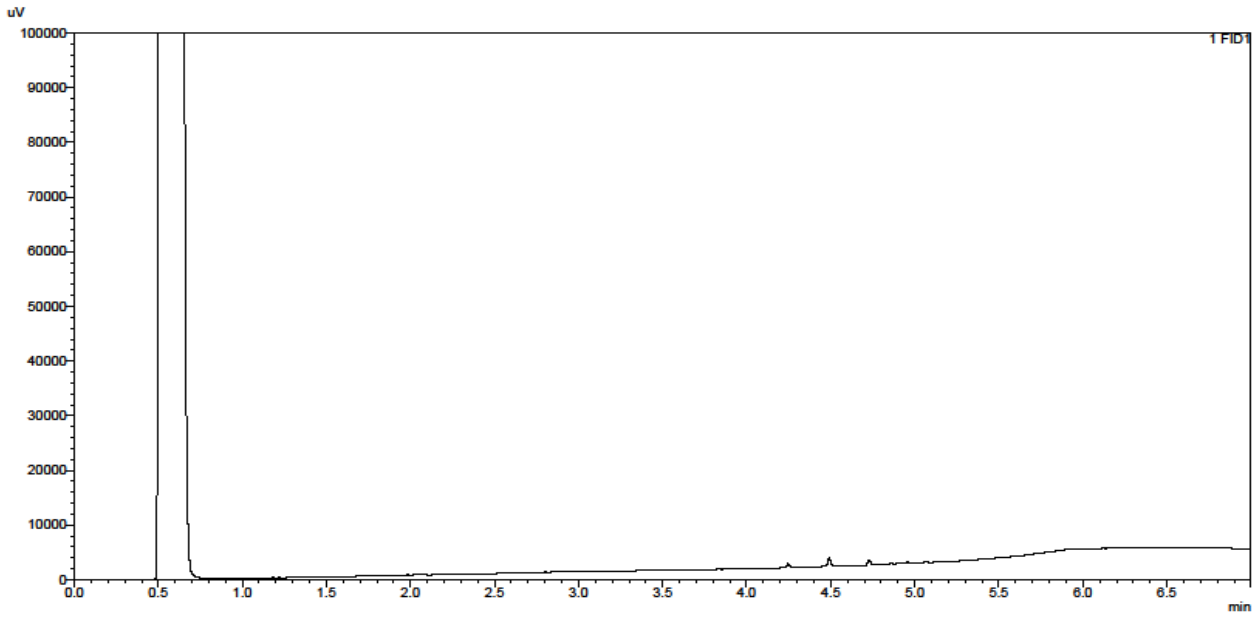


TPH Chromatogram on Soil Sample: 986366

<Sample Information>

Sample Name : 986366 20-08295
Data Filename : 19 March 2020_19032020_986366 20-08295_127.gcd
Method Filename : TPH 12m Fast OSv2.gcm
Sample # : 64
Date Acquired : 20/03/2020 02:26:22
Date Processed : 20/03/2020

<Chromatogram>



TPH Chromatogram on Soil Sample: 986367

<Sample Information>

Sample Name : 986367 20-08295
Data Filename : 19 March 2020_19032020_986367 20-08295_129.gcd
Method Filename : TPH 12m Fast OSv2.gcm
Sample # : 65
Date Acquired : 20/03/2020 02:39:07
Date Processed : 20/03/2020

Chemtest
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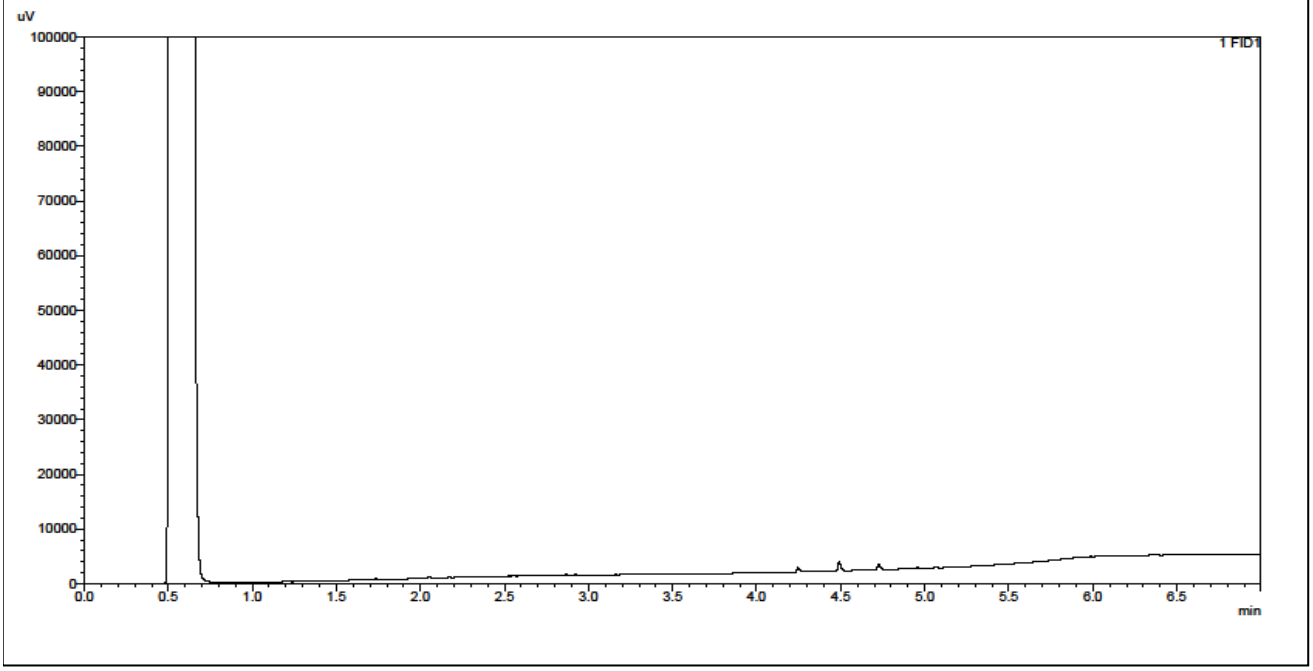
<Chromatogram>

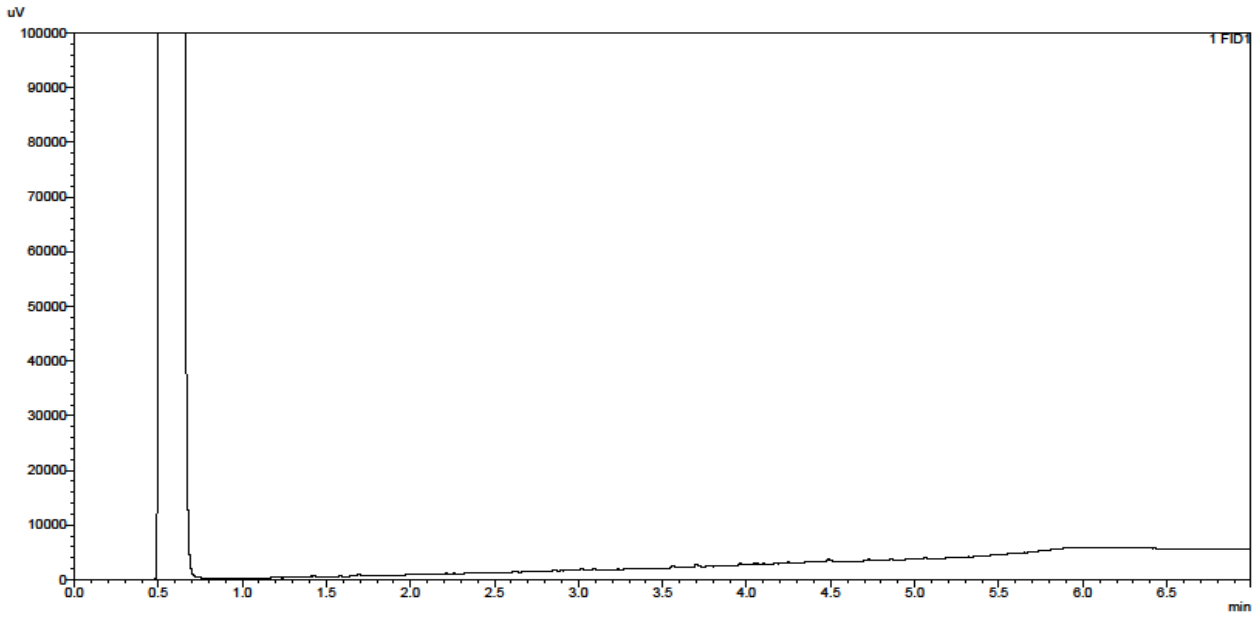


TPH Chromatogram on Soil Sample: 986369

<Sample Information>

Sample Name : 986369 20-08295
Data Filename : 19 March 2020_19032020_986369 20-08295_131.gcd
Method Filename : TPH 12m Fast OSv2.gcm
Sample # : 66
Date Acquired : 20/03/2020 02:51:54
Date Processed : 20/03/2020

<Chromatogram>



Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS

Report Information

Key

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

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

Sample Deviation Codes

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

Sample Retention and Disposal

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

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

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

Final Report

Report No.:	20-08435-1
Initial Date of Issue:	23-Mar-2020
Client	Stantec UK Limited
Client Address:	3rd Floor 50-60 Station Road Cambridge Cambridgeshire CB1 2JH
Contact(s):	Oliver Belson
Project	47179 Comet Way, Hatfield

Quotation No.:		**Date Received:**	17-Mar-2020
Order No.:	32280	**Date Instructed:**	17-Mar-2020
No. of Samples:	1		
Turnaround (Wkdays):	5	**Results Due:**	23-Mar-2020
Date Approved:	23-Mar-2020		

Approved By:

[redacted]

Details: Glynn Harvey, Technical Manager

Chemtest
The right chemistry to deliver results

Results - Soil

Project: 47179 Comet Way, Hatfield

Client: Stantec UK Limited			**Chemtest Job No.:**		20-08435
Quotation No.:			**Chemtest Sample ID.:**		987061
			Client Sample ID.:		ES2
			Sample Location:		WS02
			Sample Type:		SOIL
			Top Depth (m):		2.0
			Date Sampled:		17-Mar-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Moisture	N	2030	%	0.020	11
Natural Moisture Content	N	2030	%	0.020	13
Soil Colour	N	2040		N/A	Brown
Other Material	N	2040		N/A	Stones
Soil Texture	N	2040		N/A	Clay
Chromatogram (TPH)	N			N/A	See Attached
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10
Dichlorodifluoromethane	U	2760	µg/kg	1.0	< 1.0
Chloromethane	M	2760	µg/kg	1.0	< 1.0
Vinyl Chloride	M	2760	µg/kg	1.0	< 1.0
Bromomethane	M	2760	µg/kg	20	< 20
Chloroethane	U	2760	µg/kg	2.0	< 2.0
Trichlorofluoromethane	M	2760	µg/kg	1.0	< 1.0
1,1-Dichloroethene	M	2760	mg/kg	1.0	< 1.0
Trans 1,2-Dichloroethene	M	2760	mg/kg	1.0	< 1.0
1,1-Dichloroethane	M	2760	µg/kg	1.0	< 1.0
cis 1,2-Dichloroethene	M	2760	µg/kg	1.0	< 1.0
Bromochloromethane	U	2760	µg/kg	5.0	< 5.0
Trichloromethane	M	2760	µg/kg	1.0	< 1.0
1,1,1-Trichloroethane	M	2760	µg/kg	1.0	< 1.0
Tetrachloromethane	M	2760	µg/kg	1.0	< 1.0

Chemtest
The right chemistry to deliver results

Results - Soil

Project: 47179 Comet Way, Hatfield

Client: Stantec UK Limited			**Chemtest Job No.:**		20-08435
Quotation No.:			**Chemtest Sample ID.:**		987061
			Client Sample ID.:		ES2
			Sample Location:		WS02
			Sample Type:		SOIL
			Top Depth (m):		2.0
			Date Sampled:		17-Mar-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
1,1-Dichloropropene	U	2760	µg/kg	1.0	< 1.0
Benzene	M	2760	µg/kg	1.0	< 1.0
1,2-Dichloroethane	M	2760	µg/kg	2.0	< 2.0
Trichloroethene	N	2760	µg/kg	1.0	< 1.0
1,2-Dichloropropane	M	2760	µg/kg	1.0	< 1.0
Dibromomethane	M	2760	µg/kg	1.0	< 1.0
Bromodichloromethane	M	2760	µg/kg	5.0	< 5.0
cis-1,3-Dichloropropene	N	2760	µg/kg	10	< 10
Toluene	M	2760	µg/kg	1.0	< 1.0
Trans-1,3-Dichloropropene	N	2760	µg/kg	10	< 10
1,1,2-Trichloroethane	M	2760	µg/kg	10	< 10
Tetrachloroethene	M	2760	µg/kg	1.0	< 1.0
1,3-Dichloropropane	U	2760	µg/kg	2.0	< 2.0
Dibromochloromethane	U	2760	µg/kg	10	< 10
1,2-Dibromoethane	M	2760	µg/kg	5.0	< 5.0
Chlorobenzene	M	2760	µg/kg	1.0	< 1.0
1,1,1,2-Tetrachloroethane	M	2760	µg/kg	2.0	< 2.0
Ethylbenzene	M	2760	µg/kg	1.0	< 1.0
m & p-Xylene	M	2760	µg/kg	1.0	< 1.0
o-Xylene	M	2760	µg/kg	1.0	< 1.0
Styrene	M	2760	µg/kg	1.0	< 1.0
Tribromomethane	U	2760	µg/kg	1.0	< 1.0
Isopropylbenzene	M	2760	µg/kg	1.0	< 1.0
Bromobenzene	M	2760	µg/kg	1.0	< 1.0
1,2,3-Trichloropropane	N	2760	µg/kg	50	< 50
N-Propylbenzene	U	2760	µg/kg	1.0	< 1.0
2-Chlorotoluene	M	2760	µg/kg	1.0	< 1.0
1,3,5-Trimethylbenzene	M	2760	µg/kg	1.0	< 1.0
4-Chlorotoluene	U	2760	µg/kg	1.0	< 1.0
Tert-Butylbenzene	U	2760	µg/kg	1.0	< 1.0
1,2,4-Trimethylbenzene	M	2760	µg/kg	1.0	< 1.0
Sec-Butylbenzene	U	2760	µg/kg	1.0	< 1.0
1,3-Dichlorobenzene	M	2760	µg/kg	1.0	< 1.0
4-Isopropyltoluene	U	2760	µg/kg	1.0	< 1.0
1,4-Dichlorobenzene	M	2760	µg/kg	1.0	< 1.0
N-Butylbenzene	U	2760	µg/kg	1.0	< 1.0
1,2-Dichlorobenzene	M	2760	µg/kg	1.0	< 1.0
1,2-Dibromo-3-Chloropropane	U	2760	µg/kg	50	< 50
1,2,4-Trichlorobenzene	M	2760	µg/kg	1.0	< 1.0

Results - Soil

Project: 47179 Comet Way, Hatfield

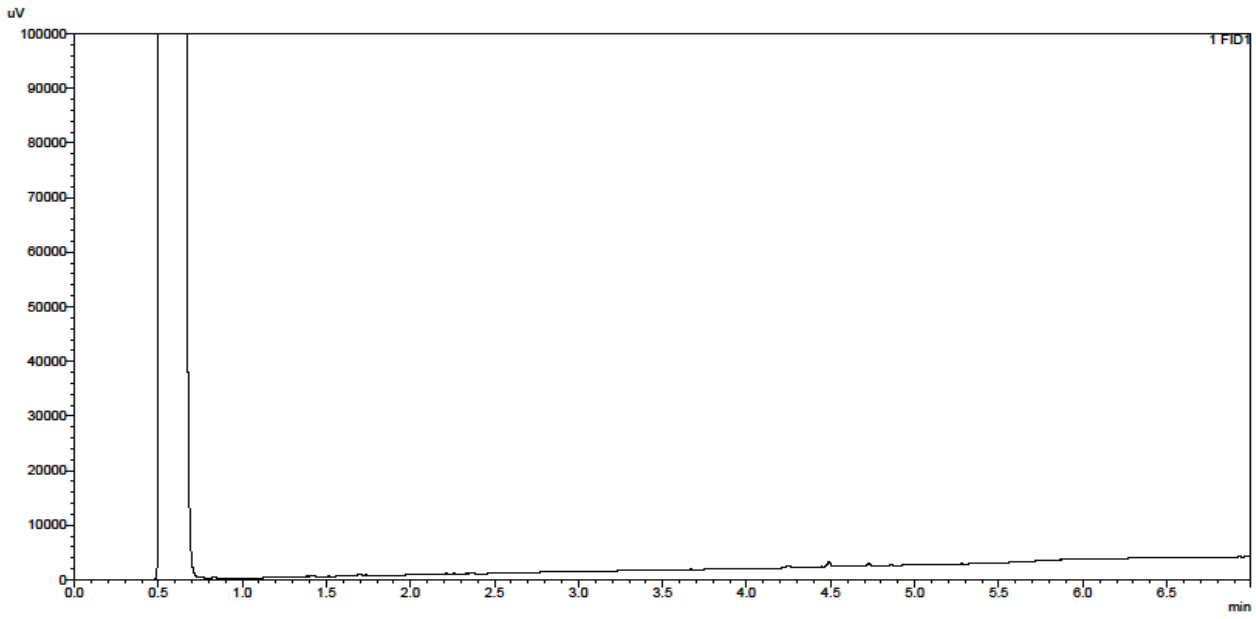
Client: Stantec UK Limited			**Chemtest Job No.:**		20-08435
Quotation No.:			**Chemtest Sample ID.:**		987061
			Client Sample ID.:		ES2
			Sample Location:		WS02
			Sample Type:		SOIL
			Top Depth (m):		2.0
			Date Sampled:		17-Mar-2020
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Hexachlorobutadiene	U	2760	µg/kg	1.0	< 1.0
1,2,3-Trichlorobenzene	U	2760	µg/kg	2.0	< 2.0
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	< 1.0
Naphthalene	N	2800	mg/kg	0.010	< 0.010
Acenaphthylene	N	2800	mg/kg	0.010	< 0.010
Acenaphthene	N	2800	mg/kg	0.010	< 0.010
Fluorene	N	2800	mg/kg	0.010	< 0.010
Phenanthrene	N	2800	mg/kg	0.010	< 0.010
Anthracene	N	2800	mg/kg	0.010	< 0.010
Fluoranthene	N	2800	mg/kg	0.010	< 0.010
Pyrene	N	2800	mg/kg	0.010	< 0.010
Benzo[a]anthracene	N	2800	mg/kg	0.010	< 0.010
Chrysene	N	2800	mg/kg	0.010	< 0.010
Benzo[b]fluoranthene	N	2800	mg/kg	0.010	< 0.010
Benzo[k]fluoranthene	N	2800	mg/kg	0.010	< 0.010
Benzo[a]pyrene	N	2800	mg/kg	0.010	< 0.010
Indeno(1,2,3-c,d)Pyrene	N	2800	mg/kg	0.010	< 0.010
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.010	< 0.010
Benzo[g,h,i]perylene	N	2800	mg/kg	0.010	< 0.010
Total Of 16 PAH's	N	2800	mg/kg	0.20	< 0.20
VOC TIC	N	2760	µg/kg	N/A	None Detected

TPH Chromatogram on Soil Sample: 987061

<Sample Information>

Sample Name : 987061 20-08435
Data Filename : 19 March 2020_19032020_987061 20-08435_099.gcd
Method Filename : TPH 12m Fast OSv2.gcm
Sample # : 50
Date Acquired : 19/03/2020 23:27:53
Date Processed : 19/03/2020

<Chromatogram>



Test Methods

SOP	Title	Parameters included	Method summary
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS

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TABLE SUMMARISING SOIL RESULTS AND HIGHLIGHTING EXCEEDANCES ABOVE SOIL ASSESSMENT CRITERIA
COMET WAY, HATFIELD

SOM 1%			Assessment Criteria		WS01	WS02	WS02	WS03	WS04	WS05	WS06	WS06	WS07	WS08	CP01	CP01	CP02
Analyte	**Units**	**LOD**	**RwoHP**	**Commercial**	**0.4**	**0.8**	**2.0**	**0.5**	**0.20**	**0.5**	**0.7**	**1.9**	**0.5**	**0.25**	**0.25**	**2.5**	**0.35**
Arsenic*	mg/kg	1	40	640	22	8.4		27	10	9.7	17		13	11	22		10
Cadmium*	mg/kg	0.1	150	410	0.21	*0.1*		0.26	0.48	0.17	0.21		0.24	0.49	0.18		0.29
Chromium Trivalent	mg/kg		910	8600	25	22		30	28	17	21		24	22	23		24
Chromium Hexavalent*	mg/kg	0.5	21	49	*0.5*	*0.5*		*0.5*	*0.5*	*0.5*	*0.5*		0.52	*0.5*	*0.5*		*0.5*
Copper	mg/kg	0.5	7100	68000	13	11		21	30	22	27		92	35	19		17
Lead*	mg/kg	0.5	310	2300	32	14		54	47	46	79		310	110	34		32
Mercury	mg/kg	0.1	56	1100	*0.1*	*0.1*		*0.1*	0.12	*0.1*	0.21		0.2	0.24	*0.1*		*0.1*
Nickel	mg/kg	0.5	180	980	25	18		28	26	20	20		27	21	24		23
Selenium	mg/kg	0.2	430	12000	*0.2*	0.34		*0.2*	0.27	*0.2*	0.26		*0.2*	0.25	*0.2*		0.21
Zinc	mg/kg	0.5	40000	730000	68	43		89	100	69	60		300	91	79		61
pH	pH Units	4	-	-	10			9.8	8.2		9.3						8.8
>C5 to C6 Aliphatic	mg/kg	1	42	3200	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C6 to C8 Aliphatic	mg/kg	1	100	7800	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C8 to C10 Aliphatic	mg/kg	1	27	2000	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C10 to C12 Aliphatic	mg/kg	1	130	9700	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C12 to C16 Aliphatic	mg/kg	1	1100	59000	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C16 to C21 Aliphatic	mg/kg	1	-	-	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	2.9	*1*	*1*	*1*	*1*
>C21 to C35 Aliphatic	mg/kg	1	-	-	8.3	*1*	*1*	*1*	39	5.1	*1*	*1*	61	*1*	92	*1*	*1*
>C16 to C35 Aliphatic	mg/kg	2	65000	1600000	9.3	*2*	*2*	*2*	40	6.1	*2*	*2*	63.9	*2*	93	*2*	*2*
>C35 to C44 Aliphatic	mg/kg	1	65000	1600000	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Total Aliphatic C5-C35	mg/kg	5	-	-	8.3	*5*	*5*	*5*	39	10.1	*5*	*5*	63.9	*5*	92	1	1
>C5 to C7 Aromatic	mg/kg	1	370	26000	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C7 to C8 Aromatic	mg/kg	1	860	56000	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C8 to C10 Aromatic	mg/kg	1	47	3500	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C10 to C12 Aromatic	mg/kg	1	250	16000	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C12 to C16 Aromatic	mg/kg	1	1800	36000	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
>C16 to C21 Aromatic	mg/kg	1	1900	28000	*1*	*1*	*1*	6.9	*1*	3	*1*	*1*	2.4	*1*	*1*	*1*	*1*
>C21 to C35 Aromatic	mg/kg	1	1900	28000	380	*1*	*1*	170	73	190	*1*	*1*	160	*1*	290	*1*	*1*
>C35 to C44 Aromatic	mg/kg	1	1900	28000	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Total Aromatic C5-C35	mg/kg		-	-	380	5	5	176.9	73	193	5	5	162	*5*	290	*5*	*5*
TPH Ali/Aro	mg/kg		-	-	390	*10*	*10*	180	110	200	*10*	*10*	230	*10*	380	*10*	*10*
Hazard Index - RwoHP	-	-	-	-	0.3104	0.1108	0.1108	0.2028	0.1493	0.2114	0.1108	0.1108	0.1961	0.1108	0.2643	0.1108	0.1108
Hazard Index - Commercial	-	-	-	-	0.0151	0.0016	0.0016	0.0078	0.0042	0.0084	0.0016	0.0016	0.0074	0.0016	0.0120	0.0016	0.0016
Benzene*	mg/kg	0.001	0.89	27	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
Ethylbenzene	mg/kg	0.001	83	5700	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	6.6	*0.001*
Toluene	mg/kg	0.001	800	56000	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
M- & P- Xylene	mg/kg	0.001	-	-	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	4.8	*0.001*
O-Xylene	mg/kg	0.001	-	-	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	1.6	*0.001*
Total Xylene (M, P & O)	mg/kg	0.002	88	6600	*0.002*	*0.002*	*0.002*	*0.002*	*0.002*	*0.002*	*0.002*	*0.002*	*0.002*	*0.002*	*0.002*	6.4	*0.002*
MTBE	mg/kg		-	-	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
naphthalene	mg/kg	0.01	2.3	190	*0.01*	*0.01*	*0.01*	0.08	*0.01*	0.12	*0.01*	*0.01*	*0.01*	*0.01*	0.06	*0.01*	*0.01*
acenaphthylene	mg/kg	0.01	2900	83000	*0.01*	*0.01*	*0.01*	0.17	*0.01*	0.03	*0.01*	*0.01*	0.04	*0.01*	0.08	*0.01*	*0.01*
acenaphthene	mg/kg	0.01	3000	84000	*0.01*	*0.01*	*0.01*	0.09	*0.01*	0.05	*0.01*	*0.01*	*0.01*	*0.01*	0.1	*0.01*	*0.01*
fluorene	mg/kg	0.01	2800	63000	*0.01*	*0.01*	*0.01*	0.09	*0.01*	0.04	*0.01*	*0.01*	0.02	*0.01*	*0.01*	*0.01*	*0.01*
phenanthrene	mg/kg	0.01	1300	22000	0.14	*0.01*	*0.01*	1.1	0.75	0.33	*0.01*	*0.01*	0.62	*0.01*	0.76	*0.01*	0.26
anthracene	mg/kg	0.01	31000	520000	0.03	*0.01*	*0.01*	0.46	0.2	0.1	*0.01*	*0.01*	0.16	*0.01*	0.23	*0.01*	0.05
fluoranthene	mg/kg	0.01	1500	23000	0.37	*0.01*	*0.01*	2.7	1.7	1.4	0.31	*0.01*	1.4	0.83	1.8	0.1	1.1
pyrene	mg/kg	0.01	3700	54000	0.36	*0.01*	*0.01*	2.4	1.5	1.2	0.19	*0.01*	1.2	0.69	1.5	0.15	0.98
benzo(a)anthracene	mg/kg	0.01	11	170	*0.01*	*0.01*	*0.01*	1.2	0.58	0.71	*0.01*	*0.01*	0.72	0.44	0.71	*0.01*	0.49
chrysene	mg/kg	0.01	30	350	*0.01*	*0.01*	*0.01*	0.94	0.5	0.45	*0.01*	*0.01*	0.6	0.33	0.59	*0.01*	0.37
benzo(b)fluoranthene	mg/kg	0.01	3.9	44	*0.01*	*0.01*	*0.01*	2.2	0.86	1.1	*0.01*	*0.01*	1	0.65	1.2	*0.01*	0.87
benzo(k)fluoranthene	mg/kg	0.01	110	1200	*0.01*	*0.01*	*0.01*	0.76	0.17	0.26	*0.01*	*0.01*	0.32	0.22	0.36	*0.01*	0.18
benzo(a)pyrene	mg/kg	0.01	3.2	35	*0.01*	*0.01*	*0.01*	2.5	0.66	1.2	*0.01*	*0.01*	0.74	0.65	1.4	*0.01*	0.81
indeno(1,2,3-c,d)pyrene	mg/kg	0.01	45	500	*0.01*	*0.01*	*0.01*	1.4	0.4	0.55	*0.01*	*0.01*	0.5	0.53	0.98	*0.01*	0.44
dibenzo(ah)anthracene	mg/kg	0.01	0.31	3.5	*0.01*	*0.01*	*0.01*	0.22	0.06	0.14	*0.01*	*0.01*	0.13	0.04	0.18	*0.01*	0.04
benzo(g,h,i)perylene	mg/kg	0.01	360	3900	*0.01*	*0.01*	*0.01*	1.5	0.49	0.52	*0.01*	*0.01*	0.5	0.47	0.71	*0.01*	0.34
Total PAH	mg/kg	0.2	-	-	0.9	*0.2*	*0.2*	18	7.9	8.2	0.5	*0.2*	7.9	4.9	11	0.25	5.9
Coal Tar (Bap as surrogate)*	mg/kg	0.01	5.3	77	*0.01*	*0.01*	*0.01*	2.5	0.66	1.2	*0.01*	*0.01*	0.74	0.65	1.4	*0.01*	0.81
PCB (as Aroclors)	mg/kg		-	-					*0.1*					*0.1*			
1,2 Dichloroethane	mg/kg	0.002	3.9	270			*0.002*					*0.002*			*0.002*		
1,1,1 Trichloroethane (TCA)	mg/kg	0.001	9	660			*0.001*					*0.001*			*0.001*		
1,1,1,2 Tetrachloroethane	mg/kg	0.002	1.5	110			*0.002*					*0.002*			*0.002*		
Tetrachloroethene (PCE)	mg/kg	0.001	0.18	19			*0.001*					*0.001*			*0.001*		
Trichloroethene (TCE)	mg/kg	0.001	0.017	1.2			*0.001*					*0.001*			*0.001*		
Trichloromethane (Chloroform)	mg/kg	0.001	1.2	99			*0.001*					*0.001*			*0.001*		
Vinyl Chloride (Chloroethene)	mg/kg	0.001	0.00077	0.059			*0.001*					*0.001*			*0.001*		
Asbestos (Presence of)	TEXT		-	-	NAD	NAD		NAD	NAD	NAD	NAD	Amosite		NAD	NAD	NAD	NAD
Asbestos Analysts Comments	TEXT		-	-								Board					
Asbestos Fibre Count	%	0.001										0.005					

* Category 4 Screening Value @ 6% SOM

Karl Blanke
AF Howland Associates Ltd
Cordell Works
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Long Melford
Suffolk
CO10 9EH

DETS Ltd
Unit 1
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Lenham Heath
Kent
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t: 01622 850410

DETS Report No: 20-07645

Site Reference:	Comet Way, Hatfield
Project / Job Ref:	20.095
Order No:	KPB/20.095/00/01
Sample Receipt Date:	13/07/2020
Sample Scheduled Date:	13/07/2020
Report Issue Number:	1
Reporting Date:	27/07/2020

Authorised by:

Kevin Old
General Manager

Dates of laboratory activities for each tested analyte are available upon request.

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Water Analysis Certificate						
DETS Report No: 20-07645	**Date Sampled**	07/07/20	07/07/20			
AF Howland Associates Ltd	**Time Sampled**	None Supplied	None Supplied			
Site Reference: Comet Way, Hatfield	**TP / BH No**	CP02	CP01			
Project / Job Ref: 20.095	**Additional Refs**	GW1	GW1			
Order No: KPB/20.095/00/01	**Depth (m)**	15.60	15.50			
Reporting Date: 27/07/2020	**DETS Sample No**	486328	488178			

Determinand	Unit	RL	Accreditation	($)				
pH	pH Units	N/a	ISO17025	7.1	7.4			
Total Cyanide	ug/l	< 5	NONE	< 5	< 5			
Complex Cyanide	ug/l	< 5	NONE	< 5	< 5			
Free Cyanide	ug/l	< 5	NONE	< 5	< 5			
Thiocyanate as SCN	ug/l	< 10	NONE	< 10	< 10			
Dissolved Organic Carbon (DOC)	mg/l	< 0.1	NONE	4.7	4.9			
Alkalinity	mgCaCO3/l	< 20	NONE	275	315			
Hardness - Total	mgCaCO3/l	< 1	NONE	344	434			
Antimony (dissolved)	ug/l	< 5	ISO17025	< 5	< 5			
Arsenic (dissolved)	ug/l	< 5	ISO17025	< 5	< 5			
Beryllium (dissolved)	ug/l	< 3	ISO17025	< 3	< 3			
Cadmium (dissolved)	ug/l	< 0.4	ISO17025	< 0.4	< 0.4			
Chromium (dissolved)	ug/l	< 5	ISO17025	8	< 5			
Chromium (hexavalent)	ug/l	< 20	NONE	< 20	< 20			
Copper (dissolved)	ug/l	< 5	ISO17025	< 5	< 5			
Lead (dissolved)	ug/l	< 5	ISO17025	< 5	< 5			
Mercury (dissolved)	ug/l	< 0.05	ISO17025	0.13	< 0.05			
Nickel (dissolved)	ug/l	< 5	ISO17025	< 5	< 5			
Selenium (dissolved)	ug/l	< 5	ISO17025	< 5	< 5			
Vanadium (dissolved)	ug/l	< 5	ISO17025	< 5	< 5			
Zinc (dissolved)	ug/l	< 2	ISO17025	< 2	< 2			
Total Phenols (monohydric)	ug/l	< 10	NONE	< 10	< 10			

Subcontracted analysis (S)
Insufficient sample I/S
Unsuitable Sample U/S
($) samples exceeded recommended holding times

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Water Analysis Certificate - Speciated PAH						
DETS Report No: 20-07645	**Date Sampled**	07/07/20	07/07/20			
AF Howland Associates Ltd	**Time Sampled**	None Supplied	None Supplied			
Site Reference: Comet Way, Hatfield	**TP / BH No**	CP02	CP01			
Project / Job Ref: 20.095	**Additional Refs**	GW1	GW1			
Order No: KPB/20.095/00/01	**Depth (m)**	15.60	15.50			
Reporting Date: 27/07/2020	**DETS Sample No**	486328	488178			

Determinand	**Unit**	**RL**	**Accreditation**	($)				
Naphthalene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Acenaphthylene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Acenaphthene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Fluorene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Phenanthrene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Anthracene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Fluoranthene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Pyrene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Benzo(a)anthracene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Chrysene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Benzo(b)fluoranthene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Benzo(k)fluoranthene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Benzo(a)pyrene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Indeno(1,2,3-cd)pyrene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Dibenz(a,h)anthracene	ug/l	< 0.01	NONE	< 0.01	< 0.01			
Benzo(ghi)perylene	ug/l	< 0.008	NONE	< 0.008	< 0.008			
Total EPA-16 PAHs	ug/l	< 0.01	NONE	< 0.01	< 0.01			

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Water Analysis Certificate - TPH CWG Banded						
DETS Report No: 20-07645	**Date Sampled**	07/07/20	07/07/20			
AF Howland Associates Ltd	**Time Sampled**	None Supplied	None Supplied			
Site Reference: Comet Way, Hatfield	**TP / BH No**	CP02	CP01			
Project / Job Ref: 20.095	**Additional Refs**	GW1	GW1			
Order No: KPB/20.095/00/01	**Depth (m)**	15.60	15.50			
Reporting Date: 27/07/2020	**DETS Sample No**	486328	488178			

Determinand	**Unit**	**RL**	**Accreditation**	($)				
Aliphatic >C5 - C6	ug/l	< 10	NONE	< 10	< 10			
Aliphatic >C6 - C8	ug/l	< 10	NONE	< 10	< 10			
Aliphatic >C8 - C10	ug/l	< 10	NONE	< 10	< 10			
Aliphatic >C10 - C12	ug/l	< 10	NONE	< 10	< 10			
Aliphatic >C12 - C16	ug/l	< 10	NONE	< 10	< 10			
Aliphatic >C16 - C21	ug/l	< 10	NONE	< 10	< 10			
Aliphatic >C21 - C34	ug/l	< 10	NONE	< 10	< 10			
Aliphatic (C5 - C34)	ug/l	< 70	NONE	< 70	< 70			
Aromatic >C5 - C7	ug/l	< 10	NONE	< 10	< 10			
Aromatic >C7 - C8	ug/l	< 10	NONE	< 10	< 10			
Aromatic >C8 - C10	ug/l	< 10	NONE	< 10	< 10			
Aromatic >C10 - C12	ug/l	< 10	NONE	< 10	< 10			
Aromatic >C12 - C16	ug/l	< 10	NONE	< 10	< 10			
Aromatic >C16 - C21	ug/l	< 10	NONE	< 10	< 10			
Aromatic >C21 - C35	ug/l	< 10	NONE	< 10	< 10			
Aromatic (C5 - C35)	ug/l	< 70	NONE	< 70	< 70			
Total >C5 - C35	ug/l	< 140	NONE	< 140	< 140			

($) samples exceeded recommended holding times

DETS Ltd
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Water Analysis Certificate - BTEX / MTBE						
DETS Report No: 20-07645	**Date Sampled**	07/07/20	07/07/20			
AF Howland Associates Ltd	**Time Sampled**	None Supplied	None Supplied			
Site Reference: Comet Way, Hatfield	**TP / BH No**	CP02	CP01			
Project / Job Ref: 20.095	**Additional Refs**	GW1	GW1			
Order No: KPB/20.095/00/01	**Depth (m)**	15.60	15.50			
Reporting Date: 27/07/2020	**DETS Sample No**	486328	488178			

Determinand	Unit	RL	Accreditation	($)				
Benzene	ug/l	< 1	**ISO17025**	< 1	< 1			
Toluene	ug/l	< 5	**ISO17025**	< 5	< 5			
Ethylbenzene	ug/l	< 5	**ISO17025**	< 5	< 5			
p & m-xylene	ug/l	< 10	**ISO17025**	< 10	< 10			
o-xylene	ug/l	< 5	**ISO17025**	< 5	< 5			
MTBE	ug/l	< 10	**ISO17025**	< 10	< 10			

($) samples exceeded recommended holding times

DETS Ltd
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Water Analysis Certificate - Methodology & Miscellaneous Information
DETS Report No: 20-07645
AF Howland Associates Ltd
Site Reference: Comet Way, Hatfield
Project / Job Ref: 20.095
Order No: KPB/20.095/00/01
Reporting Date: 27/07/2020

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Water	UF	Alkalinity	Determination of alkalinity by titration against hydrochloric acid using bromocresol green as the end point	E103
Water	UF	BTEX	Determination of BTEX by headspace GC-MS	E101
Water	F	Cations	Determination of cations by filtration followed by ICP-MS	E102
Water	UF	Chemical Oxygen Demand (COD)	Determination using a COD reactor followed by colorimetry	E112
Water	F	Chloride	Determination of chloride by filtration & analysed by ion chromatography	E109
Water	F	Chromium - Hexavalent	Determination of hexavalent chromium by acidification, addition of 1,5 diphenylcarbazide followed by	E116
Water	UF	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E115
Water	UF	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E115
Water	UF	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E115
Water	UF	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through liquid:liquid extraction with cyclohexane	E111
Water	F	Diesel Range Organics (C10 - C24)	Determination of liquid:liquid extraction with hexane followed by GC-FID	E104
Water	F	Dissolved Organic Content (DOC)	Determination of DOC by filtration followed by low heat with persulphate addition followed by IR dete	E110
Water	UF	Electrical Conductivity	Determination of electrical conductivity by electrometric measurement	E123
Water	F	EPH (C10 – C40)	Determination of liquid:liquid extraction with hexane followed by GC-FID	E104
Water	F	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of liquid:liquid extraction with hexane followed by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E104
Water	F	Fluoride	Determination of Fluoride by filtration & analysed by ion chromatography	E109
Water	F	Hardness	Determination of Ca and Mg by ICP-MS followed by calculation	E102
Leachate	F	Leachate Preparation - NRA	Based on National Rivers Authority leaching test 1994	E301
Leachate	F	Leachate Preparation - WAC	Based on BS EN 12457 Pt1, 2, 3	E302
Water	F	Metals	Determination of metals by filtration followed by ICP-MS	E102
Water	F	Mineral Oil (C10 - C40)	Determination of liquid:liquid extraction with hexane followed by GI-FID	E104
Water	F	Nitrate	Determination of nitrate by filtration & analysed by ion chromatography	E109
Water	UF	Monohydric Phenol	Determination of phenols by distillation followed by colorimetry	E121
Water	F	PAH - Speciated (EPA 16)	Determination of PAH compounds by concentration through SPE cartridge, collection in dichloromethane followed by GC-MS	E105
Water	F	PCB - 7 Congeners	Determination of PCB compounds by concentration through SPE cartridge, collection in dichlorometha	E108
Water	UF	Petroleum Ether Extract (PEE)	Gravimetrically determined through liquid:liquid extraction with petroleum ether	E111
Water	UF	pH	Determination of pH by electrometric measurement	E107
Water	F	Phosphate	Determination of phosphate by filtration & analysed by ion chromatography	E109
Water	UF	Redox Potential	Determination of redox potential by electrometric measurement	E113
Water	F	Sulphate (as SO4)	Determination of sulphate by filtration & analysed by ion chromatography	E109
Water	UF	Sulphide	Determination of sulphide by distillation followed by colorimetry	E118
Water	F	SVOC	Determination of semi-volatile organic compounds by concentration through SPE cartridge, collection in dichloromethane followed by GC-MS	E106
Water	UF	Toluene Extractable Matter (TEM)	Gravimetrically determined through liquid:liquid extraction with toluene	E111
Water	UF	Total Organic Carbon (TOC)	Low heat with persulphate addition followed by IR detection	E110
Water	F	TPH CWG (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of liquid:liquid extraction with hexane, fractionating with SPE followed by GC-FID for C8 to C35. C5 to C8 by headspace GC-MS	E104
Water	F	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of liquid:liquid extraction with hexane, fractionating with SPE followed by GC-FID for C8 to C44. C5 to C8 by headspace GC-MS	E104
Water	UF	VOCs	Determination of volatile organic compounds by headspace GC-MS	E101
Water	UF	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E101

Key

F Filtered
UF Unfiltered

DETS South Report No:20-07645	Date Sampled	07/07/2020	07/07/2020
	Time Sampled		
Site Reference:Comet Way, Hatfield	TP / BH No	CP02	CP01
Project / Job Ref:20.095	Additional Refs	GW1	GW1
Order No:KPB/20.095/00/01	Depth (m)	15.60	15.50
Reporting Date:27/07/2020	DETS Sample No	486328	488178

Determinand	Unit	RL			
Deviating - Headspace		0		Ok	Ok
pH	pH Units	N/a		7.1	7.4
Total Cyanide	ug/l	< 5		< 5	< 5
Complex Cyanide	ug/l	< 5		< 5	< 5
Free Cyanide	ug/l	< 5		< 5	< 5
Thiocyanate as SCN	ug/l	< 10		< 10	< 10
Dissolved Organic Carbon (D(	mg/l	< 0.1		4.7	4.9
Alkalinity	mgCaCO3	< 20		275	315
Total Hardness	mgCaCO3	< 1		344	434
Antimony (dissolved)	ug/l	< 5		< 5	< 5
Arsenic (dissolved)	ug/l	< 5		< 5	< 5
Beryllium (dissolved)	ug/l	< 3		< 3	< 3
Cadmium (dissolved)	ug/l	< 0.4		< 0.4	< 0.4
Chromium (dissolved)	ug/l	< 5		8	< 5
Hexavalent Chromium	ug/l	< 20		< 20	< 20
Copper (dissolved)	ug/l	< 5		< 5	< 5
Lead (dissolved)	ug/l	< 5		< 5	< 5
Mercury (dissolved)	ug/l	< 0.05		0.13	< 0.05
Nickel (dissolved)	ug/l	< 5		< 5	< 5
Selenium (dissolved)	ug/l	< 5		< 5	< 5
Vanadium (dissolved)	ug/l	< 5		< 5	< 5
Zinc (dissolved)	ug/l	< 2		< 2	< 2
Monohydric Phenols	ug/l	< 10		< 10	< 10
Naphthalene	ug/l	< 0.01		< 0.01	< 0.01
Acenaphthylene	ug/l	< 0.01		< 0.01	< 0.01
Acenaphthene	ug/l	< 0.01		< 0.01	< 0.01
Fluorene	ug/l	< 0.01		< 0.01	< 0.01
Phenanthrene	ug/l	< 0.01		< 0.01	< 0.01
Anthracene	ug/l	< 0.01		< 0.01	< 0.01
Fluoranthene	ug/l	< 0.01		< 0.01	< 0.01
Pyrene	ug/l	< 0.01		< 0.01	< 0.01
Benzo(a)anthracene	ug/l	< 0.01		< 0.01	< 0.01
Chrysene	ug/l	< 0.01		< 0.01	< 0.01
Benzo(b)fluoranthene	ug/l	< 0.01		< 0.01	< 0.01
Benzo(k)fluoranthene	ug/l	< 0.01		< 0.01	< 0.01
Benzo(a)pyrene	ug/l	< 0.01		< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	ug/l	< 0.01		< 0.01	< 0.01
Di-benzo(a,h)anthracene	ug/l	< 0.01		< 0.01	< 0.01
Benzo(ghi)perylene	ug/l	< 0.008		< 0.008	< 0.008
Total EPA-16 PAHs	ug/l	< 0.01		< 0.01	< 0.01
TPH CWG - Aliphatic >C5 - C(	ug/l	< 10		< 10	< 10
TPH CWG - Aliphatic >C6 - C(	ug/l	< 10		< 10	< 10
TPH CWG - Aliphatic >C8 - C	ug/l	< 10		< 10	< 10
TPH CWG - Aliphatic >C10 - (	ug/l	< 10		< 10	< 10
TPH CWG - Aliphatic >C12 - (	ug/l	< 10		< 10	< 10
TPH CWG - Aliphatic >C16 - (	ug/l	< 10		< 10	< 10
TPH CWG - Aliphatic >C21 - (	ug/l	< 10		< 10	< 10
TPH CWG - Aliphatic >C5 - C	ug/l	< 70		< 70	< 70
TPH CWG - Aromatic >C5 - C	ug/l	< 10		< 10	< 10
TPH CWG - Aromatic >C7 - C	ug/l	< 10		< 10	< 10
TPH CWG - Aromatic >C8 - C	ug/l	< 10		< 10	< 10

TPH CWG - Aromatic >C10 -	ug/l	< 10		< 10	< 10
TPH CWG - Aromatic >C12 -	ug/l	< 10		< 10	< 10
TPH CWG - Aromatic >C16 -	ug/l	< 10		< 10	< 10
TPH CWG - Aromatic >C21 -	ug/l	< 10		< 10	< 10
TPH CWG - Aromatic >C5 - C	ug/l	< 70		< 70	< 70
TPH CWG - Total >C5 - C35	ug/l	< 140		< 140	< 140
Benzene	ug/l	< 1		< 1	< 1
Toluene	ug/l	< 5		< 5	< 5
Ethylbenzene	ug/l	< 5		< 5	< 5
m & p-xylene	ug/l	< 10		< 10	< 10
o-Xylene	ug/l	< 5		< 5	< 5
MTBE	ug/l	< 10		< 10	< 10

Appendix C Geotechnical Laboratory Analysis Results

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 03/04/2020

0998

Contract	**Comet Way, Hatfield**
Serial No.	**36699_1**

Client:

Stantec UK Limited

3rd Floor
50-60 Station Road
Cambridge
CB1 2JH

Soil Property Testing Ltd

15, 16, 18 Halcyon Court, St Margaret's Way,
Stukeley Meadows, Huntingdon,
Cambridgeshire, PE29 6DG

Tel: 01480 455579
Email: enquiries@soilpropertytesting.com
Website: www.soilpropertytesting.com

Samples Submitted By:

Stantec UK Limited

Samples Labelled:

Comet Way, Hatfield

Approved Signatories:

- ☐ **J.C. Garner B.Eng (Hons) FGS** — Technical Director & Quality Manager
- ☐ **S.P. Townend** — Chairman
- ☐ **W. Johnstone** — Materials Lab Manager
- ☑ **D. Sabnis** — Operations Manager

[redacted]

Date Received: 19/03/2020

Samples Tested Between: 19/03/2020 **and** 03/04/2020

Remarks:

For the attention of Christopher Radbone
Your Reference No: 47179

Notes:

1. All remaining samples or remnants from this contract will be disposed of after 21 days from today, unless we are notified to the contrary.
2. (a) UKAS - United Kingdom Accreditation Service.
   (b) Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.
3. Tests marked "NOT UKAS ACCREDITED" in this test report are not included in the UKAS Accreditation Schedule for this testing laboratory.
4. This test report may not be reproduced other than in full except with the prior written approval of the issuing laboratory.

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 03/04/2020

0998

Contract	**Comet Way, Hatfield**		
Serial No.	**36699_1**	**Target Date**	02/04/2020
Scheduled By	Stantec UK Limited		

SCHEDULE OF LABORATORY TESTS

Schedule Remarks

Bore Hole No.	Type	Sample Ref.	Top Depth	Water Content (BSEN)	Liquid/Plastic Limits	Wet Sieve Preparation	Sulphate Content/pH Value	Particle Size Distribution (BS1377)	Triaxial Test	One Dimensional Consolidation																	Sample Remarks
CP01	B	1	1.20	1	1	1	1																				
CP01	B	3	3.10					1																			
CP01	B	5	9.70	1	1			1																			
CP01	D	10	13.50	1	1	1																					
CP01	U	1	13.90						1	1																	
CP01	D	14	18.30					1																			
CP02	D	2	1.60	1	1	1																					
CP02	B	2	2.10					1																			
CP02	D	6	9.50	1	1	1																					
CP02	B	5	9.80				1																				
CP02	U	2	12.50						1	1																	
CP02	D	8	13.00	1	1	1																					
CP02	B	10	28.70				1																				
WS01	SPT	01	1.20	1	1	1																					
WS01	SPT	02	2.00	1	1	1																					
WS03	SPT	02	2.00	1	1	1																					
WS04	SPT	01	1.20	1	1	1																					
WS04	SPT	02	2.00				1																				
WS05	SPT	03	3.00				1																				
WS08	SPT	02	2.00	1	1	1	1																				
Totals				**11**	**11**	**10**	**6**	**4**	**2**	**2**																	**End of Schedule**

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 03/04/2020

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Contract	**Comet Way, Hatfield**
Serial No.	**36699_1**

SUMMARY OF WATER CONTENT, LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole /Pit No.	Depth (m)	Type	Ref.	Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasti-city Index (%)	Liquid-ity Index	SAMPLE PREPARATION				Description	CLASS
									Method	Ret'd 0.425mm (%)	Corr'd W/C <0.425mm	Curing Time (hrs)		
CP01	1.20	B	1	**21.8**	39	17	22	0.22	Wet Sieved	26 (M)	29.5*	25	Firm dark yellowish brown slightly gravelly slightly sandy silty CLAY with rare decayed roots. Gravel is brown, white and grey fine to medium chert.	CI
CP01	9.70	B	5	**20.8**	29	17	12	0.32	Wet Sieved	6 (M)	22.1*	25	Firm dark grey slightly gravelly slightly sandy silty calcareous CLAY. Gravel is fine to medium chalk and chert.	CL
CP01	13.50	D	10	**16.9**	48	16	32	0.03	Wet Sieved	9 (M)	18.6*	24	Very stiff dark grey slightly gravelly slightly sandy silty calcareous CLAY. Gravel is fine chalk, and rare fine to medium chert.	CI
CP02	1.60	D	2	**16.7**	36	18	18	-0.07	Wet Sieved	29 (M)	23.5*	25	Firm dark yellowish brown slightly gravelly slightly sandy silty CLAY. Gravel is fine to medium subangular to rounded chert.	CI
CP02	9.50	D	6	**19.3**	51	20	31	-0.02	Wet Sieved	6 (M)	20.5*	24	Very stiff dark grey slightly gravelly slightly sandy silty calcareous CLAY. Gravel is fine to medium chalk, and rare chert.	CH
CP02	13.00	D	8	**15.9**	47	16	31	0.00	Wet Sieved	12 (M)	18.1*	24	Very stiff dark grey slightly gravelly slightly sandy silty calcareous CLAY. Gravel is fine to medium chalk and chert.	CI
WS01	1.20	SPT	01	**21.1**	35	17	18	0.23	Wet Sieved	11 (M)	23.7*	24	Firm yellowish brown slightly gravelly slightly sandy silty CLAY. Gravel is fine to medium chert.	CL/CI
WS01	2.00	SPT	02	**12.4**	31	13	18	-0.03	Wet Sieved	43 (M)	21.8*	72	Firm olive yellow slightly gravelly slightly sandy silty CLAY with occasional yellowish brown mottling. Gravel is brown, black and white fine to medium angular to subangular chert.	CL

Method Of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2:1990:4.2
Method of Test: BS EN ISO: 17892-1: 2014 & BS1377:Part 2:1990:3.2, 4.4
Type of Sample Key: U = Undisturbed, L = Liner, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments: *Corrected water content assume material greater than 0.425mm is non-porous. See BS1377: Part 2: 1990 Clause 3 Note 1.

Table Notation: Ret'd 0.425mm: (A) = Assumed, (M) = Measured

TEST REPORT

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Contract	**Comet Way, Hatfield**
Serial No.	**36699_1**

SUMMARY OF WATER CONTENT, LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole /Pit No.	Depth (m)	Type	Ref.	Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasti-city Index (%)	Liquid-ity Index	SAMPLE PREPARATION				Description	CLASS
									Method	Ret'd 0.425mm (%)	Corr'd W/C <0.425mm	Curing Time (hrs)		
WS03	2.00	SPT	02	**8.8**	23	12	11	-0.29	Wet Sieved	59 (M)	21.6*	24	Black, brown and white fine to coarse angular to subangular chert GRAVEL and olive yellow slightly clayey sand with rare orange mottling, and firm clayey lumps.	CL
WS04	1.20	SPT	01	**22.3**	34	19	15	0.22	Wet Sieved	6 (M)	23.7*	25	Firm yellowish brown slightly gravelly slightly sandy silty CLAY. Gravel is fine to medium chert.	CL
WS08	2.00	SPT	02	**11.1**	29	13	16	-0.12	Wet Sieved	58 (M)	26.4*	24	Stiff yellowish brown slightly gravelly slightly sandy silty CLAY with occasional medium and coarse sand pockets. Gravel is fine to medium angular chert.	CL

Method Of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2:1990:4.2
Method of Test: BS EN ISO: 17892-1: 2014 & BS1377:Part 2:1990:3.2, 4.4
Type of Sample Key: U = Undisturbed, L = Liner, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments: *Corrected water content assume material greater than 0.425mm is non-porous. See BS1377: Part 2: 1990 Clause 3 Note 1.

Table Notation: Ret'd 0.425mm: (A) = Assumed, (M) = Measured

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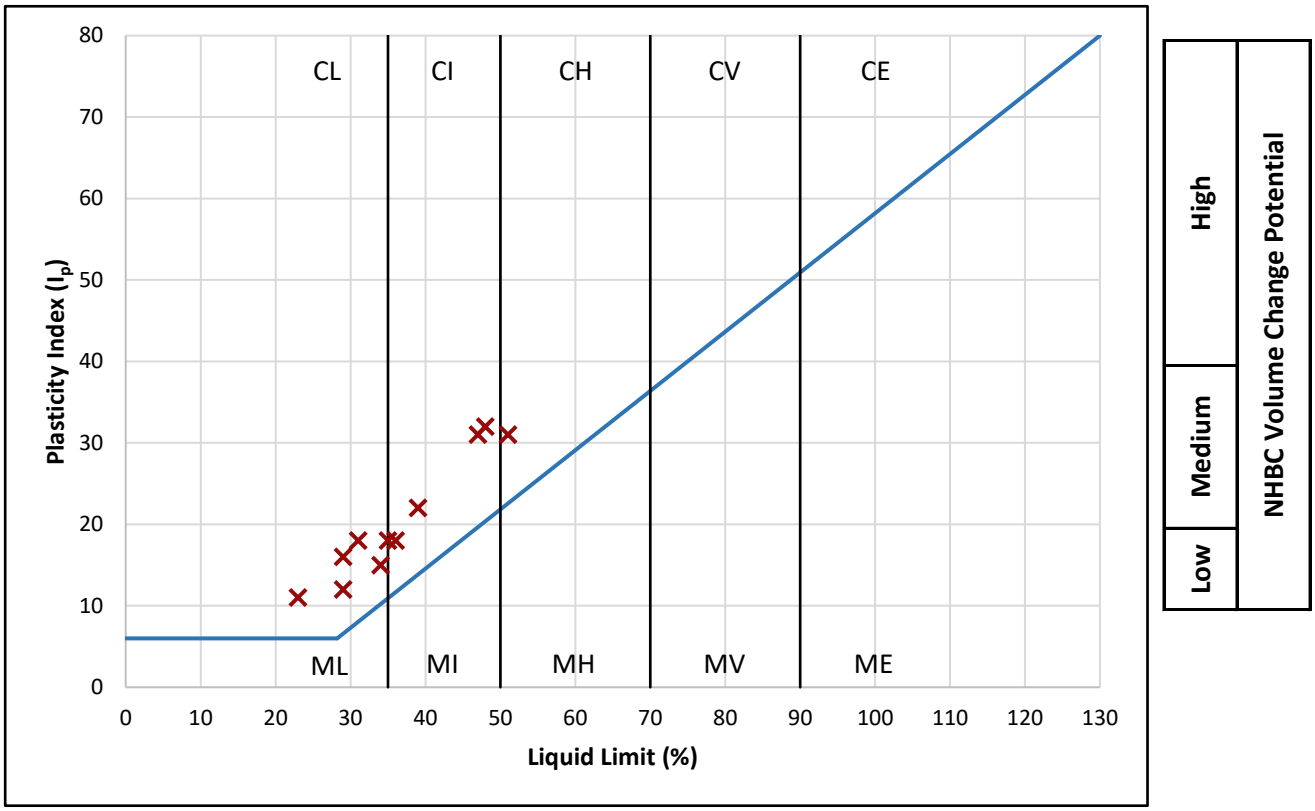
Serial No.	**36699_1**

PLOT OF PLASTICITY INDEX AGAINST LIQUID LIMIT USING CASAGRANDE CLASSIFICATION CHART

Plasticity				
Low	Medium	High	Very High	Extremely High



Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation:	BS 1377: Part 2: 1990: 4.2
Method of Test:	BS1377: Part 2: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments:	Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

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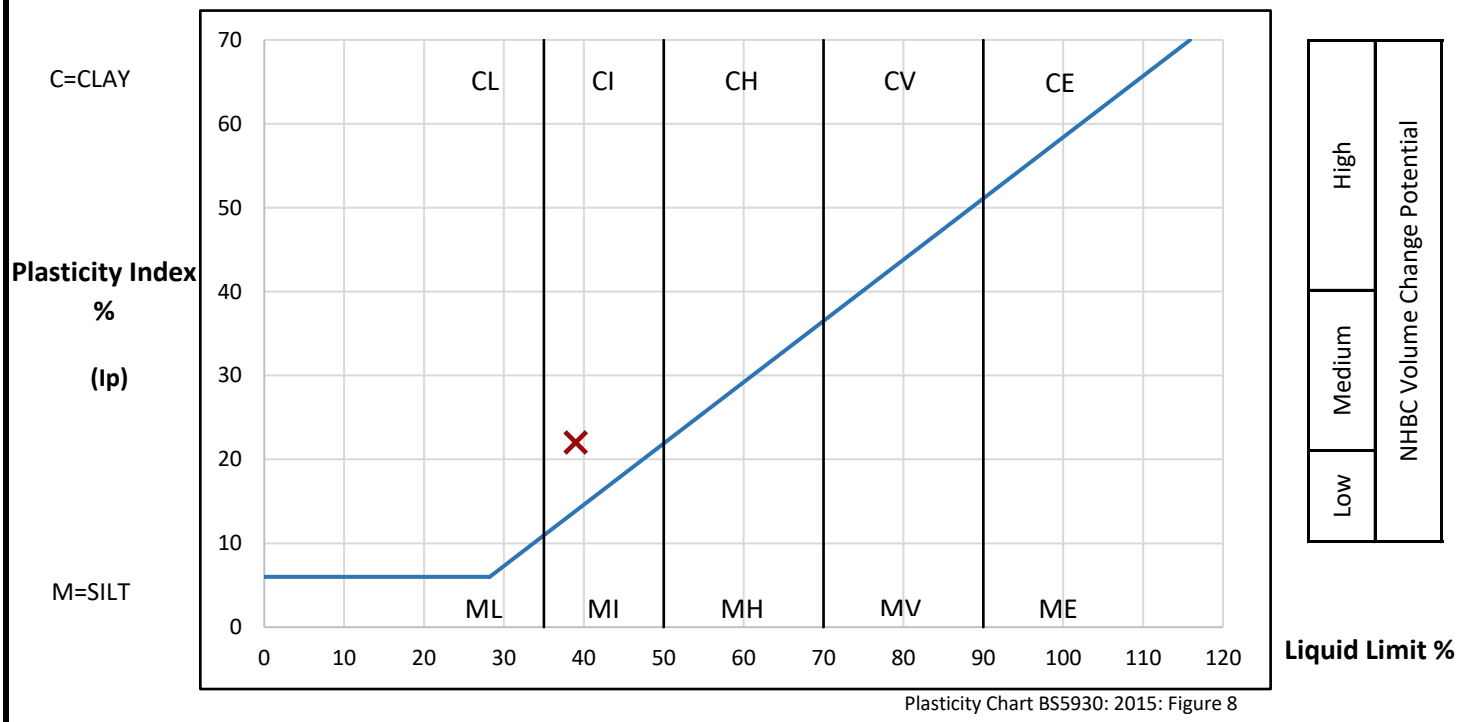
Contract	**Comet Way, Hatfield**
Serial No.	**36699_1**

DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample Type	Sample Reference	Water Content (W) %	Description	Remarks
CP01	1.20	B	1	21.8	Firm dark yellowish brown slightly gravelly slightly sandy silty CLAY with rare decayed roots. Gravel is brown, white and grey fine to medium chert.	

PREPARATION			Liquid Limit	39 %
Method of preparation	Wet sieved over 0.425mm sieve		Plastic Limit	17 %
Sample retained 0.425mm sieve	(Measured)	26 %	Plasticity Index	22 %
Corrected water content for material passing 0.425mm		29.5 %	Liquidity Index	0.22
Sample retained 2mm sieve	(Measured)	20 %	NHBC Modified (I'p)	16 %
Curing time	25 hrs	Clay Content Not analysed	Derived Activity	Not analysed



Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:	Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)

TEST REPORT

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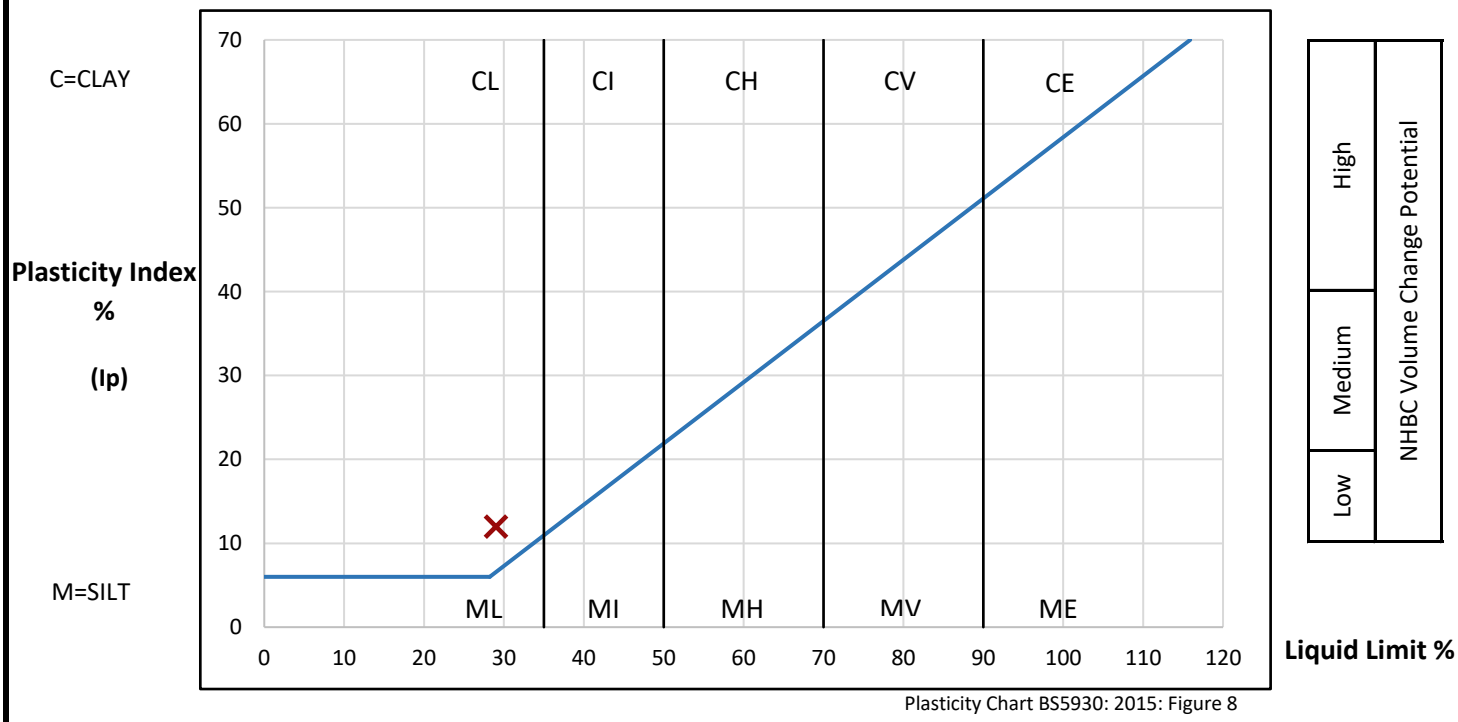
Contract	**Comet Way, Hatfield**
Serial No.	**36699_1**

DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample Type	Sample Reference	Water Content (W) %	Description	Remarks
CP01	9.70	B	5	20.8	Firm dark grey slightly gravelly slightly sandy silty calcareous CLAY. Gravel is fine to medium chalk and chert.	

PREPARATION				Liquid Limit	29 %
Method of preparation	Wet sieved over 0.425mm sieve			Plastic Limit	17 %
Sample retained 0.425mm sieve	(Measured)	6 %		Plasticity Index	12 %
Corrected water content for material passing 0.425mm		22.1 %		Liquidity Index	0.32
Sample retained 2mm sieve	(Measured)	3 %		NHBC Modified (I'p)	11 %
Curing time	25 hrs	Clay Content	19 %	Derived Activity	0.63



Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:	Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)

TEST REPORT

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Contract	**Comet Way, Hatfield**
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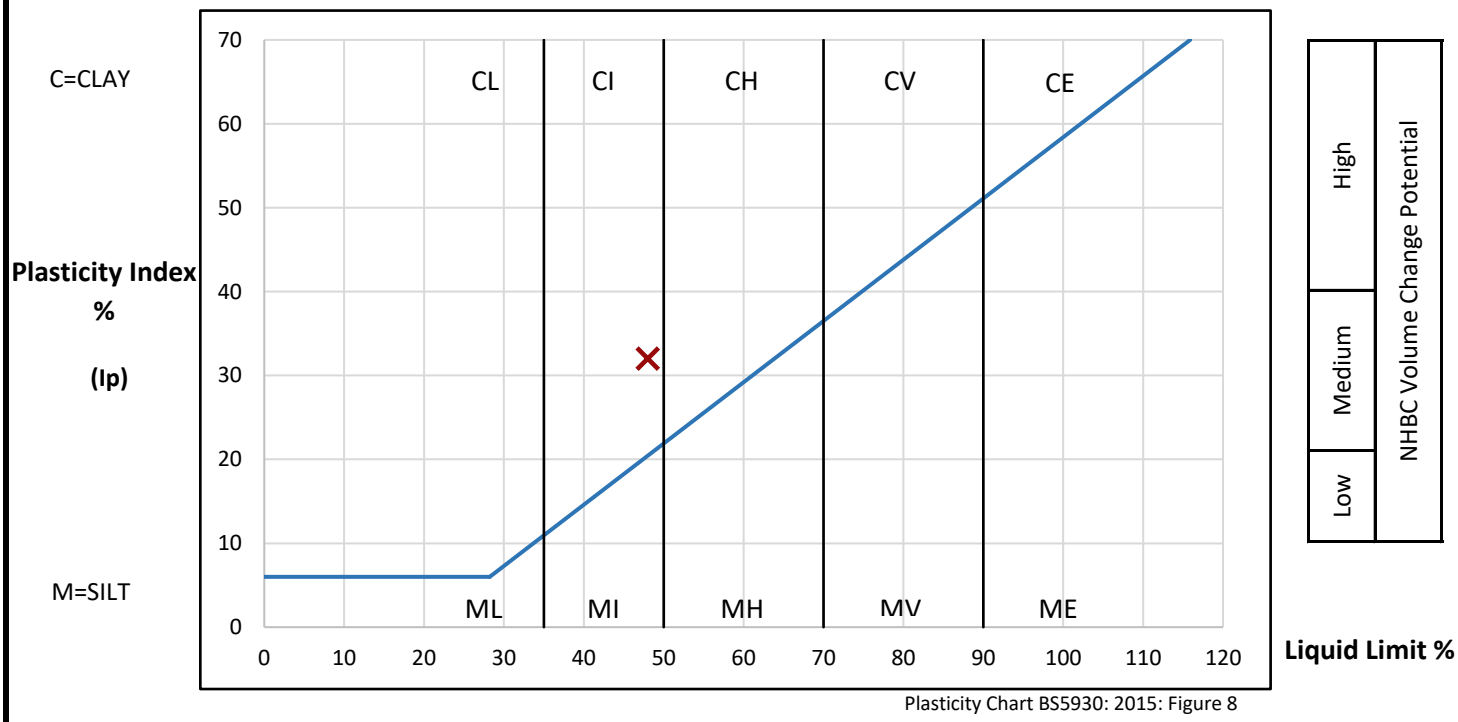
DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample Type	Sample Reference	Water Content (W) %	Description	Remarks
CP01	13.50	D	10	16.9	Very stiff dark grey slightly gravelly slightly sandy silty calcareous CLAY. Gravel is fine chalk, and rare fine to medium chert.	

PREPARATION				Liquid Limit	48 %
Method of preparation	Wet sieved over 0.425mm sieve			Plastic Limit	16 %
Sample retained 0.425mm sieve	(Measured)	9 %		Plasticity Index	32 %
Corrected water content for material passing 0.425mm		18.6 %		Liquidity Index	0.03
Sample retained 2mm sieve	(Measured)	4 %		NHBC Modified (I'p)	29 %
Curing time	24 hrs	Clay Content	Not analysed	Derived Activity	Not analysed



Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:	Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)

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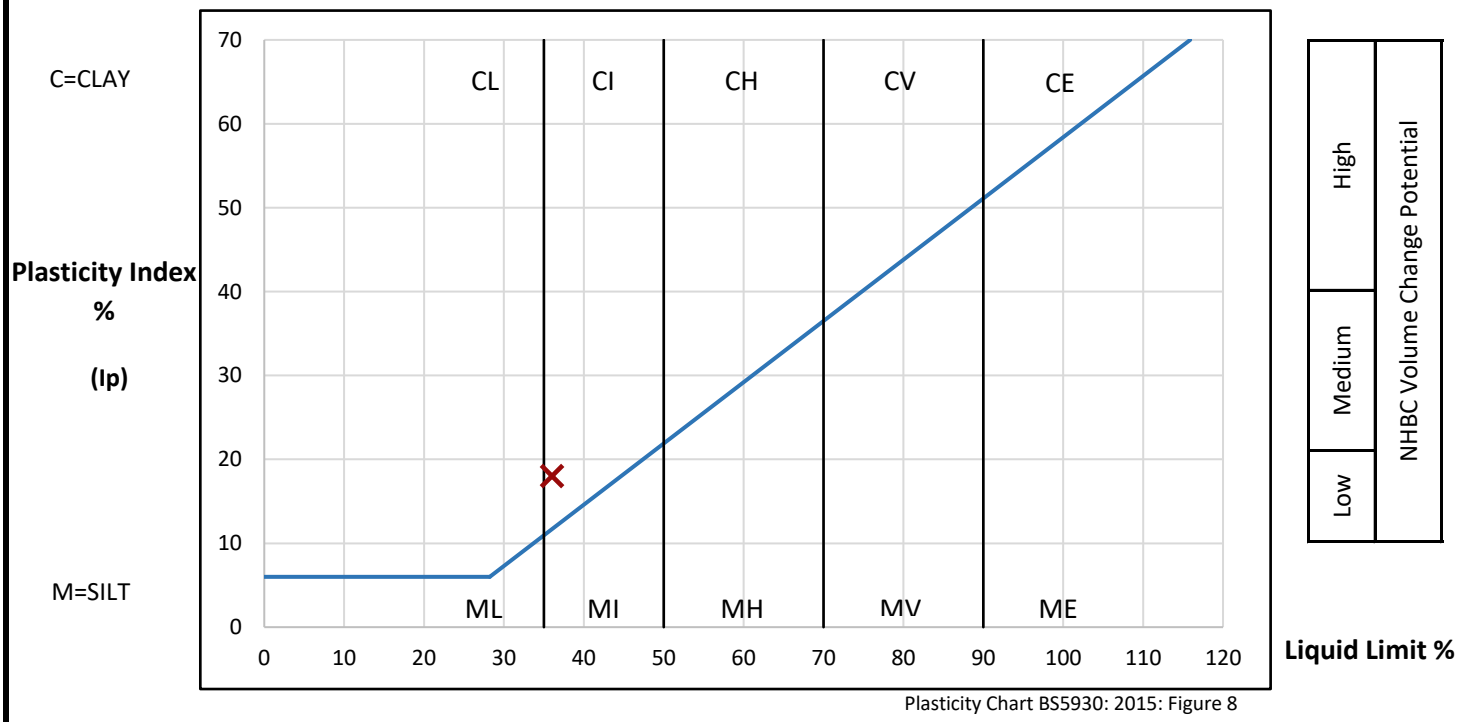
DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample Type	Sample Reference	Water Content (W) %	Description	Remarks
CP02	1.60	D	2	16.7	Firm dark yellowish brown slightly gravelly slightly sandy silty CLAY. Gravel is fine to medium subangular to rounded chert.	

PREPARATION			Liquid Limit	36 %
Method of preparation	Wet sieved over 0.425mm sieve		Plastic Limit	18 %
Sample retained 0.425mm sieve	(Measured)	29 %	Plasticity Index	18 %
Corrected water content for material passing 0.425mm		23.5 %	Liquidity Index	-0.07
Sample retained 2mm sieve	(Measured)	25 %	NHBC Modified (I'p)	13 %
Curing time	25 hrs	Clay Content Not analysed	Derived Activity	Not analysed



Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:	Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)

TEST REPORT

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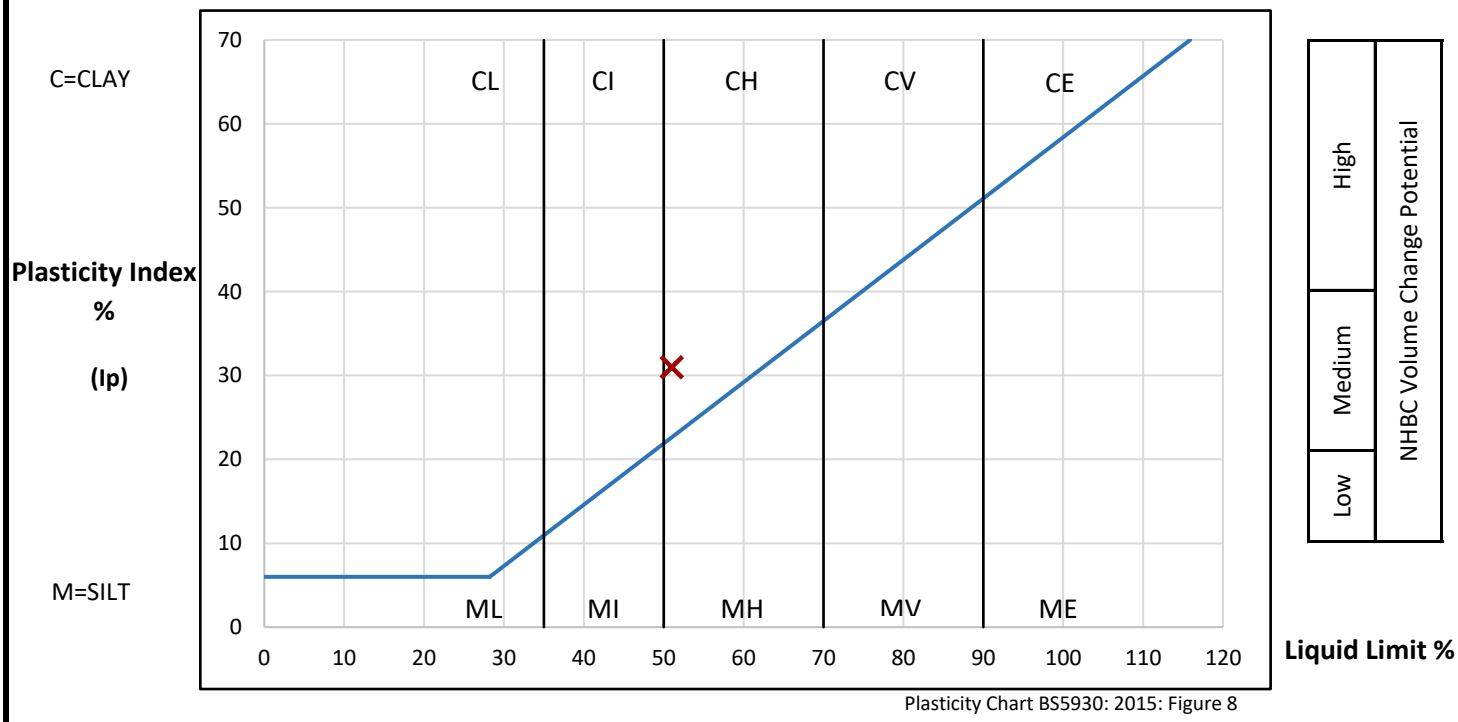
Contract	**Comet Way, Hatfield**
Serial No.	**36699_1**

DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample Type	Sample Reference	Water Content (W) %	Description	Remarks
CP02	9.50	D	6	19.3	Very stiff dark grey slightly gravelly slightly sandy silty calcareous CLAY. Gravel is fine to medium chalk, and rare chert.	

PREPARATION			Liquid Limit	51 %
Method of preparation	Wet sieved over 0.425mm sieve		Plastic Limit	20 %
Sample retained 0.425mm sieve	(Measured)	6 %	Plasticity Index	31 %
Corrected water content for material passing 0.425mm		20.5 %	Liquidity Index	-0.02
Sample retained 2mm sieve	(Measured)	3 %	NHBC Modified (I'p)	29 %
Curing time	24 hrs	Clay Content: Not analysed	Derived Activity	Not analysed



Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:	Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)

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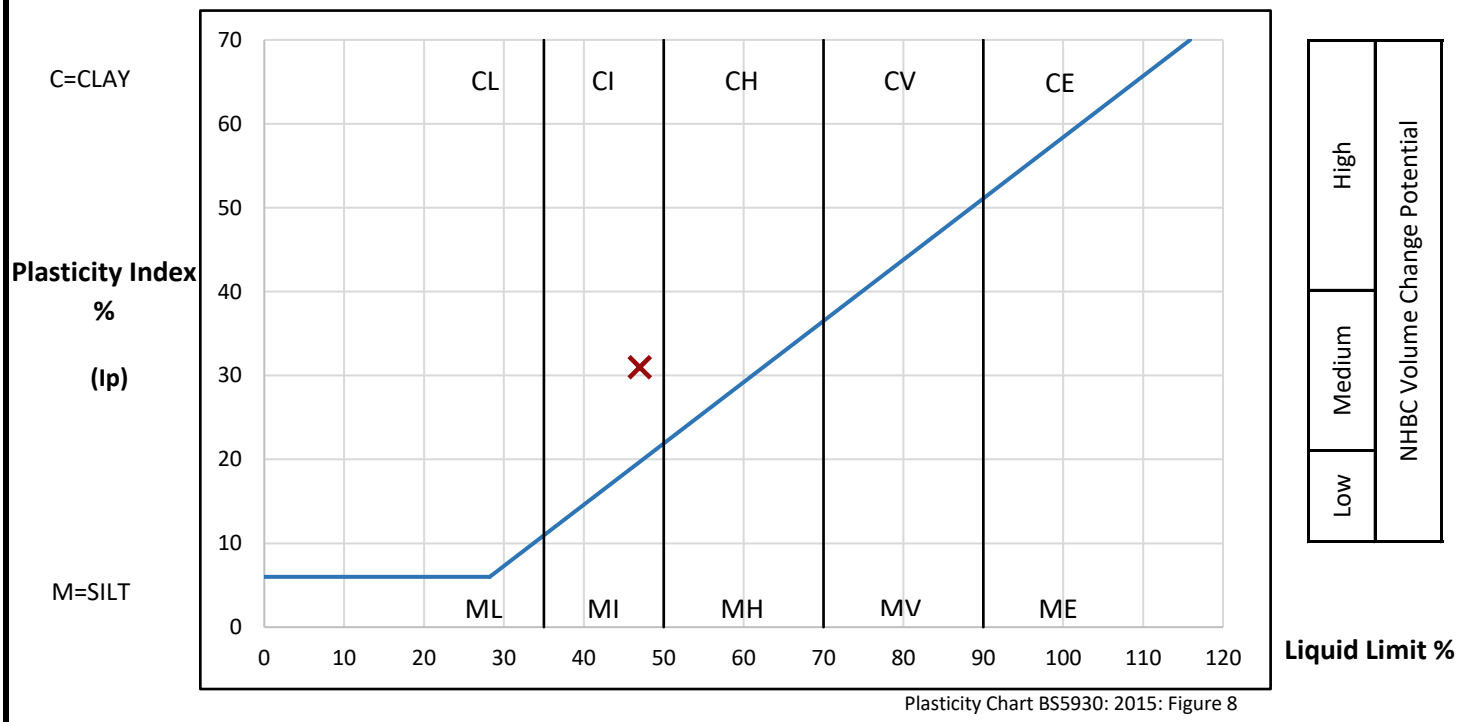
DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample Type	Sample Reference	Water Content (W) %	Description	Remarks
CP02	13.00	D	8	15.9	Very stiff dark grey slightly gravelly slightly sandy silty calcareous CLAY. Gravel is fine to medium chalk and chert.	

PREPARATION				Liquid Limit	47 %
Method of preparation	Wet sieved over 0.425mm sieve			Plastic Limit	16 %
Sample retained 0.425mm sieve	(Measured)	12 %		Plasticity Index	31 %
Corrected water content for material passing 0.425mm		18.1 %		Liquidity Index	0.00
Sample retained 2mm sieve	(Measured)	7 %		NHBC Modified (I'p)	27 %
Curing time	24 hrs	Clay Content	Not analysed	Derived Activity	Not analysed



Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:	Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)

TEST REPORT

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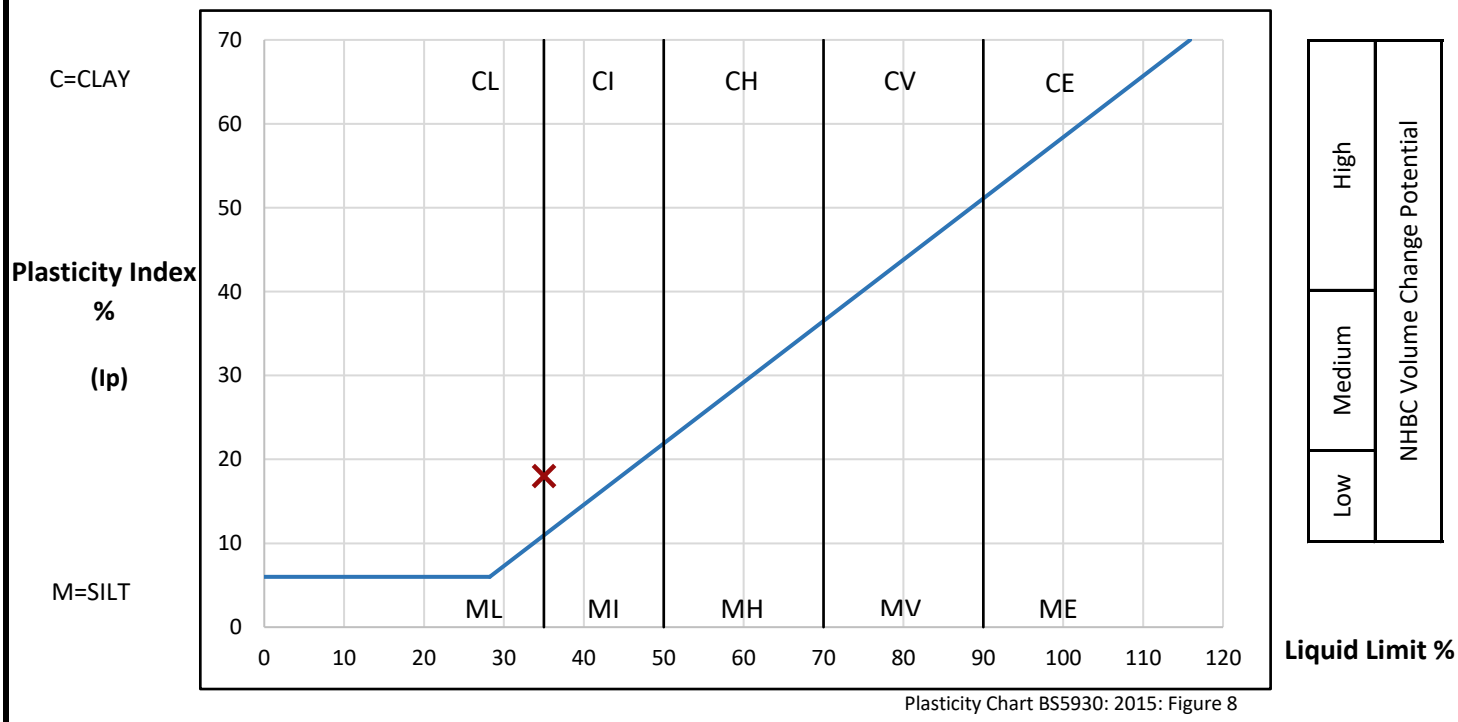
Serial No.	**36699_1**

DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample Type	Sample Reference	Water Content (W) %	Description	Remarks
WS01	1.20	SPT	01	21.1	Firm yellowish brown slightly gravelly slightly sandy silty CLAY. Gravel is fine to medium chert.	

PREPARATION				Liquid Limit	35 %
Method of preparation	Wet sieved over 0.425mm sieve			Plastic Limit	17 %
Sample retained 0.425mm sieve	(Measured)	11 %		Plasticity Index	18 %
Corrected water content for material passing 0.425mm		23.7 %		Liquidity Index	0.23
Sample retained 2mm sieve	(Measured)	7 %		NHBC Modified (I'p)	16 %
Curing time	24 hrs	Clay Content	Not analysed	Derived Activity	Not analysed



Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:	Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 03/04/2020

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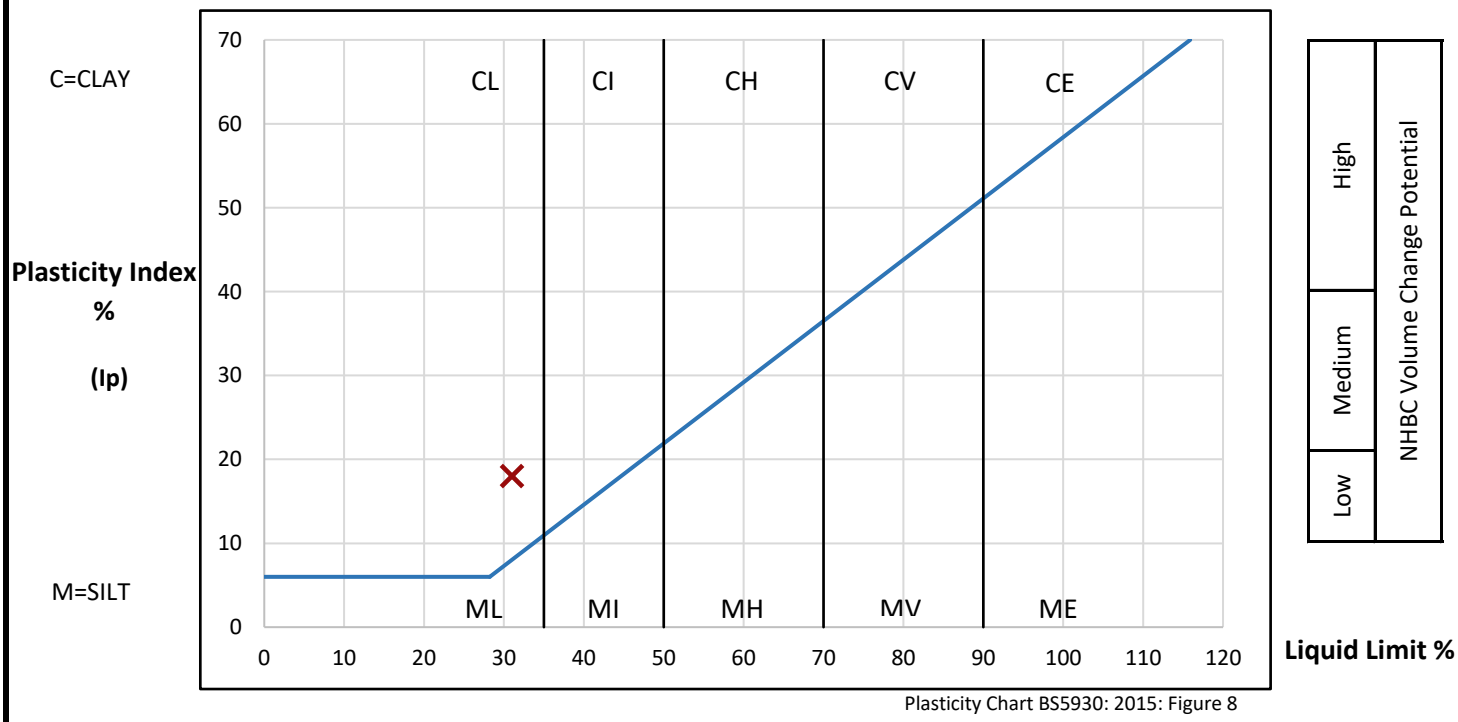
Contract	**Comet Way, Hatfield**
Serial No.	**36699_1**

DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample Type	Sample Reference	Water Content (W) %	Description	Remarks
WS01	2.00	SPT	02	12.4	Firm olive yellow slightly gravelly slightly sandy silty CLAY with occasional yellowish brown mottling. Gravel is brown, black and white fine to medium angular to subangular chert.	

PREPARATION				Liquid Limit	31 %
Method of preparation	Wet sieved over 0.425mm sieve			Plastic Limit	13 %
Sample retained 0.425mm sieve	(Measured)	43 %		Plasticity Index	18 %
Corrected water content for material passing 0.425mm		21.8 %		Liquidity Index	-0.03
Sample retained 2mm sieve	(Measured)	28 %		NHBC Modified (I'p)	10 %
Curing time	72 hrs	Clay Content	Not analysed	Derived Activity	Not analysed



Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:	Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)

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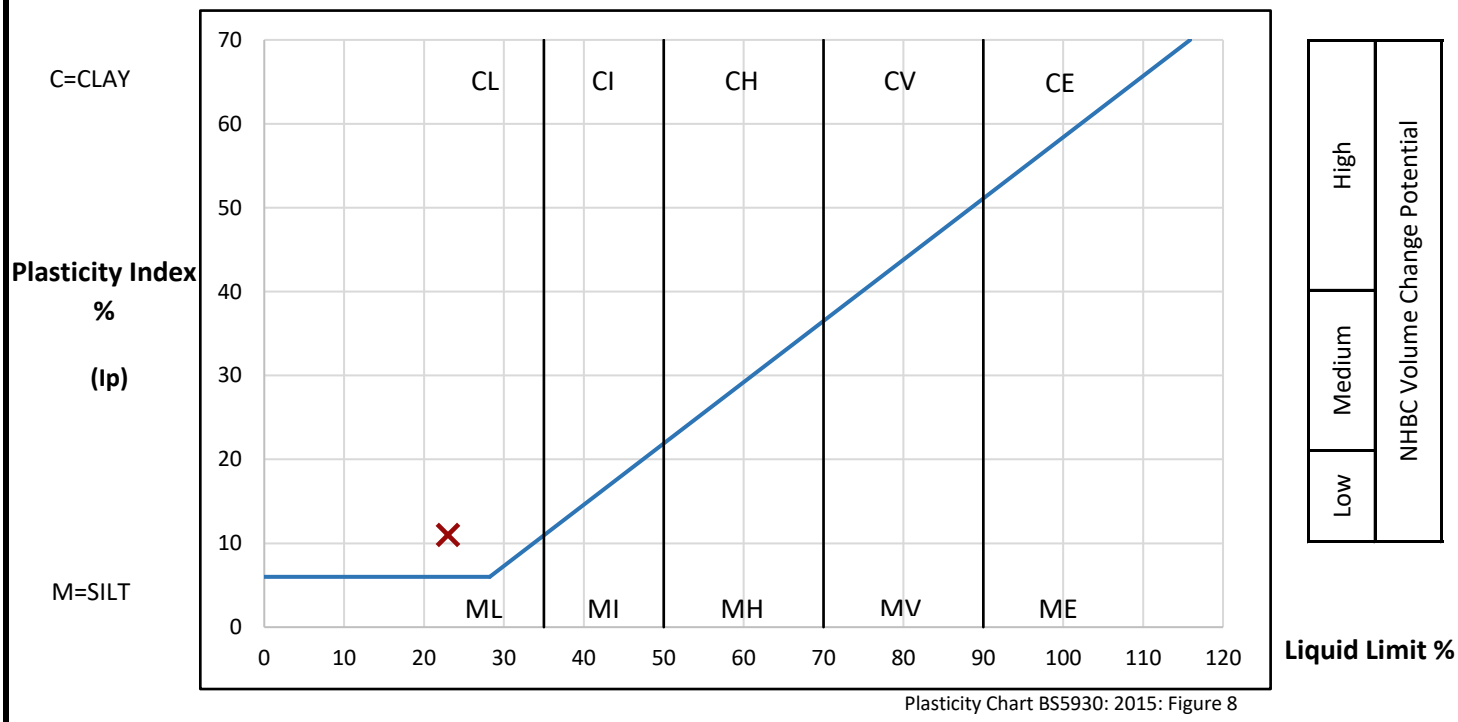
DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample Type	Sample Reference	Water Content (W) %	Description	Remarks
WS03	2.00	SPT	02	8.8	Black, brown and white fine to coarse angular to subangular chert GRAVEL and olive yellow slightly clayey sand with rare orange mottling, and firm clayey lumps.	

PREPARATION					
Method of preparation	Wet sieved over 0.425mm sieve			Liquid Limit	23 %
Sample retained 0.425mm sieve	(Measured)	59 %		Plastic Limit	12 %
Corrected water content for material passing 0.425mm		21.6 %		Plasticity Index	11 %
Sample retained 2mm sieve	(Measured)	40 %		Liquidity Index	-0.29
Curing time	24 hrs	Clay Content	Not analysed	NHBC Modified (I'p)	5 %
				Derived Activity	Not analysed



Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:	Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)

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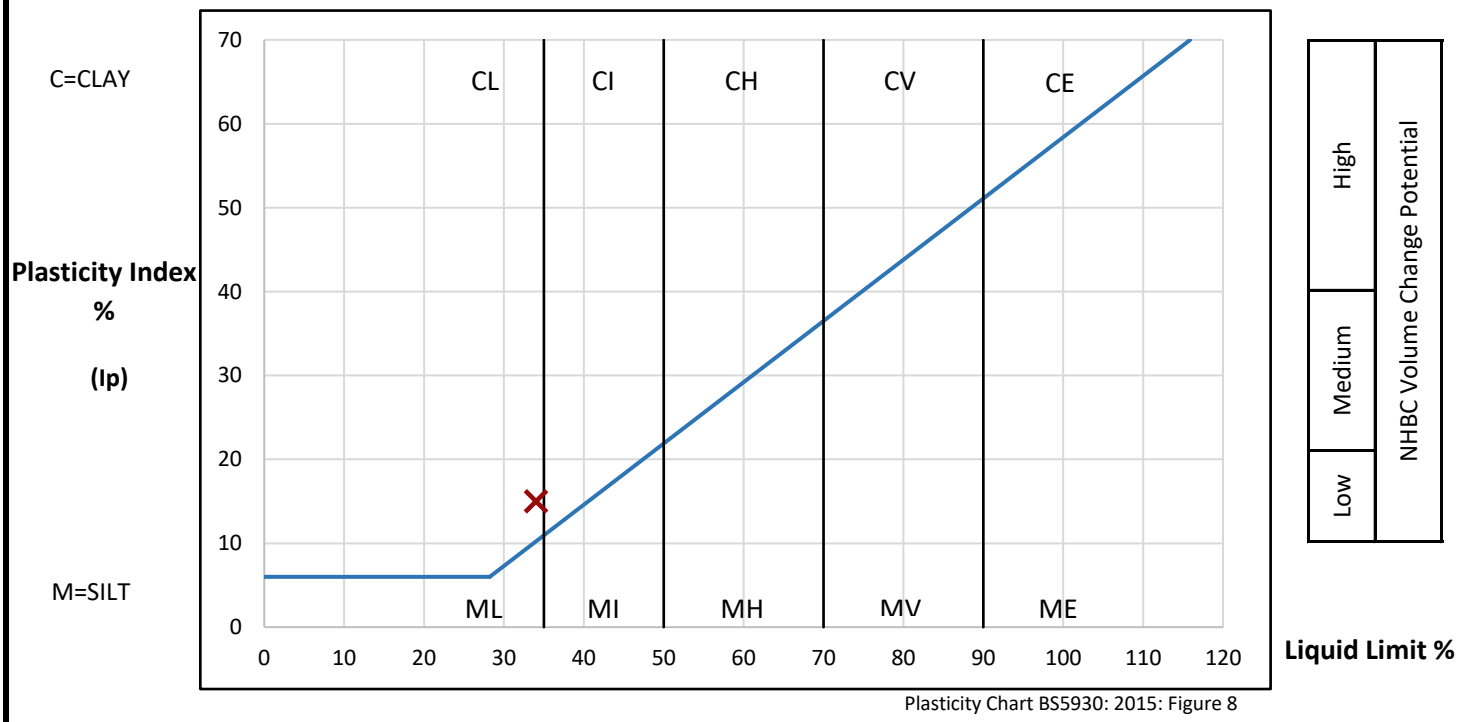
DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample Type	Sample Reference	Water Content (W) %	Description	Remarks
WS04	1.20	SPT	01	22.3	Firm yellowish brown slightly gravelly slightly sandy silty CLAY. Gravel is fine to medium chert.	

PREPARATION				Liquid Limit	34 %
Method of preparation	Wet sieved over 0.425mm sieve			Plastic Limit	19 %
Sample retained 0.425mm sieve	(Measured)	6 %		Plasticity Index	15 %
Corrected water content for material passing 0.425mm		23.7 %		Liquidity Index	0.22
Sample retained 2mm sieve	(Measured)	4 %		NHBC Modified (I'p)	14 %
Curing time	25 hrs	Clay Content	Not analysed	Derived Activity	Not analysed



Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:	Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)

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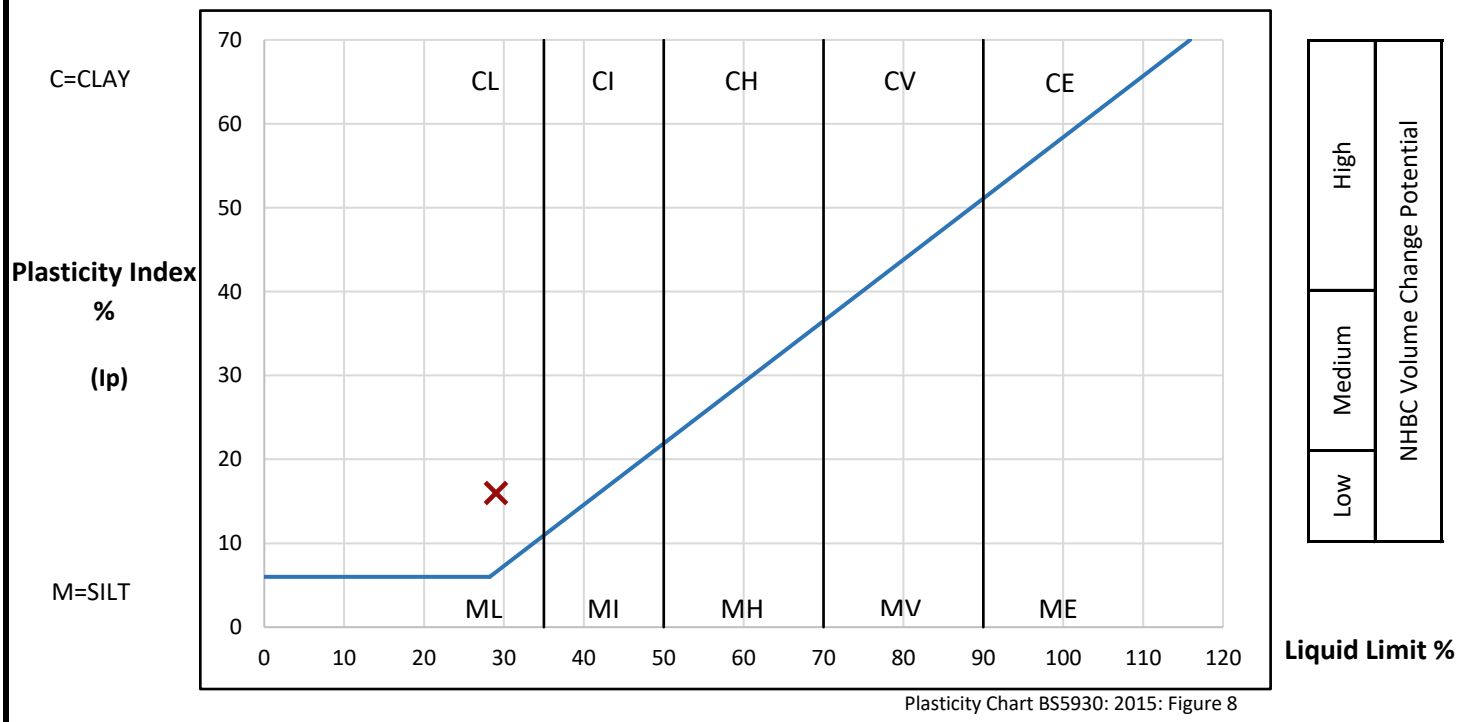
DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

Borehole / Pit No.	Depth m	Sample Type	Sample Reference	Water Content (W) %	Description	Remarks
WS08	2.00	SPT	02	11.1	Stiff yellowish brown slightly gravelly slightly sandy silty CLAY with occasional medium and coarse sand pockets. Gravel is fine to medium angular chert.	

PREPARATION				Liquid Limit	29 %
Method of preparation		Wet sieved over 0.425mm sieve		Plastic Limit	13 %
Sample retained 0.425mm sieve	(Measured)	58 %		Plasticity Index	16 %
Corrected water content for material passing 0.425mm		26.4 %		Liquidity Index	-0.12
Sample retained 2mm sieve	(Measured)	39 %		NHBC Modified (I'p)	7 %
Curing time	24 hrs	Clay Content	Not analysed	Derived Activity	Not analysed



Plasticity Chart BS5930: 2015: Figure 8

Method of Preparation:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
Method of Test:	BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
Type of Sample Key:	U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:	Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)

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Contract	**Comet Way, Hatfield**
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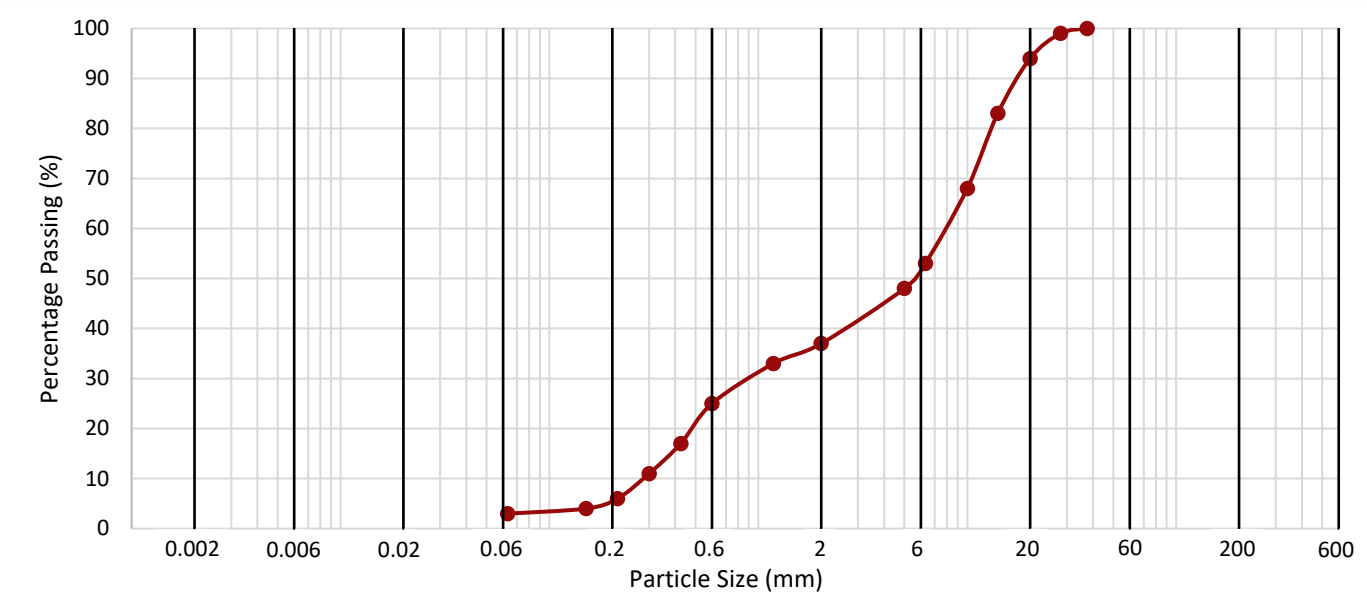
DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Pit No.	Depth (m)	Sample Type	Sample Reference	Description	Remarks
CP01	3.10 - 3.50	B	3	Black, brown and white subangular to subrounded chert and rare white and yellowish brown subrounded to rounded quartzite very sandy slightly silty GRAVEL. Sand is yellowish brown.	

Method of Test:	Wet Sieve	Method of Pretreatment:	Not required



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

Hydrometer	Particle Size (mm)	Passing (%)	Silt by Dry Mass (%)	Clay by Dry Mass (%)

Sieve Size (mm)	Passing (%)	Sand By Dry Mass (%)
2.00	37	34
1.18	33	
0.600	25	
0.425	17	
0.300	11	
0.212	6	
0.150	4	
0.063	3	

Fines By Dry Mass (%)	
<0.063mm	3

Sieve Size (mm)	Passing (%)	2mm+ By Dry Mass (%)
300		63
125		
90		
63		
50		
37.5	100	
28	99	
20	94	
14	83	
10	68	
6.3	53	
5	48	

Method of Preparation: BS1377: Part 1: 2016: 8.3 & 8.4.5
Method of test: BS1377: Part 2: 1990: 9.2
Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:

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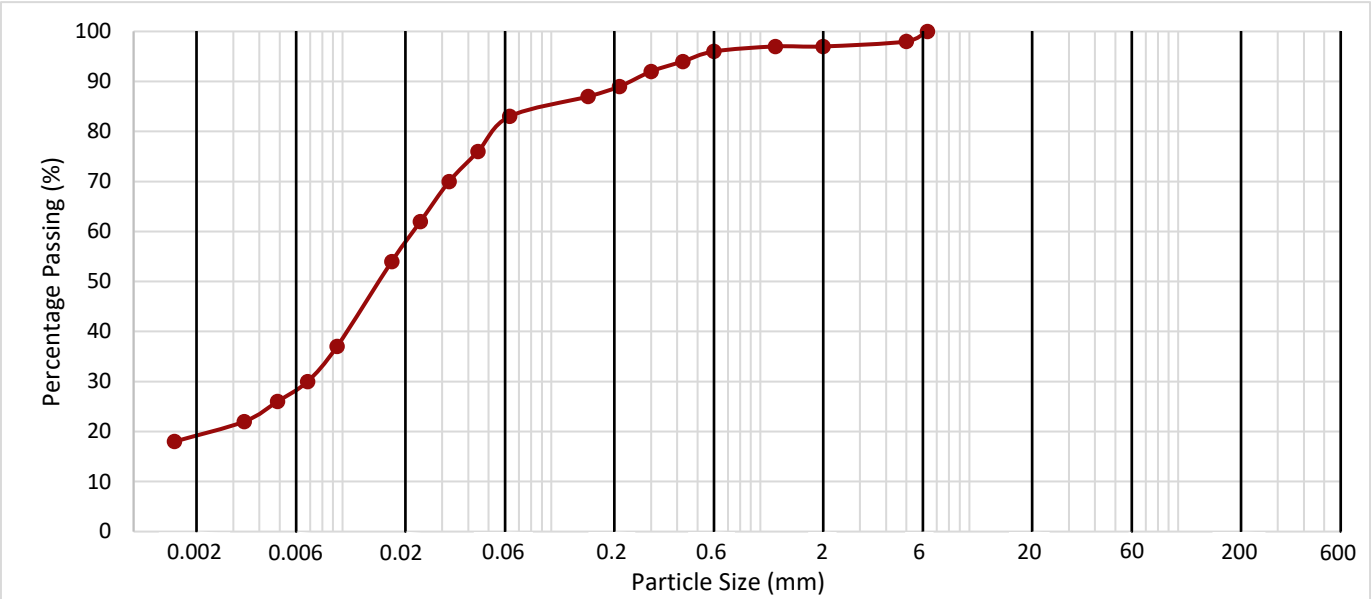
Contract	**Comet Way, Hatfield**
Serial No.	**36699_1**

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Pit No.	Depth (m)	Sample Type	Sample Reference	Description	Remarks
CP01	9.70	B	5	Firm dark grey slightly gravelly slightly sandy silty calcareous CLAY. Gravel is fine to medium chalk and chert.	

Method of Test:	Hydrometer + Pre-sieve	Method of Pretreatment:	Not required



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

Hydrometer	Particle Size (mm)	Passing (%)	Silt by Dry Mass (%)
	0.0445	76	64
	0.0324	70	
	0.0236	62	
	0.0172	54	Clay by Dry Mass (%)
	0.0094	37	
	0.0068	30	
	0.0049	26	19
	0.0034	22	
	0.0016	18	

Sieve Size (mm)	Passing (%)	Sand By Dry Mass (%)
2.00	97	14
1.18	97	
0.600	96	
0.425	94	
0.300	92	
0.212	89	
0.150	87	
0.063	83	

Fines By Dry Mass (%)	
<0.063mm	83

Sieve Size (mm)	Passing (%)	2mm+ By Dry Mass (%)
300		3
125		
90		
63		
50		
37.5		
28		
20		
14		
10		
6.3	100	
5	98	

Method of Preparation: BS1377: Part 1: 2016: 8.3 & 8.4.5
Method of test: BS1377: Part 2: 1990: 9.2,9.5
Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:

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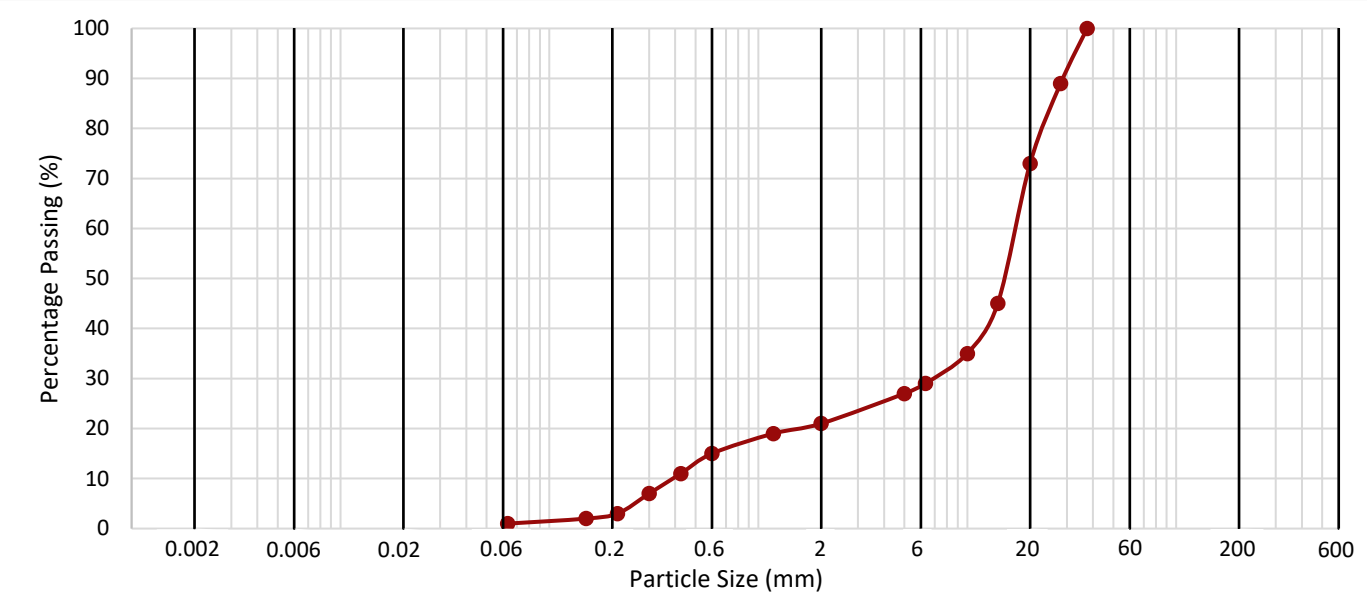
DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Pit No.	Depth (m)	Sample Type	Sample Reference	Description	Remarks
CP01	18.30	D	14	Black, white and brown subangular to subrounded chert and rare yellowish brown and white subrounded to rounded quartzite sandy slightly silty GRAVEL. Sand is dark yellowish brown.	Dry mass of sample required 6kg. Mass of sample submitted 1.838kg. Sample Unrepresentative BS1377:Part 2:1990 Table 3.

Method of Test:	Wet Sieve	Method of Pretreatment:	Not required



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

Hydrometer	Particle Size (mm)	Passing (%)	Silt by Dry Mass (%)
			Clay by Dry Mass (%)

Sieve Size (mm)	Passing (%)	Sand By Dry Mass (%)
2.00	21	20
1.18	19	
0.600	15	
0.425	11	
0.300	7	
0.212	3	
0.150	2	
0.063	1	

Fines By Dry Mass (%)	
<0.063mm	1

Sieve Size (mm)	Passing (%)	2mm+ By Dry Mass (%)
300		79
125		
90		
63		
50		
37.5	100	
28	89	
20	73	
14	45	
10	35	
6.3	29	
5	27	

Method of Preparation: BS1377: Part 1: 2016: 8.3 & 8.4.5
Method of test: BS1377: Part 2: 1990: 9.2
Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:

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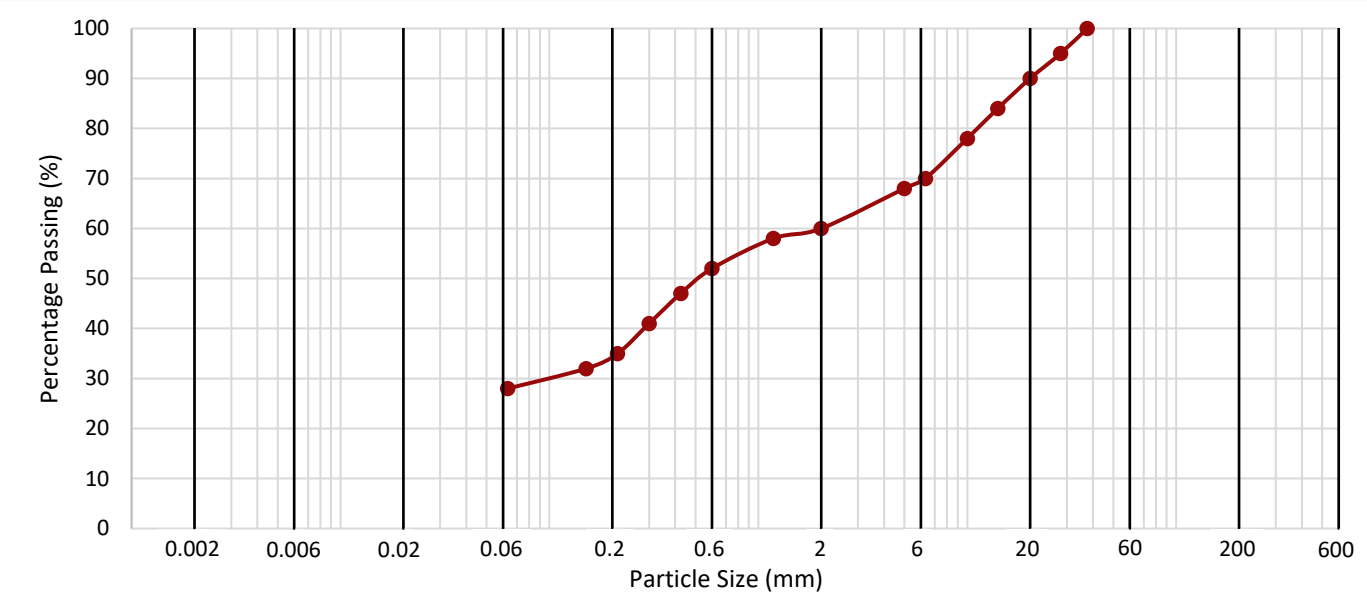
DETERMINATION OF PARTICLE SIZE DISTRIBUTION

Borehole / Pit No.	Depth (m)	Sample Type	Sample Reference	Description	Remarks
CP02	2.10 - 2.50	B	2	Dark yellowish brown gravelly slightly sandy silty CLAY. Gravel is black, brown and white subangular to subrounded chert.	Description based on possible engineering behaviour.

Method of Test:	Wet Sieve	Method of Pretreatment:	Not required



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES	BOULDERS
	SILT			SAND			GRAVEL				

Hydrometer	Particle Size (mm)	Passing (%)	Silt by Dry Mass (%)	Clay by Dry Mass (%)

Sieve Size (mm)	Passing (%)	Sand By Dry Mass (%)
2.00	60	32
1.18	58	
0.600	52	
0.425	47	
0.300	41	
0.212	35	
0.150	32	
0.063	28	

Fines By Dry Mass (%)	
<0.063mm	28

Sieve Size (mm)	Passing (%)	2mm+ By Dry Mass (%)
300		40
125		
90		
63		
50		
37.5	100	
28	95	
20	90	
14	84	
10	78	
6.3	70	
5	68	

Method of Preparation: BS1377: Part 1: 2016: 8.3 & 8.4.5
Method of test: BS1377: Part 2: 1990: 9.2
Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
Comments:

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Contract	**Comet Way, Hatfield**
Serial No.	**36699_1**

DETERMINATION OF DENSITY, WATER CONTENT AND UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASURMENT OF PORE PRESSURE

Borehole /Pit No.	Depth (m)	Type	Reference	Water Content (%)	Bulk Density (Mg/m³)	Dry Density (Mg/m³)	Lateral Pressure (kPa)	Deviator Stress (kPa)	Shear Stress (kPa)	Mohrs Circle Analysis		Description
										Cu (kPa)	Ø degrees	
CP01	14.02	U	1	15.8	2.16	1.87	282	624	312			Hard (extremely high strength) dark greyish brown slightly gravelly slightly sandy silty calcareous CLAY. Gravel is fine to medium chert and chalk.
CP02	12.61	U	2	15.7	2.22	1.92	250	574	287			Very stiff (very high strength) dark greyish brown slightly gravelly slightly sandy silty calcareous CLAY. Gravel is fine to medium chert and chalk.

Method of Preparation:	BS 1377: Part 1: 1990: 7.4.2 & 8, Part 2: 1990: 7.2, Part 7: 1990: 8.3
Method of Test:	BS 1377: Part 2: 1990:3 Determination of Moisture Content, Part2: 1990:7 Determination of Density, Part 7: 1990: 8 Undrained Shear Strenth, 9 Multistage Loading
Type of Sample Key:	U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments:	
Remarks to Include:	Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample, oven drying temperature if not 105-110°C

TEST REPORT

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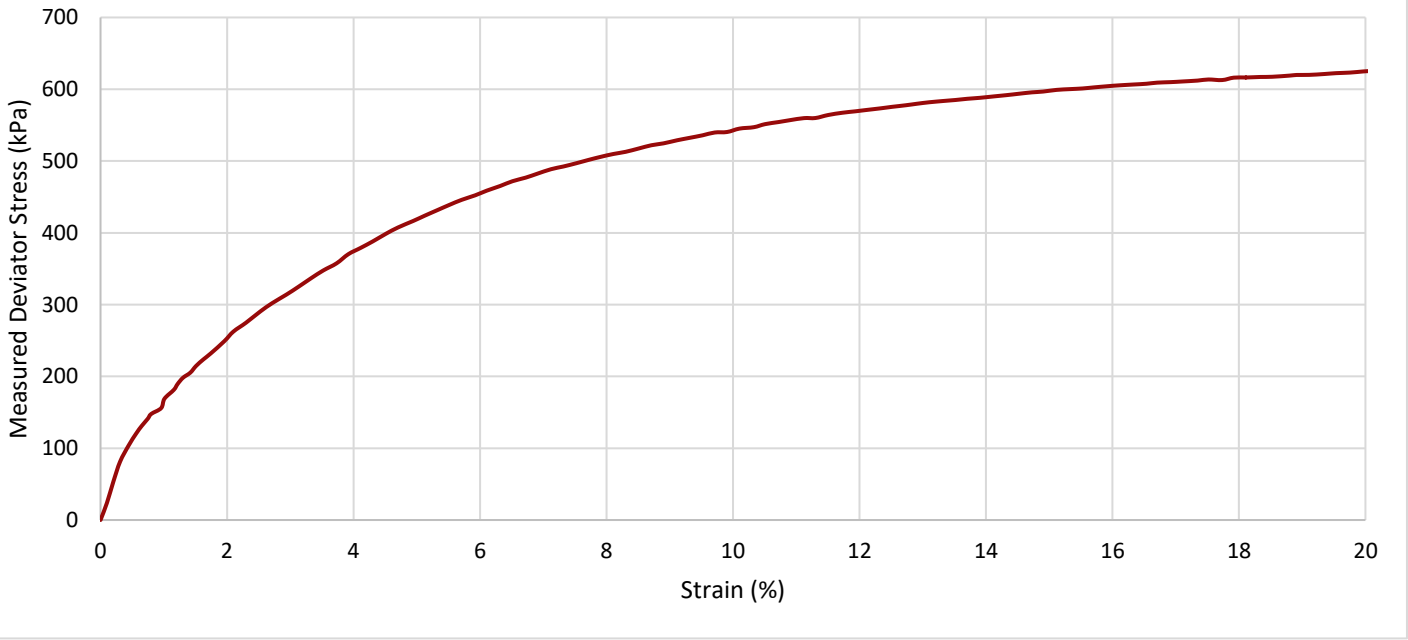
Contract	**Comet Way, Hatfield**
Serial No.	**36699_1**

DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole /Pit No.	Depth (m)	Type	Reference	Description	Remarks
CP01	13.90	U	1	Hard (extremely high strength) dark greyish brown slightly gravelly slightly sandy silty calcareous CLAY. Gravel is fine to medium chert and chalk.	

Initial Specimen	Height (mm)	Diameter (mm)	Weight (g)	Water Content (%)	Bulk Density (Mg/m³)	Dry Density (Mg/m³)
Depth of Top of Specimen (m) 14.02	199.1	102.8	3573	15.8	2.16	1.87

TEST INFORMATION — Rate of Strain 1.9 % per Min — Rubber Membrane Thickness 0.6 mm



Specimen at failure	Measured Cell Pressure, σ3 (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress, (σ1-σ3)f (kPa)	Shear Stress Cu, ½(σ1-σ3)f (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI (degrees)
	282	20.1	2.3	\	624	312		

Method of Preparation:	BS 1377: Part 1: 1990
Method of Test:	BS 1377: Part 7: 1990: 8 Definitive Method, 1990: 9 Multi-stage loading
Type of Sample Key:	U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments:	Tested in Vertical Condition
	UKAS Calibration - loads from 0.2 to 10kN
Remarks to Include:	Sample disturbance, loss of moisture, variation form test procedure, location and origin of test specimen within original sample, oven drying temperature if not 105-110°C

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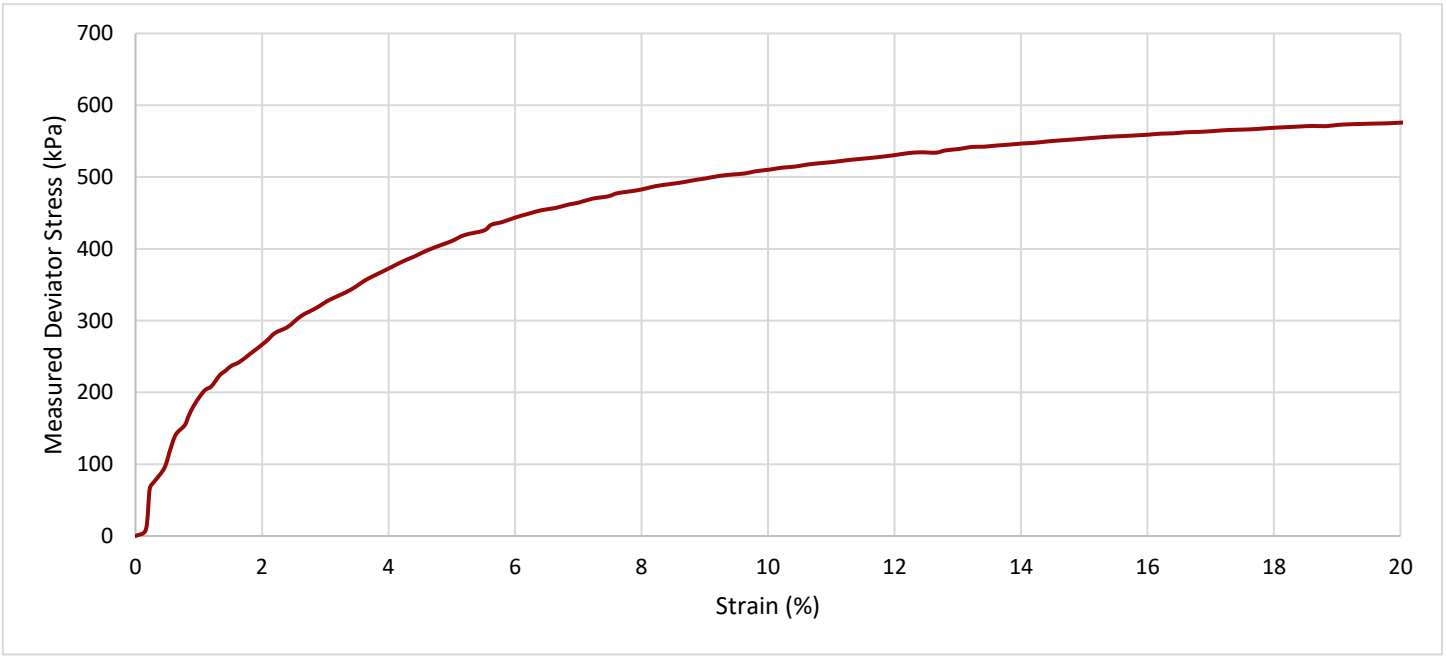
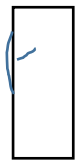
DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

Borehole /Pit No.	Depth (m)	Type	Reference	Description	Remarks
CP02	12.50	U	2	Very stiff (very high strength) dark greyish brown slightly gravelly slightly sandy silty calcareous CLAY. Gravel is fine to medium chert and chalk.	

Initial Specimen	Height (mm)	Diameter (mm)	Weight (g)	Water Content (%)	Bulk Density (Mg/m³)	Dry Density (Mg/m³)
Depth of Top of Specimen (m) 12.61	155.2	102.5	2841	15.7	2.22	1.92

TEST INFORMATION — Rate of Strain 1.8 % per Min — Rubber Membrane Thickness 0.6 mm



Specimen at failure	Measured Cell Pressure, σ3 (kPa)	Strain at Failure (%)	Stress Corrections (kPa)		Corrected Max. Deviator Stress, (σ1-σ3)f (kPa)	Shear Stress Cu, ½(σ1-σ3)f (kPa)	Mohrs Circle Analysis	
			Rubber Membrane	Piston Friction			Cu (kPa)	PHI (degrees)
	250	20.0	2.3	\	574	287		

Method of Preparation:	BS 1377: Part 1: 1990
Method of Test:	BS 1377: Part 7: 1990: 8 Definitive Method, 1990: 9 Multi-stage loading
Type of Sample Key:	U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments:	Tested in Vertical Condition
	UKAS Calibration - loads from 0.2 to 10kN
Remarks to Include:	Sample disturbance, loss of moisture, variation form test procedure, location and origin of test specimen within original sample, oven drying temperature if not 105-110°C

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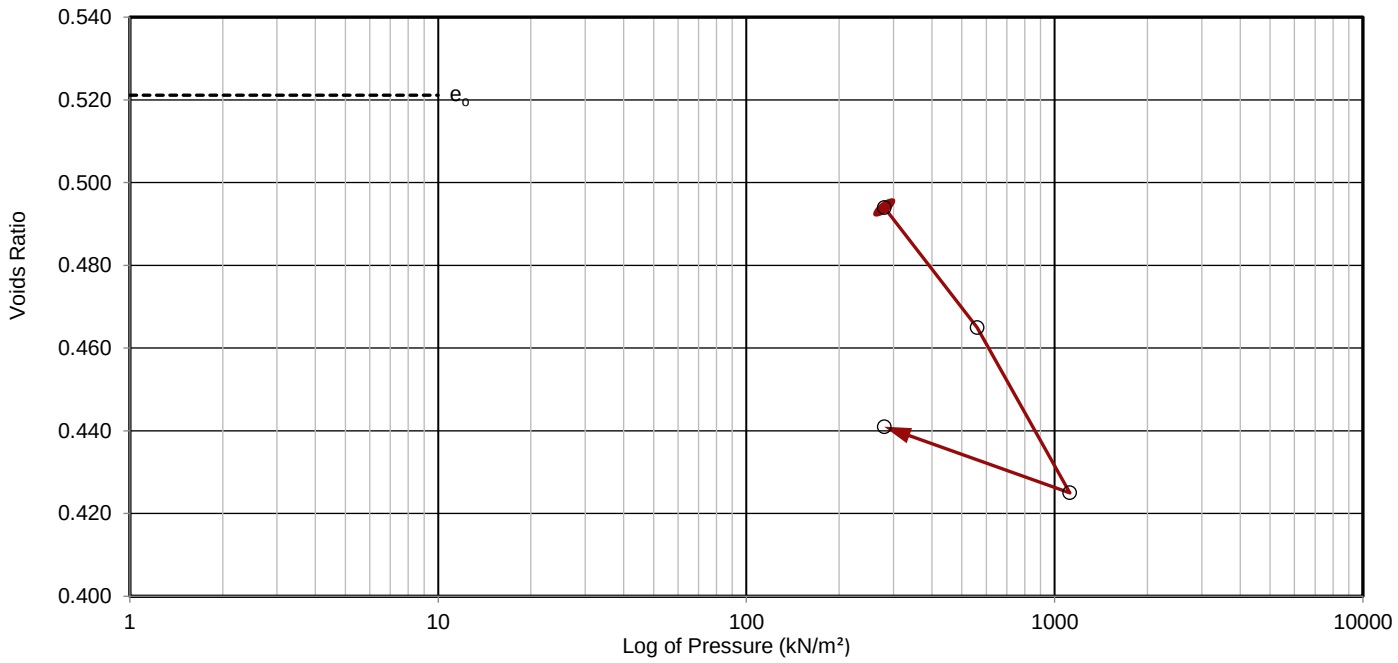
Contract	**Comet Way, Hatfield**
Serial No.	**36699_1**

DETERMINATION OF THE ONE-DIMENSIONAL CONSOLIDATION PROPERTIES

Borehole/ Pit No.	Depth (m)	Type	Ref.	Specimen Depth (m) and Orientation	Water Content (%)	Description	Remarks
CP01	13.90	U	1	13.95 Horizontal	16.8	Hard (extremely high strength) dark greyish brown slightly gravelly slightly sandy silty calcareous CLAY. Gravel is fine to medium chert and chalk.	

Initial Conditions			Increment No.	Load (kN/m²)	Change in Height (mm)	Void Ratio	Cv (m²/yr)	Mv (m²/MN)	Temp (°C)	Corrected Cv
Height	mm	18.73	1	280	0.339	0.494			21	
Diameter	mm	50.01	2	560	0.691	0.465	0.99	0.07	21	0.96
Wet Weight	g	79.06	3	1120	1.189	0.425	0.37	0.05	21	0.36
Water Content	%	16.8	4	280	0.982	0.441		0.01	21	
Bulk Density	Mg/m³	2.15								
Particle Density		Assumed 2.80								
Voids Ratio		0.521								
Degree of Saturation	%	90								
Swelling Pressure	kN/m²	280								
Dry Density	Mg/m³	1.84								



Method of Preparation:	BS 1377: Part 5: 1990: 3.3 & 3.4
Method of Test:	BS 1377: Part 5: 1990: 3.5
Method of Time Fitting Used:	Square root
Type of Sample Key:	U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments:	
Remarks to Include:	Sample disturbance, loss of water, variation from test procedure, location and origin of test specimen within original sample, oven drying temperature if not 105-110 °C.

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 03/04/2020

0998

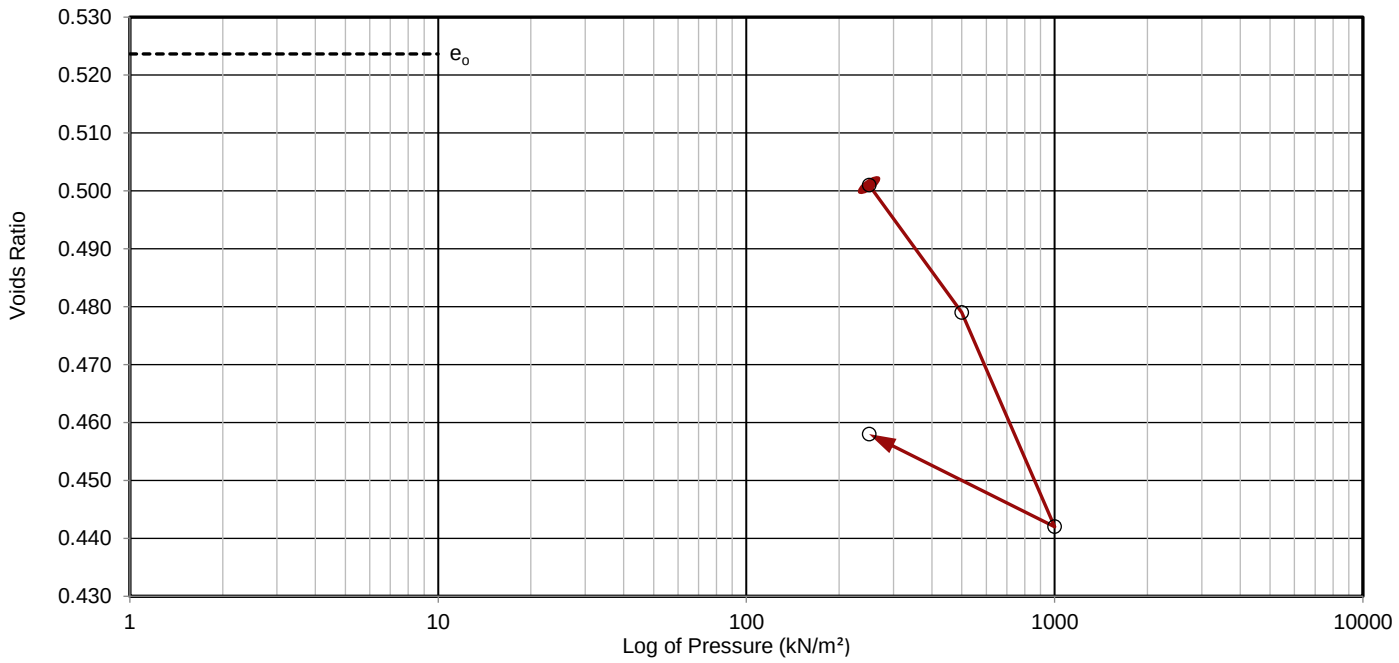
Contract	**Comet Way, Hatfield**
Serial No.	**36699_1**

DETERMINATION OF THE ONE-DIMENSIONAL CONSOLIDATION PROPERTIES

Borehole/ Pit No.	Depth (m)	Type	Ref.	Specimen Depth (m) and Orientation	Water Content (%)	Description	Remarks
CP02	12.50	U	2	12.53 Horizontal	17.1	Very stiff (very high strength) dark greyish brown slightly gravelly slightly sandy silty calcareous CLAY. Gravel is fine to medium chert and chalk.	

Initial Conditions			
Height	mm	18.70	
Diameter	mm	50.00	
Wet Weight	g	78.68	
Water Content	%	17.1	
Bulk Density	Mg/m³	2.14	
Particle Density		Assumed	2.79
Voids Ratio		0.524	
Degree of Saturation	%	91	
Swelling Pressure	kN/m²	250	
Dry Density	Mg/m³	1.83	

Increment No.	Load (kN/m²)	Change in Height (mm)	Void Ratio	Cv (m²/yr)	Mv (m²/MN)	Temp (°C)	Corrected Cv
1	250	0.278	0.501			21	
2	500	0.543	0.479	0.49	0.06	21	0.47
3	1000	1.005	0.442	0.33	0.05	21	0.32
4	250	0.807	0.458		0.02	21	



Method of Preparation:	BS 1377: Part 5: 1990: 3.3 & 3.4
Method of Test:	BS 1377: Part 5: 1990: 3.5
Method of Time Fitting Used:	Square root
Type of Sample Key:	U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
Comments:	
Remarks to Include:	Sample disturbance, loss of water, variation from test procedure, location and origin of test specimen within original sample, oven drying temperature if not 105-110 °C.

TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD

DATE ISSUED: 03/04/2020

Contract:	**Comet Way, Hatfield**
Serial No:	**36699_1**

DETERMINATION OF THE SULPHATE CONTENT AND pH OF SOIL AND GROUNDWATER

Borehole / Pit No.	Depth (m)	Sample		Conc. of Soluble SO3		Calc'd Conc. Of SO4 (g/L)	pH Value	% Sample Passing 2mm Sieve	Description	Remarks
		Type	Ref.	Water Soluble 2:1 (g/L)	Ground Water (g/L)					
CP01	1.20	B	1	0.07		0.08	7.1	80	Firm dark yellowish brown slightly gravelly slightly sandy silty CLAY with rare decayed roots. Gravel is brown, white and grey fine to medium chert.	
CP02	9.80	B	5	0.28		0.34	7.0	88	Stiff dark grey slightly gravelly slightly sandy calcareous CLAY. Gravel is fine to coarse chalk, and chert.	
CP02	28.70	B	10	0.02		0.03	7.1	0	Intact white CHALK fragments of fine to coarse gravel size with occasional black angular flint gravel and rare structureless chalk.	Chalk crushed to pass 2mm sieve
WS04	2.00	SPT	02	0.04		0.04	7.1	72	Firm olive yellow slightly gravelly slightly sandy CLAY with occasional grey and orange mottling. Gravel is fine to medium angular to subangular chert.	
WS05	3.00	SPT	03	<0.01		<0.01	7.2	88	Olive yellow gravelly fine to medium SAND. Gravel is fine to medium angular to subangular chert.	
WS08	2.00	SPT	02	0.01		0.02	6.9	61	Stiff yellowish brown slightly gravelly slightly sandy silty CLAY with occasional medium and coarse sand pockets. Gravel is fine to medium angular chert.	

Method of Preparation:	BS1377: Part 1: 2016: 8.5, BS1377: Part 3: 1990: 5.3 Soil/Water Extract, 5.4 Groundwater
Method of Test:	BS1377: Part 3: 1990: 5.5
Type of Sample Key:	U= Undisturbed, B= Bulk, D= Disturbed, J= Jar, W= Water, SPT= Split Spoon Sample, C= Core Cutter
Comments:	**Test not UKAS accredited**
Remarks to Include:	Sample disturbance, loss of moisture, variation from test procedure, location, and origin of test specimen within original sample. Oven drying temperature if not 105-110C.

Appendix D Ground Gas Monitoring Records

RECORD SHEET - GAS MONITORING

Job Title	Comet Way, Hatfield
Job No	47179
Date	20.3.2020
Operator	C Radbone

Instrument (type/serial no)	GAS DATA GFM SERIES 436

Atmospheric Pressure	Time	- 48 hrs	- 24 hrs	0	+ 24 hrs	+ 48 hrs		Comment	+/-48hrs and +/-24hrs data has been obtained from timeanddate.com
	mbar			1023					

Ground conditions	Dry

Weather	Cold, clear

Borehole identification and construction	CP01
Comment/Condition	

Start time with pump time (minutes)	Flow (l/hr)	Differential Pressure (Pa)	CO2 (%v/v)	O2 (%v/v)	CH4 (%LEL)	CH4 (%v/v)	H2S (ppm)	C6H14 (%)	CO (ppm)	PID (ppm)	Groundwater Level Level (mBGL)	Depth to base (mBGL)
0.5	0.0	0.0	0.2	19.8	0.0	0.0	0.0	0.0	0.0	1.0	13.59	20.00
1	0.0	0.0	0.2	18.4	0.0	0.0	0.0	0.0	0.0	1.0		
1.5	0.0	0.0	0.0	17.1	0.0	0.0	0.0	0.0	0.0	1.0		
2	0.0	0.0	0.0	16.9	0.0	0.0	0.0	0.0	10.0	1.0		

Borehole identification and construction	CP02
Comment/Condition	

Start time with pump time (minutes)	Flow (l/hr)	Differential Pressure (Pa)	CO2 (%v/v)	O2 (%v/v)	CH4 (%LEL)	CH4 (%v/v)	H2S (ppm)	C6H14 (%)	CO (ppm)	PID (ppm)	Groundwater Level Level (mBGL)	Depth to base (mBGL)
0.5	0.0	0.0	0.4	19.1	0.0	0.0	0.0	0.0	0.0	1.0	15.23	20.00
1	0.0	0.0	0.6	18.8	0.0	0.0	0.0	0.0	0.0	1.0		
1.5	0.0	0.0	0.7	18.7	0.0	0.0	0.0	0.0	0.0	1.0		
2	0.0	0.0	0.7	18.6	0.0	0.0	0.0	0.0	0.0	1.0		

Borehole identification and construction	WS01
Comment/Condition	

Start time with pump time (minutes)	Flow (l/hr)	Differential Pressure (Pa)	CO2 (%v/v)	O2 (%v/v)	CH4 (%LEL)	CH4 (%v/v)	H2S (ppm)	C6H14 (%)	CO (ppm)	PID (ppm)	Groundwater Level Level (mBGL)	Depth to base (mBGL)
0.5	-0.4	-1.0	0.6	19.5	0.0	0.0	0.0	0.0	0.0	1.0	Dry	5.00
1	-0.4	-1.0	0.8	18.5	0.0	0.0	0.0	0.0	0.0	1.0		
1.5	-0.3	-1.0	0.9	18.4	0.0	0.0	0.0	0.0	0.0	1.0		
2	-0.4	-1.0	0.9	18.3	0.0	0.0	0.0	0.0	0.0	1.0		

Borehole identification and construction	WS02
Comment/Condition	

Start time with pump time (minutes)	Flow (l/hr)	Differential Pressure (Pa)	CO2 (%v/v)	O2 (%v/v)	CH4 (%LEL)	CH4 (%v/v)	H2S (ppm)	C6H14 (%)	CO (ppm)	PID (ppm)	Groundwater Level Level (mBGL)	Depth to base (mBGL)
0.5	-0.4	-2.0	0.8	18.4	0.0	0.0	0.0	0.0	0.0	1.0	Dry	
1	-0.4	-2.0	0.2	19.8	0.0	0.0	0.0	0.0	0.0	1.0		
1.5	-0.4	-2.0	0.2	19.9	0.0	0.0	0.0	0.0	0.0	1.0		
2	-0.4	-2.0	0.2	20.0	0.0	0.0	0.0	0.0	0.0	1.0		

N.B: Where measured gas concentration is shown to be '0.0' this indicates the actual concentration is below the limit of detection for the gas monitoring equipment

Typed By:	JC	Date	04.12.2019	Checked By:	Date

RECORD SHEET - GAS MONITORING

Job Title	Comet Way, Hatfield
Job No	47179
Date	20.03.2020
Operator	C Radbone

Borehole identification and construction	WS04											
Comment/Condition	Unable to access borehole, parked car on top of cover											
Start time with pump time (minutes)	Flow (l/hr)	Differential Pressure (Pa)	CO2 (%v/v)	O2 (%v/v)	CH4 (%LEL)	CH4 (%v/v)	H2S (ppm)	C6H14 (%)	CO (ppm)	PID (ppm)	Groundwater Level Level (mBGL)	Depth to base (mBGL)

Borehole identification and construction	WS05											
Comment/Condition												
Start time with pump time (minutes)	Flow (l/hr)	Differential Pressure (Pa)	CO2 (%v/v)	O2 (%v/v)	CH4 (%LEL)	CH4 (%v/v)	H2S (ppm)	C6H14 (%)	CO (ppm)	PID (ppm)	Groundwater Level Level (mBGL)	Depth to base (mBGL)
0.5	-0.2	-2.0	0.1	18.6	0.0	0.0	0.0	0.0	0.0	1.0	4.95	5.00
1	-0.2	-2.0	0.1	19.7	0.0	0.0	0.0	0.0	0.0	1.0		
1.5	-0.2	-2.0	0.1	19.9	0.0	0.0	0.0	0.0	0.0	1.0		
2	-0.2	-2.0	0.1	20.0	0.0	0.0	0.0	0.0	0.0	1.0		

Borehole identification and construction	WS06											
Comment/Condition												
Start time with pump time (minutes)	Flow (l/hr)	Differential Pressure (Pa)	CO2 (%v/v)	O2 (%v/v)	CH4 (%LEL)	CH4 (%v/v)	H2S (ppm)	C6H14 (%)	CO (ppm)	PID (ppm)	Groundwater Level Level (mBGL)	Depth to base (mBGL)
0.5	-0.2	-2.0	0.4	19.8	0.0	0.0	0.0	0.0	10.0	1.0	Dry	5.00
1	-0.2	-2.0	0.4	19.3	0.0	0.0	0.0	0.0	10.0	1.0		
1.5	-0.2	-2.0	0.5	19.2	0.0	0.0	0.0	0.0	10.0	1.0		
2	-0.2	-2.0	0.4	19.1	0.0	0.0	0.0	0.0	10.0	1.0		

Borehole identification and construction												
Comment/Condition												
Start time with pump time (minutes)	Flow (l/hr)	Differential Pressure (Pa)	CO2 (%v/v)	O2 (%v/v)	CH4 (%LEL)	CH4 (%v/v)	H2S (ppm)	C6H14 (%)	CO (ppm)	PID (ppm)	Groundwater Level Level (mBGL)	Depth to base (mBGL)

N.B: Where measured gas concentration is shown to be '0.0' this indicates the actual concentration is below the limit of detection for the gas monitoring equipment

Typed By:	JC	Date	04.12.2019	Checked By:	Date

Appendix E Stantec Methodology for the Assessment of Potentially Contaminated Land

Stantec Guide: Methodology for Assessment of Land Contamination (England)

1 INTRODUCTION

This document defines the approach adopted by Stantec in relation to the assessment of land contamination in England. The aim is for the approach to (i) be systematic and objective, (ii) provide for the assessment of uncertainty and (iii) provide a rational, consistent, transparent framework.

When preparing our methodology, we have made reference to various technical guidance documents and legislation referenced in Section 7 of which the principal documents are (i) Contaminated Land Statutory Guidance (Defra 2012), (ii) online guidance Land Contamination: Risk Management (LC:RM) accessed from GOV.UK which replaced the Contaminated Land Research (CLR) Report 11: Model Procedures for the Management of Contamination CLR 11 (EA 2004), (iii) Contaminated land risk assessment: A guide to good practice (C552) (CIRIA 2001) (iv) National Planning Policy Framework (NPPF, 2019) (v) BS 10175 Investigation of potentially contaminated sites - Code of Practice (BSI 2017) and (vi) The series of British Standards on Soil Quality BS 18400.

2 DEALING WITH LAND CONTAMINATION

Government policy on land contamination aims to prevent new contaminated land from being created and promotes a risk-based approach to addressing historical contamination. For historical contamination, regulatory intervention is held in reserve for land that meets the legal definition and cannot be dealt with through any other means, including through planning. Land is only considered to be "*contaminated land*" in the legal sense if it poses an unacceptable risk.

UK legislation on contaminated land is principally contained in Part 2A of the Environmental Protection Act, 1990 (which was inserted into the 1990 Act by section 57 of the Environment Act 1995). Part 2A was introduced in England on 1 April 2000 and provides a risk-based approach to the identification and remediation of land where contamination poses an unacceptable risk to human health or the environment.

The Model Procedures for the Management of Land Contamination (CLR 11), were developed to provide the technical framework for applying a risk management process when dealing with land affected by contamination. The process involves identifying, making decisions on, and taking appropriate action to deal with land contamination in a way that is consistent with government policies and legislation within the UK. The approach, concepts and principles for land contamination management promoted by LC:RM (and its predecessor CLR 11) are applied to the determination of planning applications.

Other legislative regimes may also provide a means of dealing with land contamination issues, such as the regimes for waste, water, environmental permitting, and environmental damage. Further, the law of statutory nuisance may result in contaminants being unacceptable to third parties whilst not attracting action under Part 2A or other environmental legislation.

2.1 Part 2A

The Regulations and Statutory Guidance that accompanied the Act, including the Contaminated Land (England) Regulations 2006, has been revised with the issue of The Contaminated Land (England) (Amendment) Regulations 2012 (SI 2012/263) and the Contaminated Land Statutory Guidance for England 2012.

Part 2A defines contaminated land as "*land which appears to the Local Authority in whose area it is situated to be in such a condition that, by reason of substances in, on or under the land that significant harm is being caused, or there is a significant possibility that such significant harm (SPOSH) could be caused, or significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution (SPOSP) being caused*".

Harm is defined as "*harm to the health of living organisms or other interference with the ecological systems of which they form part, and in the case of man, includes harm to his property*".

Part 2A provides a means of dealing with unacceptable risks posed by land contamination to human health and the environment, and under the guidance enforcing authorities should seek to find and deal with such land. It states that "*under Part 2A the starting point should be that land is not contaminated land unless there is reason to consider otherwise. Only land where unacceptable risks are clearly identified, after a risk assessment has been undertaken in accordance with the Guidance, should be considered as meeting the Part 2A definition of contaminated land"*. Further, the guidance makes it clear that *"regulatory decisions should be based on what is reasonably likely, not what is hypothetically possible".*

The overarching objectives of the Government's policy on contaminated land and the Part 2A regime are:

"(a) To identify and remove unacceptable risks to human health and the environment.

(a) To seek to ensure that contaminated land is made suitable for its current use.

(b) To ensure that the burdens faced by individuals, companies and society as a whole are proportionate, manageable and compatible with the principles of sustainable development".

The enforcing authority may need to decide whether and how to act in situations where decisions are not straight forward, and where there is uncertainty. "*In so doing, the authority should use its judgement to strike a reasonable balance between: (a) dealing with risks raised by contaminants in land and the benefits of remediating land to remove or reduce those risks; and (b) the potential impacts of regulatory intervention including financial costs to whoever will pay for remediation, health and environmental impacts of taking action, property blight, and burdens on affected people".*

The authority is required to "*take a precautionary approach to the risks raised by contamination, whilst avoiding a disproportionate approach given the circumstances of each case".* The aim is "*that the regime produces net benefits, taking account of local circumstances*".

The guidance recognises that *"normal levels of contaminants in soils should not be considered to cause land to qualify as contaminated land, unless there is a particular reason to consider otherwise".* Normal levels are quoted as:

"a) natural presence of contaminants' such as from underlying geology *'that have not been shown to pose an unacceptable risk to health and the environment*

b) …low level diffuse pollution, and common human activity…"

Similarly the guidance states that significant pollution or significant possibility of significant pollution of controlled waters is required for land to be considered contaminated and the "*fact that substances are merely entering water"* or "*where discharge from land is not discernible at a location immediately downstream"* does not constitute contaminated land.

To help achieve a more targeted approach to identifying and managing contaminated land in relation to the risk (or possibility) of harm to human health, the revised Statutory Guidance presented a new four category system for considering land under Part 2A, ranging from Category 4, where there is no risk that land poses a significant possibility of significant harm (SPOSH), or the level of risk is low, to Category 1, where the risk that land poses a significant possibility of significant harm (SPOSH) is unacceptably high.

For land that cannot be readily placed into Categories 1 or 4 further assessment is required. If there is sufficient concern that the risks could cause significant harm or have the significant possibility of significant harm the land is to be placed into Category 2. If the concern is not met land is considered Category 3.

The technical guidance clearly states that the currently published Soil Guidance Values (SGV's) and Generic Assessment Criteria (GAC's) represent *"cautious estimates of level of contaminants in soils"* which should be considered *"no risk to health or, at most, a minimal risk"*. These values do not represent the boundary between categories 3 and 4 and "*should be considered to be comfortably within Category 4".*

At the end of 2013 technical guidance in support of Defra's revised Statutory Guidance (SG) was published and then revised in 2014 (CL: AIRE 2014) which provided:

- A methodology for deriving C4SLs for four generic land-uses comprising residential, commercial, allotments and public open space; and
- A demonstration of the methodology, via the derivation of C4SLs for six substances – arsenic, benzene, benzo(a)pyrene, cadmium, chromium (VI) and lead.

For controlled waters, the revised Statutory Guidance states that the following types of pollution should be considered to constitute significant pollution of controlled waters:

"(a) Pollution equivalent to "environmental damage" to surface water or groundwater as defined by The Environmental Damage (Prevention and Remediation) Regulations 2009, but which cannot be dealt with under those Regulations.

(b) Inputs resulting in deterioration of the quality of water abstracted, or intended to be used in the future, for human consumption such that additional treatment would be required to enable that use.

(c) A breach of a statutory surface water Environment Quality Standard, either directly or via a groundwater pathway.

(d) Input of a substance into groundwater resulting in a significant and sustained upward trend in concentration of contaminants (as defined in Article 2(3) of the Groundwater Daughter Directive (2006/118/EC)".

The guidance also states that, in some circumstances, significant concentrations at a compliance point (in groundwater or surface water) may constitute pollution of controlled waters.

As with SPOSH for human health, the revised Statutory Guidance presents a four-category system for Significant Pollution of controlled waters. Category 1 covers land where there is a strong and compelling case for SPOSP, for example where significant pollution would almost certainly occur if no action was taken to avoid it. Category 4 covers land where there is no risk or the risk is low, for example, where the land contamination is having no discernible impact on groundwater or surface water quality. Category 2 is for land where the risks posed

to controlled waters are not high enough to consider the land as Category 1 but nonetheless are of sufficient concern to constitute SPOSP, Category 3 is for land where the risks posed to controlled waters are higher than low but not of sufficient concern to constitute SPOSP.

2.2 Planning

The Local Planning Authority (LPA) is responsible for the control of development, and in doing so it has a duty to take account of all material considerations, including contamination.

The principal planning objective is to ensure that any unacceptable risks to human health, buildings and other property and the natural and historical environment from the contaminated condition of the land are identified so that appropriate action can be considered and taken to address those risks.

The National Planning Policy Framework (NPPF, 2019), includes the following.

Paragraph 118 states that planning policies and decisions should "*(c) give substantial weight to the value of using suitable brownfield land within settlements for homes and other identified needs, and support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land*."

Paragraph 179 states "*Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner*".

Paragraph 170 states "*planning policies and decisions should contribute to and enhance the natural and local environment by:*

(e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; *and*

(f) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate."

Paragraph 178 describes the policy considerations the Government expects LPA's to have in regard to land affected by contamination when preparing policies for development plans and in taking decisions on applications.

Paragraph 178 states "*planning policies and decisions should ensure that:*

(a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);

(b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and

c) adequate site investigation information, prepared by a competent person, is available to inform these assessments."

Paragraph 183 states "*The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities*."

The Glossary in Annex 2 provides the following:

***Brownfield land registers**: Registers of previously developed land that local planning authorities consider to be appropriate for residential development, having regard to criteria in the Town and Country Planning (Brownfield Land Registers) Regulations 2017. Local planning authorities will be able to trigger a grant of permission in principle for residential development on suitable sites in their registers where they follow the required procedures.*

***Competent person (to prepare site investigation information)**: A person with a recognised relevant qualification, sufficient experience in dealing with the type(s) of pollution or land instability, and membership of a relevant professional organisation.*

***Previously developed land**: Land which is or was occupied by a permanent structure, including the curtilage of the developed land (although it should not be assumed that the whole of the curtilage should be developed) and any associated fixed surface infrastructure. This excludes: land that is or was last occupied by agricultural or forestry buildings; land that has been developed for minerals extraction or waste disposal by landfill, where provision for restoration has been made through development management procedures; land in built-up areas such as residential gardens, parks, recreation grounds and allotments; and land that was previously developed but where the remains of the permanent structure or fixed surface structure have blended into the landscape.*

***Site investigation information**: Includes a risk assessment of land potentially affected by contamination, or ground stability and slope stability reports, as appropriate. All investigations of land potentially affected by contamination should be carried out in accordance with established procedures (such as BS10175 Investigation of Potentially Contaminated Sites – Code of Practice).*

Stantec adopt the principle that a Preliminary Investigation (Desk Study and Site Reconnaissance) and Preliminary Risk Assessment (see below) is the minimum assessment requirement to support a planning application.

The level at which contamination is deemed to be unacceptable, or, gives rise to adverse effects under a planning context has not been identified but is envisaged to be more precautionary than the level required to determine land as contaminated under Part 2A.

2.3 Building Control

The building control department of the local authority or private sector approved inspectors are responsible for the operation and enforcement of the Building Regulations (DCLG 2010) to protect the health, safety and welfare of people in and around buildings. Approved Document C requires the protection of buildings and associated land from the effects of contamination, to be applied (non-exclusively) in all changes of use from commercial or industrial premises, to residential property.

3 APPROACH

As with CLR11 the guidance given in LC:RM presents three stages of risk management: -

(a) Stage 1 - Risk Assessment;

(b) Stage 2 - Options Appraisal; and

(c) Stage 3 - Remediation.

Each stage has three tiers. The three tiers of Stage 1 Risk Assessment are: -

- Tier 1 - Preliminary Risk Assessment (PRA) - first tier of RA that develops the outline conceptual model (CM) and establishes whether there are any potentially unacceptable risks.

- Tier 2 - Generic Quantitative Risk Assessment (GQRA) - carried out using generic assessment criteria and assumptions to estimate risk.

- Tier 3 - Detailed Quantitative Risk Assessment (DQRA) - carried out using detailed site-specific information to generate Site Specific Assessment Criteria (SSAC) as risk evaluation criteria.

For each tier of a Stage 1 - Risk Assessment you must:

1. Identify the hazard - establish contaminant sources.

2. Assess the hazard - use a source-pathway-receptor (S-P-R) pollutant linkage approach to find out if there is the potential for unacceptable risk.

3. Estimate the risk - predict what degree of harm or pollution might result and how likely it is to occur.

4. Evaluate the risk - decide whether a risk is unacceptable.

A Stantec Preliminary Investigation report normally comprises a desk study, walkover site reconnaissance and preliminary risk assessment (PRA). The project specific proposal defines the actual scope of work which might include review of ground investigation data in which case the report includes a GQRA.

Risk estimation involves identifying the magnitude of the potential consequence (taking into account both the potential severity of the hazard and the sensitivity of the receptor) and the magnitude of the likelihood i.e. the probability (taking into account the presence of the hazard and the receptor and the integrity of the pathway). This approach is promoted in current guidance such as R&D 66 (NHBC 2008).

For a PRA, Stantec's approach is that if a pollution linkage is identified then it represents a potentially unacceptable risk which either (1) remediation / direct risk management or (2) progression to further tiers of risk assessment (GQRA and GQRA) requiring additional data collection and enabling refinement of the CM using the site specific data.

4 IDENTIFICATION OF POLLUTANT LINKAGES AND DEVELOPMENT OF A CONCEPTUAL MODEL (CM)

For all Tiers of a Stage 1 Risk Assessment, the underlying principle to ground condition assessment is the identification of *pollutant linkages* in order to evaluate whether the presence of a source of contamination could potentially lead to harmful consequences. A pollutant linkage consists of the following three elements: -

- A source/hazard – a substance or situation which has the potential to cause harm or pollution;
- A pathway – a means by which the hazard moves along / generates exposure; and
- A receptor/target – an entity which is vulnerable to the potential adverse effects of the hazard.

The *Conceptual Model* identifies the types and locations of potential contaminant sources/hazards and potential receptors and potential migration/transportation pathway(s). The CM is refined through progression to further tiers of risk assessment (GQRA and GQRA) requiring additional data collection.

4.1 Hazard Identification

A hazard is a substance or situation that has the potential to cause harm. Hazards may be chemical, biological or physical.

In a PRA the potential for hazards to be present is determined from consideration of the previous or ongoing activities on or near to the site in accordance with the criteria presented in the **Table 1**.

Based on the land use information Contaminants of Potential Concern (COPC) are identified. The COPC direct the scope of the collection of site-specific data and the analytical testing selected for subsequent Tiers.

At Tier 2 the site-specific data is evaluated using appropriate published assessment criteria (refer to Stantec document entitled Rationale for the Selection of Evaluation Criteria for a Generic Quantitative Risk Assessment (GQRA)). In general, published criteria have been developed using highly conservative assumptions and therefore if the screening criterion is not exceeded (and if enough samples from appropriate locations have been analysed) then the COPC is eliminated as a potential Hazard. It should be noted that exceedance does not necessarily indicate that a site is contaminated and/or unsuitable for use only that the COPC is retained as a potential Hazard. Published criteria are generated using models based on numerous and complex assumptions. Whether or not these assumptions are appropriate or sufficiently protective requires confirmation on a project by project basis. Manipulation of the default assumptions would normally form part of a Tier 3 Detailed Quantitative Risk Assessment (DQRA).

When reviewing or assessing site specific data Stantec utilise published guidance on comparing contamination data with a critical concentration (CL:AIRE/CIEH 2008) which presents a structured process for employing statistical techniques for data assessment purposes.

4.2 Receptor and Pathway Identification

For all Tiers the potential receptors (for both on site and adjoining land) that will be considered are:

- Human Health – including current and future occupiers, construction and future maintenance workers, and neighbouring properties/third parties;
- Ecological Systems; [1]
- Controlled Waters [2] – Under section 78A(9) of Part 2A the term "pollution of controlled waters" means the entry into controlled waters of any poisonous, noxious or polluting matter or any solid waste matter. The term "controlled waters" in relation to England has the same meaning as in Part 3 of the Water Resources Act 1991, except that "ground waters" does not include waters contained in underground strata but above the saturation zone.
- Property - Animal or Crop (including timber; produce grown domestically, or on allotments, for consumption; livestock; other owned or domesticated animals; wild animals which are the subject of shooting or fishing rights); and
- Property - Buildings (any structure or erection, and any part of a building including any part below ground level, but does not include plant or machinery comprised in a building, or buried services such as sewers, water pipes or electricity cables including archaeological sites and ancient monuments).

If a receptor is taken forward for further assessment it will be classified in terms of its sensitivity, the criteria for which are presented in **Table 2**. Table 2 has been generated using descriptions of environmental receptor importance/value given in various guidance documents including R&D 66 (NHBC 2008), EA 2017 and Transport Analysis Guidance (based on DETR 2000). Human health and buildings classifications have been generated by Stantec using the attribute description for each class. Surface water sensitivity is classified using the Water Framework Directive (WFD) status for the River Basin obtained from: https://environment.data.gov.uk/catchment-planning/

[1] International or nationally designated sites (as defined in the statutory guidance (Defra Circular 04/12)) "*in the local area*" will be identified as potential ecological receptors. A search radius of 1, 2 or 5km will be utilised depending on the site-specific circumstances (see also pathway identification). The Environment Agency has published an ecological risk assessment framework (EA 2008) which promotes (as opposed to statutorily enforces) consideration of additional receptors to include locally protected sites and protected or notable species. These additional potential receptors will only be considered if a Phase 1 habitat survey, undertaken in accordance with guidance (JNCC 1993), is commissioned and the data provided to Stantec. It should be noted that without such a survey a Land Contamination risk assessment may conclude that the identification of potential ecological receptors is inconclusive (refer to Stantec Specification for a Preliminary Investigation (Desk Study and Site Reconnaissance).

[2] The definition of "pollution of controlled water" was amended by the introduction of Section 86 of the Water Act 2003. For the purposes of Part 2A groundwater does not include waters above the saturated zone and our assessment does not therefore address perched water other than where development causes a pathway to develop.

The exposure pathway and modes of transport that will be considered are presented in **Table 3**.

4.3 Note regarding Ecological Systems

The Environment Agency (EA) has developed an ecological risk assessment framework which aims to provide a structured approach for assessing the risks to ecology from chemical contaminants in soils (EA 2008). In circumstances where contaminants in water represent a potential risk to aquatic ecosystems then risk assessors will need to consider this separately.

The framework consists of a three-tiered process: -

- Tier 1 is a screening step where the site soils chemical data is compared to a soil screening value (SSV)
- Tier 2 uses various tools (including surveys and biological testing) to gather evidence for any harm to the ecological receptors
- Tier 3 seeks to attribute the harm to the chemical contamination

Tier 1 is preceded by a desk study to collate information about the site and the nature of the contamination to assess whether pollutant linkages are feasible. The framework presents ten steps for ecological desk studies and development of a conceptual model as follows.

1. Establish Regulatory Context
2. Collate and Assess Documentary Information
3. Summarise Documentary Information
4. Identify Contaminants of Potential Concern
5. Identify Likely Fate Transport of Contaminants
6. Identify Potential Receptors of Concern
7. Identify Potential Pathways of Concern
8. Create a Conceptual Model
9. Identify Assessment and Measurement Endpoints
10. Identify Gaps and Uncertainties

The information in a standard PRA report covers Steps 1 to 4 inclusive. Step 5 considers fate and transport of contaminants and it should be noted that our standard report adopts a simplified approach considering only transport mechanisms. A simplified approach has also been adopted in respect of Steps 6 and 7 receptors (a detailed review of the ecological attributes has not been undertaken) and pathways (a food chain assessment has not been undertaken). Step 9 is outside the scope of our standard PRA report.

It should be noted that the PRA report will present an assessment for ecological systems (where identified as a receptor for a land contamination assessment) considering the viability of the mode of transport given the site-specific circumstances and not specific pathways. The PRA may conclude that the risk to potential ecological receptors is inconclusive.

4.4 Note regarding controlled waters

Controlled waters are rivers, estuaries, coastal waters, lakes and groundwaters, but not perched waters.

The EU Water Framework Directive (WFD) 2000/60/EC provides for the protection of sub-surface, surface, coastal and territorial waters through a framework of river basin management. The EU Updated Water Framework Standards Directive 2014/101/EU amended the EU WFD to update the international standards therein; it entered into force on 20 November 2014 with the requirements for its provisions to be transposed in Member State law by 20 May 2016. Other EU Directives in the European water management framework include:

- the EU Priority Substances Directive 2013/39/EU;
- EU Groundwater Pollutants Threshold Values Directive 2014/80/EU amending the EU Groundwater Directive 2006/118/EC; and
- EU Biological Monitoring Directive 2014/101/EU.

The Ground Water Daughter Directive (GWDD) was enacted by the Groundwater Regulations (2009), which were subsumed by the Environmental Permitting Regulations (2010) which provide essential clarification including on the four objectives specifically for groundwater quality in the WFD: -

Achieve ‘Good’ groundwater chemical status by 2015, commonly referred to as ‘status objective’;
Achieve Drinking Water Protected Area Objectives;
Implement measures to reverse any significant and sustained upward trend in groundwater quality, referred to as ‘trend objective’; and

Prevent or limit the inputs of pollutants into groundwater, commonly referred to as ‘prevent or limit’ objectives

The Water Act 2003 (Commencement No.11) Order 2012 amends the test for 'contaminated land' which relates to water pollution so that pollution of controlled waters must now be "significant" to meet the definition of contaminated land.

The Water Framework Directive (WFD) requires the preparation, implementation and review of River Basin Management Plans (RBMP) on a six-year cycle. River basins are made up of lakes, rivers, groundwaters, estuaries and coastal waters, together with the land they drain. River Basin Districts (RBD) and the WFD Waterbodies that they comprise are important spatial management units, regularly used in catchment management studies. River Basin Management Plans (RBMP) have been developed for the 11 River Basin Districts in England and Wales.

These were released by Defra in 2009 (Defra 2009) and updated in 2015.

These RBMP's establish the current status of waters within the catchments of the respective Districts and the current status of adjoining waters identified. As part of a Tier 2 risk assessment water quality data is screened against the WFD assessment criteria. Comparison with the RBMP's current status of waters for the catchment under consideration would form part of a Tier 3 assessment.

5 RISK ESTIMATION

Risk estimation classifies what degree of harm might result to a receptor (defined as consequence) and how likely it is that such harm might arise (probability).
At Tier 1 the consequence classification is generated by multiplying the hazard classification score and the receptor sensitivity score. This approach follows that presented in the republished R&D 66 (NHBC 2008).

The criteria for classifying probability are set out in **Table 4** and have been taken directly from Table 6.4 CIRIA C552 (CIRIA 2001). Probability considers the integrity of the exposure pathway.

The consequence classifications detailed in **Table 5** have been adapted from Table 6.3 presented in C552 and R&D 66 (Annex 4 Table A4.3).

The Tier 1 risk classification is estimated for each pollutant linkage using the matrix given in **Table 6** which is taken directly from C552 (Table 6.5).

Subsequent Tiers refine the CM through retention or elimination of potential hazards and pollutant linkages.

6 RISK EVALUATION

Evaluation criteria are the parameters used to judge whether harm or pollution needs further assessment or is unacceptable. The evaluation criteria used will depend on:

- the reasons for doing the RA and the regulatory context such as Part 2A or planning;
- the CM and pollutant linkages present;
- any criteria set by regulators;
- any advisory requirements such as from Public Health England;
- the degree of confidence and precaution required;
- the level of confidence required to judge whether a risk is unacceptable;
- how you've used or developed more detailed assessment criteria in the later tiers of RA;
- the availability of robust scientific data;
- how much is known - for example, about the pathway mechanism and how the contaminants affect receptors; and
- any practical reasons such as being able to measure or predict against the criteria.

In order to put the Tier 1 risk classification into context the likely actions are described in **Table 7** which is taken directly from Table 6.6 of C552 (CIRIA 2001).

REFERENCES

BSI 2017 BS 10175:2011+A2:2017 Investigation of potentially contaminated sites - Code of Practice

BSI 2019 BS 8485:2015+A1:2019 Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings

CIRIA 2001: Contaminated land risk assessment – a guide to good practice C552.

CIRIA 2008: Assessing risks posed by hazardous ground gases to buildings C655

CL: AIRE/EIH 2008 Guidance on Comparing Soil Contamination Data with a Critical Concentration. Published by Contaminated Land: Applications in Real Environments (CL: AIRE)

CL: AIRE 2013 SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. Final Project Report published by Contaminated Land: Applications in Real Environments (CL: AIRE) 20th December 2013

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DEFRA, 2006 The Contaminated Land (England) Regulations 2006.

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DEFRA, 2013 Environmental Damage (Prevention and Remediation) Regulations 2009: Guidance for England and Wales

Defra '2009 Water for Life and Livelihoods. River Basin Management Plan. (11 Districts: Anglia, Dee, Humber, Northumbria, Northwest, Severn, Solway and Tweed, Southeast, Thames, Western Wales) December 2009

EA 2004: Contaminated Land Research (CLR) Report 11: The Model Procedures for the Management of Land Contamination CRL 11 by the Environment Agency (EA).

EA 2008 Ecological Risk Assessment Science Report Series SC070009 published by the Environment Agency (EA).

EA 2017 New groundwater vulnerability mapping methodology in England and Wales Report – SC040016/R Environment Agency (EA) September 2017

JNCC 1993 Handbook for Phase 1 Habitat Survey – A Technical for Environmental Audit prepared by the Joint Nature Conservancy Council (JNCC)

NHBC/EA/CIEH 2008: R&D Publication 66 Guidance for the safe development of housing on land affected by contamination.

National Planning Policy Framework (February 2019 revised), published by the Ministry of Housing, Communities and Local Government (MHCLG) at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/810197/NPPF_Feb_2019_revised.pdf

Stantec Methodology for Assessment of Land Contamination (England)

Table 1: Criteria for Classifying Hazards / Potential for Generating Contamination

Classification/Score	Potential for generating contamination/gas based on land use
Very Low 1	Land Use: Residential, retail or office use, agriculture Contamination: Limited. Gas generation potential: Soils with low organic content
Low 2	Land Use: Recent small scale industrial and light industry Contamination: locally slightly elevated concentrations. Gas generation potential: Soils with high organic content (limited thickness)
Moderate 3	Land Use: Railway yards, collieries, scrap yards, engineering works. Contamination: Possible widespread slightly elevated concentrations and locally elevated concentrations. Gas generation potential: Dock silt and substantial thickness of organic alluvium/peat
High 4	Land Use: Heavy industry, non-hazardous landfills. Contamination: Possible widespread elevated concentrations. Gas generation potential: Shallow mine workings Pre 1960s landfill
Very High 5	Land Use: Hazardous waste landfills, gas works, chemical works, Contamination: Likely widespread elevated concentrations. Gas generation potential: Landfill post 1960

"Greenfield" is land which has not been developed and there has been no use of agrochemicals

Table 2: Criteria for Classifying Receptor Sensitivity/Value

Classification	Definition
Very Low 1	Receptor of limited importance • Groundwater: Unproductive strata (Strata with negligible significance for water supply or river baseflow) (previously Non-aquifer), Secondary B (water-bearing parts of non-aquifers), Secondary undifferentiated (previously minor or non-aquifer, but information insufficient to classify as secondary A or B) • Surface water: WFD Surface Water status Bad • Ecology: No local designation • Buildings: Replaceable • Human health: Unoccupied/limited access
Low 2	Receptor of local or county importance with potential for replacement • Groundwater: Secondary A aquifer • Surface water: WFD Surface Water status Poor • Ecology: local habitat resources • Buildings: Local value • Human health: Minimum score 4 where human health identified as potential receptor
Moderate 3	Receptor of local or county importance with potential for replacement • Groundwater: Principal aquifer • Surface water: WFD Surface Water status Moderate • Ecology: County wildlife sites, Areas of Outstanding Natural Beauty (AONB) • Buildings: Area of Historic Character • Human health: Minimum score 4 where human health identified as potential receptor
High 4	Receptor of county or regional importance with limited potential for replacement • Groundwater: Source Protection Zone 2 or 3 • Surface water: WFD Surface Water status Good • Ecology: SSSI, National or Marine Nature Reserve (NNR or MNR) • Buildings: Conservation Area • Human health: Minimum score 4 where human health identified as potential receptor
Very High 5	Receptor of national or international importance • Groundwater: Source Protection Zone (SPZ) 1 • Surface water: WFD Surface Water status High • Ecology: Special Areas of Conservation (SAC and candidates), Special Protection Areas (SPA and potentials) or wetlands of international importance (RAMSAR) • Buildings: World Heritage site • Human health: Residential, open spaces and uses where children are present

Table 3: Exposure Pathway and Modes of Transport

Receptor	Pathway	Mode of transport
Human health	Ingestion	Fruit or vegetable leaf or roots
		Contaminated water
		Soil/dust indoors
		Soil/dust outdoors
	Inhalation	Particles (dust / soil) – outdoor
		Particles (dust / soil) - indoor
		Vapours – outdoor - migration via natural or anthropogenic pathways
		Vapours - indoor - migration via natural or anthropogenic pathways
	Dermal absorption	Direct contact with soil
		Direct contact with waters (swimming / showering)
		Irradiation
Groundwater	Leaching	Gravity / permeation
	Migration	Natural – groundwater as pathway Anthropogenic (e.g. boreholes, culverts, pipelines etc.)
Surface Water	Direct	Runoff or discharges from pipes
	Indirect	Recharge from groundwater
	Indirect	Deposition of windblown dust
Buildings	Direct contact	Sulphate attack on concrete, hydrocarbon corrosion of plastics
	Gas ingress	Migration via natural or anthropogenic paths
Ecological systems	See Notes	Runoff/discharge to surface water body
	See Notes	Windblown dust
	See Notes	Groundwater migration
	See Notes	At point of contaminant source
Animal and crop	Direct	Windblown or flood deposited particles / dust / sediments
	Indirect	Plants via root up take or irrigation. Animals through watering
	Inhalation	By livestock / fish - gas / vapour / particulates / dust
	Ingestion	Consumption of vegetation / water / soil by animals

Table 4: Classification of Probability

Classification	Definition
High likelihood	There is a pollution linkage and an event either appears very likely in the short-term and almost inevitable over the long-term, or there is already evidence at the receptor of harm / pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long-term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter-term.
Unlikely	There is a pollution linkage, but circumstances are such that it is improbable that an event would occur even in the very long-term.

Table 5: Classification of Consequence (score = magnitude of hazard and sensitivity of receptor)

Classification / Score	Examples
Severe **17-25** **(3 out of 25 outcomes)**	Human health effect - exposure likely to result in "significant harm" as defined in the Defra (2012) Part 2A Statutory Guidance [1]. Controlled water effect - short-term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Equivalent to EA Category 1 incident (persistent and/or extensive effects on water quality leading to closure of potable abstraction point or loss of amenity, agriculture or commercial value. Major fish kill. Ecological effect - short-term exposure likely to result in a substantial adverse effect. Catastrophic damage to crops, buildings or property
Medium **10-16** **(7 out of 25 outcomes)**	Human health effect - exposure could result in "significant harm" [1]. Controlled water effect - equivalent to EA Category 2 incident requiring notification of abstractor Ecological effect - short-term exposure may result in a substantial adverse effect. Damage to crops, buildings or property
Mild **5-9** **(7 out of 25 outcomes)**	Human health effect - exposure may result in "significant harm" [1]. Controlled water effect - equivalent to EA Category 3 incident (short lived and/or minimal effects on water quality). Ecological effect - unlikely to result in a substantial adverse effect. Minor damage to crops, buildings or property. Damage to building rendering it unsafe to occupy (for example foundation damage resulting in instability).
Minor **1-4** **(8 out of 25 outcomes)**	No measurable effect on humans. Protective equipment is not required during site works. Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems. Repairable effects to crops, buildings or property. The loss of plants in a landscaping scheme. Discolouration of concrete.

[1] Significant harm includes death, disease, serious injury, genetic mutation, birth defects or impairment of reproductive function. The local authority may also consider other health effects to constitute significant harm such as physical injury; gastrointestinal disturbances; respiratory tract effects; cardio-vascular effects; central nervous system effects; skin ailments; effects on organs such as the liver or kidneys; or a wide range of other health impacts. Whether or not these would constitute significant harm would depend on the seriousness of harm including impact on health, quality of life and scale of impact.

Table 6: Classification of Risk (Combination of Consequence Table 5 and Probability Table 4)

	Consequence			
Probability	***Severe***	***Medium***	***Mild***	***Minor***
High likelihood	Very high	High	Moderate	Low
Likely	High	Moderate	Moderate/	Low
Low likelihood	Moderate	Moderate	Low	Very low
Unlikely	Low	Low	Very low	Very low

Table 7: Description of Risks and Likely Action Required

Risk Classification	Description
Very high risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation is likely to be required in the short term.
High risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short-term and are likely over the longer-term.
Moderate risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer-term.
Low risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very low risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

Appendix F Stantec Rationale for Selection of Generic Assessment Criteria for Generic Quantitative Risk Assessment

Stantec Guide: Generic Quantitative Risk Assessment - Evaluation Criteria (England)

1 INTRODUCTION

The aim of this document is to present an explanation for the selection of the evaluation criteria routinely used by Stantec UK Ltd when undertaking a land contamination Tier 2 Generic Quantitative Risk Assessment (GQRA).

A GQRA uses published criteria to screen the site-specific contamination testing data and identify potential hazards to specific receptors. Generic criteria are typically conservative in derivation and exceedance does not indicate that a site is statutorily contaminated and/or unsuitable for use in the planning context. These criteria are used to identify situations where further assessment and/or action may be required. This document is divided into general introductory text and sections on soils, waters and gases.

2 GENERAL NOTES

This document should be read in conjunction with another entitled "Stantec Methodology for Assessment of Land Contamination" which summarises the legislative regime and our approach to ground contamination and risk assessment.

Any Stantec interpretation of contamination test results is based on a scientific and engineering appraisal. The perceptions of, for example, banks, insurers, lay people etc are not taken into account.

Any tables included in this document are produced for ease of reference to the criteria, they do not in any way replace the documents of origin (which are fully referenced) and which should be read to ensure appropriate use and interpretation of the data.

Generic criteria provide an aid to decision-making, but they do not replace the need for sound professional judgement in risk assessment (EA, 2006). The criteria are based on numerous and complex assumptions. The appropriateness of these assumptions in a site-specific context requires confirmation on a project by project basis. Our interpretative report will comment on the appropriateness of the routine criteria for project objectives or ground conditions. In some cases the published criteria whilst typically conservative may in some circumstances not be suitable for the site being assessed, either because they do not address the identified pollutant linkages or because they may not be sufficiently precautionary in the context of the site. Under these circumstances it may be necessary to recommend deriving site-specific assessment criteria. Any deviation from the routine criteria and/or selection of criteria for parameters not covered in this document will be described in the report text.

3 CRITERIA FOR EVALUATING SOIL RESULTS

3.1 Potential Harm to Human Health

The criteria used by Stantec UK Ltd to assess the potential for harm to human health are:-

- Category 4 Screening Levels (C4SLs) (DEFRA, 2014).
- Suitable 4 Use Levels (S4ULs) (Nathanail *et al*, 2015).
- CL:AIRE/EIC/AGS Generic Assessment Criteria (GAC) (CL:AIRE, 2010).
- Soil Guideline Values (SGVs) (EA, 2009a).

These criteria have been generated using the Contaminated Land Exposure Assessment model (CLEA) and supporting technical guidance (EA, 2009b, 2009c, 2009d, 2009e). The CLEA model uses generic assumptions about the fate and transport of chemicals in the environment and a generic conceptual model for site conditions and human behaviour to estimate child and adult exposures to soil contaminants for those potentially living, working, and/or playing on contaminated sites over long time periods (EA, 2009c).

The S4ULs, SGVs and GACs are all based on use of minimal/tolerable risk Health Criteria Values (HCVs) as the toxicological benchmark whereas the C4SL are based on use of a "low level of toxicological concern" (LLTC) as the toxicological benchmark. The LLTC represents a slightly higher level of risk than the HCV.

An update to the software (1.071) was published on 04/09/2015 (the handbook (EA 2009f) referring to version 1.05 is still valid). The update includes the library data sets from the DEFRA research project SP1010 (Development of Category 4 Screening Levels for assessment of land affected by contamination).

The CLEA model uses ten exposure pathways (Ingestion (outdoor soil, indoor dust, homegrown vegetables and soil attached to homegrown vegetables), Dermal Contact (outdoor soil and indoor dust) and Inhalation (outdoor dust, indoor dust, outdoor vapours and indoor vapours)). There are exposure pathways not included in the CLEA model such as the permeation of organics into plastic water supply pipes.

The presence and/or significance of each of the potential exposure pathways is dependent on the land use being considered. The model uses standard land use scenarios as follows:-

Residential – habitation of a dwelling up to two storeys high with various default material and design parameters, access to either private or nearby community open space with soil track back

to form indoor dust. Assumes ingestion of homegrown produce.

Allotments – the model has default parameters for use and consumption of vegetables but not animals or their products (eggs).

Industrial/Commercial – assumes office or light physical work in a permanent three storey structure with breaks taken outside and that the site is NOT covered in hardstanding.

Public Open Space – two public open space (POS) scenarios are considered: POS_{resi} is shared communal space within a residential development where tracking back of soil into the home is assumed to occur. POS_{park} is intended for a public park sufficiently distant from housing (i.e. not adjacent to housing) such that tracking back of soil into the home is negligible. Note that the POS assessment criteria may not be appropriate for assessing sports fields.

The assessment criteria generated using CLEA can be used as a conservative starting point for evaluating long-term risks to human health from chemicals in soil.

It is important to note that the model does not assess all the potential exposure scenarios, for example risk to workers in excavations (short term exposure) or diffusion of contaminants through drinking water pipes.

Recent guidance (DEFRA 2012) introduces a four stage classification system where Category 1 sites are clearly contaminated land and Category 4 sites are definitely not contaminated land as defined by EPA 1990. Outside of these categories further specific risk assessment is required to determine if the site should fall into Category 2 (contaminated land) or Category 3 (not contaminated land). Category 4 screening values are considered to be more pragmatic than the current published SGV/GAC criteria but still strongly precautionary with the aim of allowing rapid identification of sites where the risk is above minimal but still low/acceptable.

Category 4 Screening Levels (C4SLs)

At the end of 2013, technical guidance in support of DEFRA's revised Statutory Guidance (SG) was published and then revised in 2014 (CL:AIRE 2014) which provided:

- A methodology for deriving C4SLs for the standard land-uses and two new public open space scenarios using the updated assumptions relating to the modelling of human exposure to soil contaminants; and
- A demonstration of the methodology, via the derivation of C4SLs for six substances – arsenic, benzene, benzo(a)pyrene, cadmium, chromium (VI) and lead.

Following issue of an Erratum in December 2014, a Policy Companion Document was published (DEFRA 2014).

A letter from Lord de Mauley dated 3rd September 2014 provides more explicit direction to local authorities on the use of the C4SL in a planning context. The letter identifies four key points:

1) that the screening values were developed expressly with the planning regime in mind

2) their use is recommended in DCLG's planning guidance

3) soil concentrations below a C4SL limit are considered to be 'definitely not contaminated' under Part IIA of the 1990 Environmental Protection Act and pose at most a 'low level of toxicological concern' and,

4) exceedance of a C4SL screening value does not mean that land is definitely contaminated land, just that further investigation may be warranted.

Stantec use the C4SLs as the Tier 2 soil screening criteria protective of human health for substances with C4SL available. Table 1 summarises the C4SL (DEFRA 2014) for each of the six substances.

Note that, with the exception of benzene, the DEFRA published C4SL are not dependent on soil organic matter content (SOM) ("*Given that BaP is non volatile and that empirical soil to plant concentration factors have been used, soil organic matter content has a negligible influence on the C4SLs for this chemical"*). The DEFRA published C4SL for benzene is based on an SOM of 6%. Stantec have used the CLEA model (v1.071) to derive C4SL for benzene for 1% and 2.5% SOM which are also shown in Table 1.

Note that an industry led project to derive C4SL for a further 20 substances has commenced (CL:AIRE, 2018). The project is being project managed by CL:AIRE and is funded by the Soil and Groundwater Technology Association (SAGTA), the Society of Brownfield Briefing (SoBRA) and others. A dedicated steering group, made up of representatives from SAGTA, DEFRA, Welsh Government, Public Health England, Environment Agency, Natural Resources Wales, Food Standards Agency, Homes England and further Land Forum representatives, has been set up to oversee the project. The new C4SL will be added to this document as they are published.

Suitable 4 Use Levels (S4ULs)

In July 2009, Generic Assessment Criteria (GACs) for 82 substances were published (LQM and CIEH, 2009) using the then current version of the CLEA software v1.04 and replaced those generated in

2006 using the original version of the model CLEA UK *beta*. In 2015 S4ULs were published by LQM/CIEH (Nathanail *et al*, 2015) to replace the second edition GACs. Table 2 summarises the S4ULs which are reproduced with permission; Publication Number S4UL3202.

Soil Guideline Values (SGVs) and Generic Assessment Criteria (GAC)

In 2009, Soil Guideline Values (SGVs) were published by the Environment Agency for arsenic, cadmium, mercury, nickel, selenium, benzene, toluene, ethyl benzene, xylenes, phenol and dioxins, furans and dioxin-like PCBs. These were derived using the CLEA model for residential, allotments and commercial land-uses.

These SGVs have now largely been superseded by the C4SLs and the S4ULs, with the exception of the SGVs for dioxins, furans and dioxin-like PCBs which are shown in Table 3.

In January 2010, Generic Assessment Criteria (GAC) derived using CLEA were published by CL:AIRE for 35 substances. These GAC are listed in Table 4.

Note that the SGVs for dioxins, furans and dioxin like PCBs and CL:AIRE GAC were derived using an older version of CLEA (v1.06) than used to derive the S4UL and C4SL (v1.07). This older version used slightly more conservative values for some exposure parameters and therefore the derived SGVs/GAC are still considered suitably precautionary for use as screening criteria.

Note on Mercury, Chromium and Arsenic

The analytical testing routinely undertaken by Stantec determines total concentration, however, the toxicity depends on the form of the contaminant.

If a source of Mercury, Chromium or Arsenic is identified or the total concentration exceeds the relevant worst case speciated criteria it will be desirable/necessary to undertake additional speciated testing and further assessment.

Note on Polycyclic Aromatic Hydrocarbons

Polycyclic Aromatic Hydrocarbons (PAHs) are a family of hundreds of different congeners whose chemical structures contain two or more fused aromatic rings. Whilst it is recognised that there is an ongoing debate on the most appropriate method to assess health effects of PAH mixtures, in 2010 the Health Protection Agency recommended the use of benzo[a]pyrene (BaP) as a surrogate marker approach in the assessment of carcinogenic risks posed by PAHs in soils (HPA, 2010).

In most cases, BaP is chosen as the surrogate marker (SM) due to its ubiquitous nature and the vast amount of data available and has been used by various authoritative bodies to assess the carcinogenic risk of PAHs in food. The SM approach estimates the carcinogenic toxicity of a mixture of PAHs in an environmental matrix by using toxicity data for a PAH mixture for which the composition is known.

Exposure to the SM is assumed to represent exposure to all PAHs in that matrix therefore the toxicity of the SM represents the toxicity of the mixture. The SM approach relies on a number of assumptions (HPA, 2010).

- The SM (BaP) must be present in all the samples.
- The profile of the different PAH relative to BaP should be similar in all samples.
- The PAH profile in the soil samples should be sufficiently similar to that used in the pivotal toxicity study on which HBGV was based i.e. the Culp study (Culp et al. (1998)).

In order to justify the use of a surrogate marker assessment criterion (C4SL for benzo(a)pyrene and S4UL coal tar) the LQM PAH Profiling Tool is used by Stantec to assess the similarity of the PAH profile in a soil sample to that of the toxicity study. The spreadsheet calculates the relative proportions of the genotoxic PAHs and plots them relative to the composition of the two coal mixtures used by Culp et al. Provided that the relative proportions are within an order of magnitude of those from the Culp Study (as suggested by HPA) Stantec will use the C4SL for benzo(a)pyrene as a surrogate marker for the carcinogenic PAHs, i.e. benzo(a)pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(ah)anthracene, indeno(123-cd)pyrene and benzo(ghi)perylene. For projects where this approach is appropriate the results will be assessed using the Coal Tar criterion (BAP C4SL) and the criteria for non-carcinogenic PAHs (S4ULs), i.e. naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene and pyrene.

Note on Total Petroleum Hydrocarbons

The S4UL for Total Petroleum Hydrocarbon (TPH) fractions are based on 'threshold' health effects. In accordance with Environment Agency guidance (EA, 2005) and the S4UL report (Nathanail *et al*, 2015) the potential for additivity of toxicological effects between fractions should be considered. Practically, to address this issue the hazard quotient (HQ) for each fraction should be calculated by dividing the measured concentration of the fraction by the GAC. The HQs are then added to form a hazard index (HI) for that sample. An HI greater than 1 indicates an exceedance.

Note on Dioxins, Furans and Dioxin-like PCBs

The SGVs for dioxins, furans and dioxin-like PCBs are based on an assumed congener profile for urban soils. The total measured concentration of dioxin, furan and dioxin-like PCB congeners listed in the SGV report (EA, 2009a) should be compared with the SGVs to make an initial assessment of risk. A more accurate assessment can be made using the Environment Agency's site specific worksheet for dioxins, furans and dioxin like PCBs available from https://www.claire.co.uk/useful-government-legislation-and-guidance-by-country/77-risk-assessment-info-ra/199-dioxins-site-specific-worksheets.

Note on Asbestos

Asbestos in soil and made ground is currently under review by a number of bodies. There are no current published guidance values for asbestos in soil other than the waste classification values given in the EA's Technical Guidance WM3, Hazardous Waste – Interpretation of the definition and classification of hazard waste (EA, 2015). This guidance is only appropriate for soils that are being discarded as waste.

Testing for asbestos will be carried out on selected samples of made ground encountered during investigation, initially samples will be subjected to an asbestos screen and, if asbestos is found to be present, subjected to quantification depending on the project specific requirements. The reader is directed to the report text for guidance on the approach adopted in respect to any asbestos found to be present.

Further guidance is also available in publication C733, Asbestos in soil and made ground: a guide to understanding and managing risks (CIRIA 2014).

Note on Soil Saturation Concentration

The soil saturation concentration is the concentration of an organic constituent in soil at which either the pore water or soil vapour has theoretically become saturated with the substance, i.e. the substance concentration has reached its maximum aqueous solubility or vapour pressure. The soil saturation concentration is related to the properties of the substance as well as the properties of the soil (including soil organic matter content).

The soil saturation concentrations are shown in Table 2 in brackets where exceeded by the assessment criteria and in Table 4 for all substances. Measured concentrations in excess of the soil saturation concentration have various potential implications as discussed below.

Firstly, where measured concentrations exceed the soil saturation concentration, the risk from vapour inhalation and/or consumption of produce may be limited. The CLEA model calculates the soil saturation concentration but it does not limit exposure where this concentration is exceeded. This adds an additional level of conservatism for CLEA derived assessment criteria where these exceed the calculated soil saturation concentration. Secondly, the soil saturation concentration is sometimes used to flag the potential presence of non-aqueous phase liquid (NAPL, a.k.a. free phase) in soil. The presence of NAPL is an important consideration in the Tier 2 assessment because, where present, the risks from NAPL may need to be considered separately. Theoretically, where a measured concentration exceeds the soil saturation concentration NAPL could be present. However, using theoretical saturation values is not always reliable for the following reasons: The soil saturation concentration is based on the aqueous solubility and vapour pressure of a pure substance and not a mixture, of which NAPLs are often comprised; and

The soil saturation concentration does not account for the sorption capacity of the soil. As a result, exceedance of the soil saturation concentration does not necessarily imply that NAPL is present. This is particularly the case for longer chain hydrocarbons such as PAHs which have low solubility and vapour pressure and hence a low soil saturation concentration but that are strongly sorbed to soil.

The measured concentrations will be compared to the soil saturation concentrations shown in Tables 2 and 4. Where exceeded Stantec will use additional lines of evidence (such as visual evidence and concentration of total TPH) to determine whether or not NAPL is likely to be present. If the presence of NAPL is deemed plausible the implications will be considered in the risk assessment.

3.2 Potential Harm to the Built Environment

Land contamination can pose risks to buildings, building materials and services (BBM&S) in a number of ways. Volatile contaminants and gases can accumulate and cause explosion or fire. Foundations and buried services can be damaged by corrosive substances and contaminants such as steel slags can create unstable ground conditions through expansion causing structural damage.

Stantec use the following primary guidance to assess the significance of soil chemistry with respect to its potential to harm the built environment.

i) Approved Document C - Site Preparation and Resistance to Contaminants and Moisture. (DCLG, 2013);
ii) Concrete in aggressive ground SD1 (BRE 2005);
iii) Guidance for the selection of water supply pipes to be used in brownfield sites (UK WIR 2011);
iv) Protocols published by agreement between

Water UK and the Home Builders Federation providing supplementary guidance which includes the Risk Assessment for Water Pipes (the 'RA') (Water UK 2014).

v) Performance of Building Materials in Contaminated Land report BR255 (BRE 1994).
vi) Risks of Contaminated Land to Buildings, Building Materials and Services. A Literature Review - Technical Report P331 (EA, 2000).
vii) Guidance on assessing and managing risks to buildings from land contamination - Technical Report P5 035/TR/01 (EA, 2001).

3.3 Potential to Harm Ecosystems, Animals, Crops etc

The criteria routinely used by Stantec as Tier 2 screening values to assess the potential of soil chemistry to harm ecosystems are taken from the following guidance and are summarised in Table 5.

i) Derivation and Use of Soil Screening Values for assessing ecological risks (EA, 2017a);
ii) The Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing (ICRCL 70/90, 1990);
iii) Sewage sludge on farmland: code of practice for England, Wales and Northern Ireland (DEFRA, 2018); and
iv) BS 3882:2015 Specification for topsoil and requirements for use (BSI, 2015).

Unless stated in the report the assessment is solely for phytotoxic parameters and additional assessment is required to determine suitability as a growing medium.

4 CRITERIA FOR EVALUATING LIQUID RESULTS

4.1 Potential Harm to Human Health via Ingestion

The Tier 2 water screening values routinely adopted by Stantec for assessing the potential for harm to human health via ingestion (presented as Table 6) are taken from Statutory Instrument (S.I.) The Water Supply (Water Quality) Regulations (S.I. 2016/614).

It should be noted that some of the prescribed concentrations listed in the Water Supply Regulations have been set for reasons other than their potential to cause harm to human health. The concentrations of iron and manganese are controlled because they may taint potable water with an undesirable taste, odour or colour or may potentially deposit precipitates in water supply pipes.

4.2 Potential Harm to Human Health via Inhalation of Vapours

The Tier 2 water screening values adopted by Stantec for assessing the potential for chronic human health risk from the inhalation of vapours from volatile contaminants in groundwater are presented in Table 7. These generic assessment criteria have been taken from a report published by the Society of Brownfield Risk Assessment (SoBRA) (SoBRA, 2017). The methodology adopted in their generation is considered compatible with the UK approach to deriving GAC and adopts a precautionary approach. As with all published GAC the suitability for use on the site being assessed has to be decided by the assessor based on a thorough understanding of the methodology and assumptions used in their derivation. Note, that the SoBRA groundwater vapour GAC are not intended for assessing risks to ground workers from short-term exposure.

Note that Table 7 shows the theoretical maximum aqueous solubility for each contaminant and indicates the GAC that exceed solubility. Measured concentrations in excess of solubility may be an indication that NAPL is present. As for the assessment of soils, if the presence of NAPL is deemed plausible the implications will be considered in the risk assessment.

4.3 Potential to Harm Controlled Waters

When assessing ground condition data and the potential to harm Controlled Waters Stantec uses the approach presented in the groundwater protection position statements published 14.03.17 (EA, 2017b) which describe the Environment Agency's approach to managing and protecting groundwater. They update and replace Groundwater Protection: principles and practice (GP3). Controlled Waters are rivers, estuaries, coastal waters, lakes and groundwaters. Water in the unsaturated zone is not groundwater but does come within the scope of the term "ground waters" as used and defined in the Water Resources Act 1991. It will continue to be a technical decision for the Environment Agency to determine what is groundwater in certain circumstances for the purposes of the Regulations. As discussed in our Methodology for Assessment of Land Contamination perched water is not considered a receptor in Stantec assessments.

The EU Water Framework Directive (WFD) 2000/60/EC provides for the protection of sub-surface, surface, coastal and territorial waters through a framework of river basin management.

The EU Updated Water Framework Standards Directive 2014/101/EU amended the EU WFD to update the international standards therein; it entered into force on 20 November 2014 with the requirement for its provisions to be transposed in Member State law by 20 May 2016.

Member States are required under the EU WFD to update their river basin management plans every six years. The first river basin management plans for England and Wales, Scotland and Northern Ireland were published in December 2009, and these were updated in 2015.

Other EU Directives in the European water management framework include:

- the EU Priority Substances Directive 2013/39/EU;
- EU Groundwater Pollutants Threshold Values Directive 2014/80/EU amending the EU Groundwater Daughter Directive (GWDD) 2006/118/EC; and
- the EU Biological Monitoring Directive 2014/101/EU.

The Priority Substances Directive set environmental quality standards (EQS) for the substances in surface waters (river, lake, transitional and coastal) and confirmed their designation as priority or priority hazardous substances (PS), the latter being a subset of particular concern. Environmental Quality Standards for PS are determined at the European level and apply to all Member States. Member States identify and develop standards for 'Specific Pollutants'. Specific Pollutants (SP) are defined as substances that can have a harmful effect on biological quality.

The Water Framework Directive (Standards and Classification) Directions (England and Wales) (DEFRA, 2015) were issued to the Environment Agency as an associated document of the Water Environment (WFD) (England and Wales) Regulations 2015 (S.I. 2015/1623) and provide directions for the classification of surface water and groundwater bodies. Schedule 3 parts 2 and 3 relate to surface water standards for specific pollutants in fresh or salt water bodies and priority substances in inland (rivers, lakes and related modified/artificial bodies) or other surface waters respectively. Although Schedule 5 presents threshold values for groundwater the Direction specifically excludes their use as part of site-specific investigations.

Table 6 presents the criteria routinely used by Stantec as Tier 2 screening values. This table only presents a selection of the more commonly analysed parameters and the source documents should be consulted for other chemicals. For screening groundwater the criteria selected are the standards for surface water and/or human consumption as appropriate together with the following:-

For a **hazardous substance** Stantec adopts the approach that, if the concentration in a discharge to groundwater is less than the Minimum Reporting Value (MRV), the input is regarded as automatically meeting the Article 2 (b) 'de-minimus' requirement of exemption 6 (3) (b) of the GWDD. Stantec has selected hazardous substances from the latest list published by the Joint Agencies Groundwater Directive Advisory Group (JAGDAG, 2018). MRV is the lowest concentration of a substance that can be routinely determined with a known degree of confidence, and may not be equivalent to limit of detection. MRVs have been identified from DEFRA's guidance on Hazardous Substances to Groundwater: Minimum Reporting Values (DEFRA, 2017), and are shown in Table 6.

Note that for land contamination assessments, where hazardous substances have already entered groundwater, remediation targets would typically be based on achieving appropriate water quality standards (e.g. drinking water standard or EQS) at a compliance point rather than an MRV. For this reason, when assessing measured groundwater or soil leachate concentrations, the values for human consumption, fresh water and salt water shown in Table 6 (whichever is appropriate for the context of the site) will be used as the Tier 2 assessment criteria rather than MRV. For hazardous substances with no water quality standard the laboratory method detection limit will be used as the assessment criteria.

For **non-hazardous substances** the GWDD requires that inputs be limited to avoid deterioration. UKTAG guidance equates deterioration with pollution. Non-hazardous substances are all substances not classified as hazardous. For Stantec assessments the values for human consumption, fresh water and salt water shown in Table 6 (whichever is appropriate for the context of the site) are used as the assessment criteria for non-hazardous substances.

Note on Copper, Lead, Manganese, Nickel and Zinc

$EQS_{bioavailable}$ have been developed for UK Specific Pollutants copper, zinc and manganese and the EU priority substances lead and nickel. An EQS is the concentration of a chemical in the environment below which there is not expected to be an adverse effect on the specific endpoint being considered, e.g. the protection of aquatic life.

It is very difficult to measure the bioavailable concentration of a metal directly. The UK has developed simplified Metal Bioavailability Assessment Tool (M-BAT) for copper, zinc, nickel and manganese which uses local water chemistry data, specifically pH, dissolved organic carbon (DOC) (mg/L) and Calcium (Ca) (mg/L).

Where the recorded total dissolved concentration exceeds the screening criteria for these parameters ($EQS_{bioavailable}$) further assessment will be undertaken using the tools downloaded from http://www.wfduk.org/resources/rivers-lakes-metal-bioavailability-assessment-tool-m-bat

The models calculate a risk characterisation ratio (RCR) and where this is greater than 1 this indicates the bioavailable concentration is above the EQS and the parameter is then identified as a potential hazard. The report will discuss this identified hazard noting that the pH, calcium and, in particular, the dissolved organic carbon (DOC) in groundwater may be quite different to the receiving water (e.g. due to the presence to leaf litter or organic sediments dissolving in the water).

5 CRITERIA FOR EVALUATING GAS RESULTS

Stantec use the following primary guidance on gas monitoring methods and investigation, the assessment of risk posed by soil gases (including Volatile Organic Compounds (VOCs)) and mitigation measures/risk reduction during site development.

i) BS 8576:2013 – Guidance on Ground Gas Investigations: Permanent gases and Volatile Organic Compounds (VOCs) (BSI, 2013);
ii) TB18 Continuous Ground-Gas Monitoring and the Lines of Evidence Approach to Risk Assessment CL:AIRE Technical Bulletin TB18 (CL:AIRE 2019)
iii) RB17 A pragmatic approach to Ground Gas Risk Assessment. CL:AIRE Research Bulletin RB17 (Card et al, 2012);
iv) The VOCs Handbook. C682 (CIRIA, 2009).
v) Assessing risks posed by hazardous gases to buildings C665 (CIRIA, 2007);
vi) Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present. (NHBC, 2007); and
vii) BS 8485:2015+A1:2019- Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (BSI, 2019).

Gas and borehole flow data are used to obtain the gas screening value (GSV) for methane and carbon dioxide. The GSV is used to establish the characteristic situation and to make recommendations for gas protection measures for buildings if required.

Radon

Stantec use the following primary guidance to assess the significance of the radon content of soil gas.

i) Radon: guidance on protective measures for new dwellings. Report BR211 (BRE, 2015); and
ii) Indicative Atlas of Radon in England and Wales (HPA & BGS, 2007).

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Table 1: Category 4 Screening Levels (C4SL)

	Allotments	Residential (with home-grown produce)	Residential (without home-grown produce)	Commercial	Public Open Space 1	Public Open Space 2
Arsenic	49	37	40	640	79	170
Benzene - 1% SOM* - 2.5% SOM* - 6% SOM	 0.039 0.081 0.18	 0.20 0.41 0.87	 0.89 1.6 3.3	 27 50 98	 140 140 140	 190 210 230
Benzo(a)pyrene (as a surrogate marker for carcinogenic PAHs)	5.7	5.0	5.3	77	10	21
Cadmium	3.9	22	150	410	220	880
Chromium VI	170	21	21	49	21	250
Lead	80	200	310	2300	630	1300

Units mg/kg dry weight

Values taken from SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document (Department for Environment, Food and Rural Affairs December 2014), unless stated otherwise
Public Open Space 1 – for grassed area adjacent to residential housing
Public Open Space 2 - Park Type Public Open Space Scenario
Based on a sandy loam as defined in SR3 (Environment Agency, 2009b)
Note that, with the exception of benzene, these C4SL are not SOM dependent
* - Stantec derived C4SL using CLEA v1.071

Table 2: Suitable 4 Use Levels (S4UL)

Determinand	Allotment	$R_{\underline{W}}HP$	$R_{\underline{WO}}HP$	Commercial/ Industrial	POSresi	POSpark
Metals						
Arsenic (**Inorganic**)[a, b, c]	43	37	40	640	79	170
Beryllium [a, b, d, e]	35	1.7	1.7	12	2.2	63
Boron [a, b, d]	45	290	11000	240000	21000	46000
Cadmium (**pH6-8**) [a, b, d, f]	1.9	11	85	190	120	560
Chromium (trivalent) [a, b, d, g]	18000	910	910	8600	1500	33000
Chromium (hexavalent) [a, b, c]	1.8[h]	6[i]	6[i]	33[i]	7.7[i]	220[i]
Copper [a, b, c]	520	2400	7100	68000	12000	44000
Mercury (elemental) [a, b, c, j]	21	1.2	1.2	58[vap] (25.8)	16	30[vap] (25.8)
Mercury (inorganic) [a, b, c]	19	40	56	1100	120	240
Methylmercury [a, b, c]	6	11	15	320	40	68
Nickel [a, b, c]	53[k]	130[e]	180[e]	980[e]	230[e]	800[k]
Selenium [a, b, c]	88	250	430	12000	1100	1800
Vanadium [a, b, c, i, j]	91	410	1200	9000	2000	5000
Zinc [a, b, c]	620	3700	40000	730000	81000	170000
BTEX Compounds (SOM 1%/ 2.5%/ 6%)						
Benzene [a, b, l, m]	0.017/0.034/ 0.075	0.087/0.17/ 0.37	0.38/0.7/1.4	27 / 47 / 90	72 / 72 / 73	90 / 100 / 110
Toluene [a, b, l, m]	22 / 51 / 120	130 / 290 / 660	880[vap] (869) /1900/3900	56000[vap] (869) / 110000[vap] (1920)/ 180000[vap] (4360)	56000 / 56000 / 56000	87000[vap](869)/ 95000[vap](1920)/ 100000[vap](4360)
Ethylbenzene [a, b, l, m]	16 / 39 / 91	47 / 110 / 260	83 / 190 / 440	5700[vap] (518) / 13000[vap] (1220) / 27000[vap] (2840)	24000 / 24000 / 25000	17000[vap] (518) / 22000[vap](1220) / 27000[vap] (2840)
O – Xylene [a, b, l, m, n]	28 / 67 / 160	60 / 140 / 330	88 / 210 / 480	6600[sol] (478) / 15000[sol] (1120) / 33000[sol] (2620)	41000 / 42000 / 43000	17000[sol] (478) / 24000[sol] (1120) / 33000[sol] (2620)
M – Xylene [a, b, l, m, n]	31 / 74 / 170	59 / 140 / 320	82 / 190 / 450	6200[vap] (625) / 14000[vap] (1470) / 31000[vap] (3460)	41000 / 42000 / 43000	17000[vap] (625) / 24000[vap](1470) / 32000[vap] (3460)
P – Xylene [a, b, l, m, n]	29 / 69 / 160	56 / 130 / 310	79 / 180 / 430	5900[sol] (576) / 14000[sol] (1350) / 30000[sol] (3170)	41000 / 42000 / 43000	17000[sol] (576) / 23000[sol] (1350) / 31000[sol] (3170)
Total xylenes [t]	28 / 67 / 160	56 / 130 / 310	79 / 180 / 430	5900[sol] (576) / 14000[sol] (1350) / 30000[sol] (3170)	41000 / 42000 / 43000	17000[sol] (576) / 23000[sol] (1350) / 31000[sol] (3170)
Polycyclic Aromatic Hydrocarbons (SOM 1%/ 2.5%/ 6%) [a, b, l, p]						
Acenaphthene	34 / 85 / 200	210 / 510 / 1100	3000[sol](57.0)/ 4700[sol] (141)/ 6000[sol] (336)	84000[sol] (57.0)/ 97000[sol] (141)/ 100000	15000 / 15000 / 15000	29000/ 30000/ 30000
Acenaphthylene	28 / 69 / 160	170 / 420 / 920	2900[sol](86.1)/ 4600[sol] (212)/ 6000[sol] (506)	83000[sol] (86.1)/ 97000[sol] (212)/ 100000	15000 / 15000 / 15000	29000 / 30000 / 30000
Anthracene	380 / 950 / 2200	2400 / 5400 / 11000	31000[sol](1.17) /35000/ 37000	520000/ 540000/ 540000	74000 / 74000 / 74000	150000 / 150000 / 150000
Benzo(a)anthracene	2.9 / 6.5 / 13	7.2 / 11 / 13	11 / 14 / 15	170 / 170 / 180	29 / 29 / 29	49 / 56 / 62
Benzo(a)pyrene (Bap) [u]	0.97 / 2.0 / 3.5	2.2 / 2.7 / 3.0	3.2 / 3.2 / 3.2	35 / 35 / 36	5.7 / 5.7 / 5.7	11 / 12 / 13
Benzo(b)fluoranthene	0.99 / 2.1 / 3.9	2.6 / 3.3 / 3.7	3.9 / 4.0 / 4.0	44 / 44 / 45	7.1 / 7.2 / 7.2	13 / 15 / 16

Determinand	Allotment	R_WHP	$R_{WO}HP$	Commercial/ Industrial	POSresi	POSpark
Benzo(g,h,i)perylene	290 / 470 / 640	320 / 340 / 350	360 / 360 / 360	3900 / 4000 / 4000	640 / 640 / 640	1400 / 1500 / 1600
Benzo(k)fluoranthene	37 / 75 / 130	77 / 93 / 100	110 / 110 / 110	1200 / 1200 /1200	190 / 190 / 190	370 / 410 / 440
Chrysene	4.1 / 9.4 / 19	15 / 22 / 27	30 / 31 / 32	350 / 350 / 350	57 / 57 / 57	93 / 110 / 120
Dibenzo(ah)anthracene	0.14 / 0.27 / 0.43	0.24 / 0.28 / 0.3	0.31 / 0.32 / 0.32	3.5 / 3.6 / 3.6	0.57 / 0.57 / 0.58	1.1 / 1.3 / 1.4
Fluoranthene	52 / 130 / 290	280 / 560 / 890	1500 / 1600 / 1600	23000 / 23000 / 23000	3100 / 3100 / 3100	6300 / 6300 / 6400
Fluorene	27 / 67 / 160	170 / 400 / 860	2800[sol] (30.9) /3800[sol] (76.5) /4500[sol] (183)	63000[sol] (30.9) / 68000 / 71000	9900 / 9900 / 9900	20000 / 20000 / 20000
Indeno(1,2,3-cd)pyrene	9.5 / 21 / 39	27 / 36 / 41	45 / 46 / 46	500 / 510 / 510	82 / 82 / 82	150 / 170 / 180
Naphthalene [q]	4.1 / 10 / 24	2.3 / 5.6 / 13	2.3 / 5.6 / 13	190[sol] (76.4) / 460[sol] (183) / 1100[sol] (432)	4900/ 4900/ 4900	1200[sol] (76.4) / 1900[sol] (183) / 3000
Phenanthrene	15 / 38 / 90	95 / 220 / 440	1300[sol](36.0) / 1500 / 1500	22000 / 22000 / 23000	3100 / 3100 / 3100	6200 / 6200 / 6300
Pyrene	110 / 270 / 620	620 / 1200 / 2000	3700 / 3800 / 3800	54000 / 54000 / 54000	7400 / 7400 / 7400	15000 / 15000 / 15000
Coal Tar (Bap as surrogate marker) [u]	0.32 / 0.67 / 1.2	0.79 / 0.98 / 1.1	1.2 / 1.2 / 1.2	15 / 15 / 15	2.2 / 2.2 / 2.2	4.4 / 4.7 / 4.8
Explosives [a, b, l, p]						
2, 4, 6 Trinitrotoluene	0.24 / 0.58 / 1.40	1.6 / 3.7 / 8.0	65 / 66 / 66	1000 / 1000 / 1000	130 / 130 / 130	260 / 270 / 270
RDX (Royal Demolition Explosive $C_3H_6N_6O_6$)	17 / 38 / 85	120 / 250 / 540	13000 / 13000 / 13000	210000 / 210000 / 210000	26000 / 26000 / 27000	49000[sol] (18.7) / 51000 / 53000
HMX (High Melting Explosive $C_4H_8N_8O_8$)	0.86 / 1.9 / 3.9	5.7 / 13 / 26	6700 / 6700 / 6700	110000 / 110000 / 110000	13000 / 13000 / 13000	23000[vap] (0.35) /23000[vap] (0.39) /24000[vap] (0.48)
Petroleum Hydrocarbons (SOM 1%/ 2.5%/ 6%) [a, b, l, m]						
Aliphatic EC 5-6	730 / 1700 / 3900	42 / 78 / 160	42 / 78 / 160	3200[sol] (304) / 5900[sol] (558) / 12000[sol] (1150)	570000[sol](304) 590000 / 600000	95000[sol] (304) / 130000[sol] (558)/ 180000[sol](1150)
Aliphatic EC >6-8	2300 / 5600 / 13000	100 / 230 / 530	100 / 230 / 530	7800[sol] (144) / 17000[sol] (322) / 40000[sol] (736)	600000 / 610000 / 620000	150000[sol] (144) 220000[sol] (322)/ 320000[sol] (736)
Aliphatic EC >8-10	320 / 770 / 1700	27 / 65 / 150	27 / 65 / 150	2000[sol] (78) / 4800[vap] (190) / 11000[vap] (451)	13000 / 13000 / 13000	14000[sol] (78) / 18000[vap] (190) / 21000[vap] (451)
Aliphatic EC >10-12	2200 / 4400 / 7300	130v[ap] (48) / 330[vap] (118) / 760[vap] (283)	130v[ap] (48) / 330[vap] (118) / 770[vap] (283)	9700[sol] (48) / 23000[vap] (118) / 47000[vap] (283)	13000 / 13000 / 13000	21000[sol] (48) / 23000[vap] (118) / 24000[vap] (283)
Aliphatic EC >12-16	11000 / 13000 / 13000	1100[sol] (24) / 2400[sol] (59) / 4300[sol] (142)	1100[sol] (24) / 2400[sol] (59) / 4400[sol] (142)	59000[sol] (24) / 82000[sol] (59) / 90000[sol] (142)	13000 / 13000 / 13000	25000[sol] (24) / 25000[sol] (59) / 26000[sol] (142)
Aliphatic EC >16-35 °	260000 / 270000 / 270000	65000[sol](8.48 92000[sol] (21) 110000	65000[sol] (8.48 92000[sol] (21) 110000	1600000 / 1700000 / 1800000	250000 / 250000 / 250000	450000 / 480000 / 490000
Aliphatic EC >35-44 °	260000 / 270000 / 270000	65000[sol](8.48 92000[sol] (21) / 110000	65000[sol](8.48 92000[sol] (21) 110000	1600000 / 1700000 / 1800000	250000 / 250000 / 250000	450000 / 480000 / 490000
Aromatic EC 5-7 (benzene)	13 / 27 / 57	70 / 140 / 300	370 / 690 / 1400	26000[sol] (1220) / 46000[sol] (2260) / 86000[sol] (4710)	56000 / 56000 / 56000	76000[sol] (1220) /84000[sol](2260)/ 92000[sol] (4710)
Aromatic EC >7-8 (toluene)	22 / 51 / 120	130 / 290 / 660	860 / 1800 / 3900	56000[vap] (869)/ 110000[sol] (1920)/ 180000[vap] (4360)	56000 / 56000 / 56000	87000[vap](869) / 95000[sol] (1920)/ 100000[vap](4360)
Aromatic EC >8-10	8.6 / 21 / 51	34 / 83 / 190	47 / 110 / 270	3500[vap] (613) / 8100[vap] (1500) / 17000[vap] (3580)	5000 / 5000 / 5000	7200[vap](613) / 8500[vap] (1500) / 9300[vap] (3580)
Aromatic EC >10-12	13 / 31 / 74	74 / 180 / 380	250 / 590 / 1200	16000[sol] (364) / 28000[sol] (899) / 34000[sol] (2150)	5000 / 5000 / 5000	9200[sol] (364) / 9700[sol] (899) / 10000
Aromatic EC >12-16	23 / 57 / 130	140 / 330 / 660	1800 / 2300[sol] (419) / 2500	36000[sol] (169) / 37000 / 38000	5100 / 5100 / 5000	10000 / 10000 / 10000
Aromatic EC >16-21 °	46 / 110 / 260	260 / 540 / 930	1900 / 1900 / 1900	28000 / 28000 / 28000	3800 / 3800 / 3800	7600 / 7700 / 7800
Aromatic EC >21-35 °	370 / 820 / 1600	1100 / 1500 / 1700	1900 / 1900 / 1900	28000 / 28000 / 28000	3800 / 3800 / 3800	7800 / 7800 / 7900
Aromatic EC >35-44 °	370 / 820 / 1600	1100 / 1500 / 1700	1900 / 1900 / 1900	28000 / 28000 / 28000	3800 / 3800 / 3800	7800 / 7800 / 7900
Aliphatic+Aromatic EC >44-70 °	1200 / 2100 / 3000	1600 / 1800 / 1900	1900 / 1900 / 1900	28000 / 28000 / 28000	3800 / 3800 / 3800	7800 / 7800 / 7900
Chloroalkanes & Chloroalkenes (SOM 1%/ 2.5%/ 6%) [a, b, l, p]						
1,2-Dichloroethane	0.0046 / 0.0083 / 0.016	0.0071 / 0.011 / 0.019	0.0092 / 0.013 / 0.023	0.67 / 0.97 / 1.7	29 / 29 / 29	21 / 24 / 28

Determinand	Allotment	R_WHP	$R_{WO}HP$	Commercial/ Industrial	POSresi	POSpark
1,1,1 Trichloroethane (TCA)	48 / 110 / 240	8.8 / 18 / 39	9.0 / 18 / 40	660 / 1300 / 3000	140000 / 140000 / 140000	57000[vap](1425) 76000[vap](2915)/ 100000[vap](6392)
1,1,1,2 Tetrachloroethane	0.79 / 1.9 / 4.4	1.2 / 2.8 / 6.4	1.5 / 3.5 / 8.2	110 / 250 / 560	1400 / 1400 / 1400	1500 / 1800 / 2100
1,1,2,2 Tetrachloroethane	0.41 / 0.89 / 2.0	1.6 / 3.4 / 7.5	3.9 / 8.0 / 17	270 / 550 / 1100	1400 / 1400 / 1400	1800 / 2100 / 2300
Tetrachloroethene (PCE)	0.65 / 1.5 / 3.6	0.18 / 0.39 / 0.90	0.18 / 0.4 / 0.92	19 / 42 / 95	1400 / 1400 / 1400	810[sol](424)/1100[sol] (951)/1500
Tetrachloromethane (Carbon Tetrachloride)	0.45 / 1.0 / 2.4	0.026 / 0.056 / 0.13	0.026 / 0.056 / 0.13	2.9 / 6.3 / 14	890 / 920 / 950	190 / 270 / 400
Trichloroethene (TCE)	0.041 / 0.091 / 0.21	0.016 / 0.034 / 0.075	0.017 / 0.036 / 0.080	1.2 / 2.6 / 5.7	120 / 120 / 120	70 / 91 / 120
Trichloromethane (Chloroform)	0.42 / 0.83 / 1.7	0.91 / 1.7 / 3.4	1.2 / 2.1 / 4.2	99 / 170 / 350	2500 / 2500 / 2500	2600 / 2800 / 3100
Chloroethene (Vinyl Chloride)	0.00055/ 0.001/ 0.0018	0.00064 / 0.00087/ 0.0014	0.00077 / 0.001 / 0.0015	0.059 / 0.077 / 0.12	3.5 / 3.5 / 3.5	4.8 / 5.0 / 5.4
Phenol & Chlorophenols [a, b, l, p]						
Phenol	23 / 42 / 83	120 / 200 / 380	440 / 690 / 1200	440[dir] (26000) / 690[dir] (30000) / 1300[dir] (34000)	440[dir] (10000)/ 690[dir](10000) 1300[dir](10000)	440[dir] (7600) / 690[dir] (8300) / 1300[dir] (93000)
Chlorophenols (excluding PCP) [r]	0.13[s] / 0.3 / 0.7	0.87[s] / 2.0 / 4.5	94 / 150 / 210	3500 / 4000 / 4300	620 / 620 / 620	1100 / 1100 / 1100
Pentachlorophenol (PCP)	0.03 / 0.08 / 0.19	0.22/ 0.52 / 1.2	27[vap] (16.4) / 29 / 31	400 / 400 / 400	60 / 60 / 60	110 / 120 / 120
Other [a, b, l, p]						
Carbon Disulphide	4.8 / 10 / 23	0.14 / 0.29 / 0.62	0.14 / 0.29 / 0.62	11 / 22 / 47	11000 / 11000 / 12000	1300 / 1900 / 2700
Hexachlorobutadiene (HCBD)	0.25 / 0.61 / 1.4	0.29 / 0.7 / 1.6	0.32 / 0.78 / 1.8	31 / 66 / 120	25 / 25 / 25	48 / 50 / 51
Pesticides (SOM 1%/ 2.5%/ 6%) [a, b, l, p]						
Aldrin	3.2 / 6.1 / 9.6	5.7/ 6.6 /7.1	7.3 / 7.4 / 7.5	170 / 170 / 170	18 / 18 / 18	30 / 31 / 31
Atrazine	0.5 / 1.2 / 2.7	3.3 / 7.6 / 17.4	610 / 620 / 620	9300 / 9400 / 9400	1200 / 1200 / 1200	2300 / 2400 / 2400
Dichlorvos	0.0049 / 0.010 / 0.022	0.032 / 0.066 / 0.14	6.4 / 6.5 / 6.6	140 / 140 / 140	16 / 16 / 16	26 / 26 / 27
Dieldrin	0.17/0.41/0.96	0.97/ 2 / 3.5	7.0 / 7.3 / 7.4	170 / 170 / 170	18 / 18 / 18	30 / 30 / 31
Alpha - Endosulfan	1.2 / 2.9 / 6.8	7.4 / 18 / 41	160[vap] (0.003)/ 280[vap] (0.007)/ 410[vap] (0.016)	5600[vap] (0.003) / 7400[vap] (0.007) / 8400[vap] (0.016)	1200 / 1200 / 1200	2400 / 2400 / 2500
Beta - Endosulfan	1.1 / 2.7 / 6.4	7.0 / 17 / 39	190[vap](0.00007) /320[vap](0.0002) /440[vap](0.0004)	6300[vap](0.00007) /7800[vap](0.0002) / 8700	1200 / 1200 / 1200	2400 / 2400 / 2500
Alpha-Hexachlorocyclohexane	0.035/0.087/ 0.21	0.23/0.55 / 1.2	6.9 / 9.2 / 11	170 / 180 / 180	24 / 24 / 24	47 / 48 / 48
Beta - Hexachlorocyclohexane	0.013 / 0.032 / 0.077	0.085 / 0.2 / 0.46	3.7 / 3.8 / 3.8	65 / 65 / 65	8.1 / 8.1 / 8.1	15 / 15 / 16
Gamma – Hexachlorocyclohexane	0.0092 / 0.023 / 0.054	0.06 / 0.14 / 0.33	2.9 / 3.3 / 3.5	67 / 69 / 70	8.2 / 8.2 / 8.2	14 / 15 / 15
Chlorobenzenes [a, b, l, p]						
Chlorobenzene	5.9 / 14 / 32	0.46 / 1.0 / 2.4	0.46 / 1.0 / 2.4	56 / 130 / 290	11000 / 13000 / 14000	1300[sol](675)/ 2000[sol](1520)/ 2900
1,2-dichlorobenzene (1,2-DCB)	94 / 230 / 540	23 / 55 / 130	24 / 57 / 130	2000[sol] (571) / 4800[sol] (1370) / 11000[sol] (3240)	90000 / 95000 / 98000	24000[sol] (571) / 36000[sol] (1370) /51000[sol] (3240)
1,3-dichlorobenzene (1,3-DCB)	0.25 / 0.6 / 1.5	0.4 / 1.0 / 2.3	0.44 /1.1 / 2.5	30 / 73 / 170	300 / 300 / 300	390 / 440 / 470
1-4-dichlorobenzene (1,4-DCB)	15[i] / 37[i] / 88 [i]	61[q] / 150[q] /350 [q]	61[q] / 150[q] / 350[q]	4400[vap,q] (224) / 10000[vap,q] (540) / 25000[vap,q] (1280)	17000[i] / 17000[i] / 17000[i]	36000[vap,i] (224) 36000[vap, i](540)/ 36000[vap,i](1280)
1,2,3-Trichlorobenzene	4.7 / 12 / 28	1.5 / 3.6 / 8.6	1.5 / 3.7 / 8.8	102 / 250 / 590	1800 / 1800 / 1800	770[vap] (134) / 1100[vap] (330) / 1600[vap] (789)
1,2,4- Trichlorobenzene	55 / 140 / 320	2.6 / 6.4 / 15	2.6 / 6.4 / 15	220 / 530 / 1300	15000 / 17000 / 19000	1700[vap] (318) / 2600[vap] (786) / 4000[vap] (1880)
1,3,5- Trichlorobenzene	4.7 / 12 / 28	0.33 / 0.81 / 1.9	0.33 / 0.81 / 1.9	23 / 55 / 130	1700 / 1700 / 1800	380[vap] (36.7) / 580[vap] (90.8) / 860[vap] (217)
1,2,3,4-Tetrachlorobenzene	4.4 / 11 / 26	15 / 36 / 78	24 / 56 / 120	1700[vap] (122) / 3080[vap] (304) / 4400[vap] (728)	830 / 830 / 830	1500[vap] (122) / 1600 / 1600
1,2,3,5- Tetrachlorobenzene	0.38 / 0.90 / 2.2	0.66 / 1.6 / 3.7	0.75 / 1.9 / 4.3	49[vap] (39.4) / 120[vap] (98.1) / 240[vap] (235)	78 / 79 / 79	110[vap] (39.4) / 120 / 130
1,2,4,5- Tetrachlorobenzene	0.06 / 0.16 / 0.37	0.33 / 0.77 / 1.6	0.73 / 1.7 / 3.5	42[sol] (19.7) / 72[sol] (49.1) / 96	13 / 13 / 13	25 / 26 / 26

Determinand	Allotment	R_WHP	$R_{WO}HP$	Commercial/ Industrial	POSresi	POSpark
Pentachlorobenzene (P_ECB)	1.2 / 3.1 / 7.0	5.8 / 12 / 22	19 / 30 / 38	640^{sol} (43.0) / 770^{sol} (107) / 830	100 / 100 / 100	190 / 190 / 190
Hexachlorobenzene (HCB)	0.47 / 1.1 / 2.5	1.8^{vap} (0.20) / 3.3^{vap} (0.5) / 4.9	4.1^{vap} (0.20) / 5.7^{vap} (0.5) / 6.7^{vap} (1.2)	110^{vap} (0.20) / 120 / 120	16 / 16 / 16	30 / 30 / 30

Units are mg/kg Dry Weight

R_WHP Residential with homegrown produce
$R_{WO}HP$ Residential without homegrown produce
POSresi public open spaces near residential housing
POSpark public open space for recreational use but not dedicated sports pitches
SOM Soil Organic Matter – ***the S4UL for all organic compounds will vary according to SOM***

a Based on a sandy loam soil as defined in SR3 (Environment Agency, 2009b) and 6% soil organic matter (SOM)
b Figures rounded to two significant figures
c Based only on a comparison of oral and dermal soil exposure with oral Index Dose
d The background ADE is limited to being no larger than the contribution from the relevant soil ADE
e Based on comparison of inhalation exposure with inhalation TDI only
f Based on a lifetime exposure via the oral, dermal and inhalation pathways
g Based on localised effects comparing inhalation exposure with inhalation ID only
h Based on comparison of inhalation exposure with inhalation ID
i Based on comparison of oral and dermal exposure with oral TDI
j Based on comparison of oral, dermal and inhalation exposure with inhalation TDI
k Based on comparison of all exposure pathways with oral TDI
l S4ULs assume that free phase contamination is not present
m S4ULs based on a sub-surface soil to indoor air correction factor of 10
n The HCV applied is based on the intake of total Xylene and therefore exposure should not consider an isomer in isolation
o Oral, dermal and inhalation exposure compared with oral HCV
p S4ULs based on a sub-surface soil to indoor air correction factor of 1
q Based on a comparison of inhalation exposure with the inhalation TDI for localised effects
r Based on 2,4-dichlorophenol unless otherwise stated
s Based on 2,3,4,6-tetrachlorophenol
t Based on lowest GAC for all three xylene isomers
u Measured concentrations of benzo(a)pyrene should be compared to the S4UL for benzo(a)pyrene as a single compound and to the S4UL for benzo(a)pyrene as a surrogate marker of genotoxic PAHs.
vap S4UL presented exceeded the vapour saturation limit, which is presented in brackets
sol S4UL presented exceeds the solubility saturation limit, which is presented in brackets
dir S4ULs based on a threshold protective of direct skin contact, guideline in brackets based on the health effects following long term exposure provided for illustration only

Table 3: Soil Guideline Values (SGVs) for dioxins, furans and dioxin like PCBs

Determinand	Allotments	Residential with consumption of homegrown produce	Residential without consumption of homegrown produce	Commercial
Sum of PCDDs, PCDFs and dioxin-like PCBs	0.008	0.008	0.008	0.24

Units are mg/kg Dry Weight

Table 4: EIC/AGS/CL:AIRE Generic Assessment Criteria (GAC)

	Allotments	Residential with consumption of homegrown produce	Residential without consumption of homegrown produce	Commercial	Soil Saturation Concentration
Metals					
Antimony	ND	ND	550	7500	NA
Barium	ND	ND	1300	22000	NA
Molybdenum	ND	ND	670	17000	NA
Organics (SOM 1%/ 2.5%/ 6%)					
1,1,2 Trichloroethane	0.28 / 0.61 / 1.4	0.6 / 1.2 / 2.7	0.88 / 1.8 / 3.9	94 / 190 / 400	4030 / 8210 / 18000
1,1-Dichloroethane	9.2 / 17 / 35	2.4 / 3.9 / 7.4	2.5 / 4.1 / 7.7	280 / 450 / 850	1830 / 2960 / 5600
1,1-Dichloroethene	2.8 / 5.6 / 12	0.23 / 0.4 / 0.82	0.23 / 0.41 / 0.82	26 / 46 / 92	2230 / 3940 / 7940
1,2,4-Trimethylbenzene	0.38 / 0.93 / 2.2	0.35 / 0.85 / 2	0.41 / 0.99 / 2.3	42 / 99 / 220	557 / 1360 / 3250
1,2-Dichloropropane	0.62 / 1.2 / 2.6	0.024 / 0.042 / 0.084	0.024 / 0.042 / 0.085	3.3 / 5.9 / 12	1190 / 2110 / 4240
2,4-Dimethylphenol	3.1 / 7.2 / 17	19 / 43 / 97	210 / 410 / 730	16000 / 24000 / 30000	1380 / 3140 / 7240
2,4-Dinitrotoluene	0.22 / 0.49 / 1.1	1.5 / 3.2 / 7.2	170 / 170 / 170	3700 / 3700 / 3800	141 / 299 / 669
2,6-Dinitrotoluene	0.12 / 0.27 / 0.61	0.78 / 1.7 / 3.9	78 / 84 / 87	1900 / 1900 / 1900	287 / 622 / 1400
2-Chloronaphthalene	40 / 98 / 230	3.7 / 9.2 / 22	3.8 / 9.3 / 22	390 / 960 / 2200	114 / 280 / 669
Biphenyl	14 / 35 / 83	66 / 160 / 360	220 / 500 / 980	18000 / 33000 / 48000	34.4 / 84.3 / 201
Bis (2-ethylhexyl) phthalate	47 / 120 / 280	280 / 610 / 1100	2700 / 2800 / 2800	85000 / 86000 / 86000	8.68 / 21.6 / 51.7

	Allotments	Residential with consumption of homegrown produce	Residential without consumption of homegrown produce	Commercial	Soil Saturation Concentration
Bromobenzene	3.2 / 7.6 / 18	0.87 / 2 / 4.7	0.91 / 2.1 / 4.9	97 / 220 / 520	853 / 1970 / 4580
Bromodichloromethane	0.016 / 0.032 / 0.068	0.016 / 0.03 / 0.061	0.019 / 0.034 / 0.07	2.1 / 3.7 / 7.6	1790 / 3220 / 6570
Bromoform	0.95 / 2.1 / 4.6	2.8 / 5.9 / 13	5.2 / 11 / 23	760 / 1500 / 3100	2690 / 5480 / 12000
Butyl benzyl phthalate	220 / 550 / 1300	1400 / 3300 / 7200	42000 / 44000 / 44000	940000 / 940000 / 950000	26.3 / 64.7 / 154
Chloroethane	110 / 200 / 380	8.3 / 11 / 18	8.4 / 11 / 18	960 / 1300 / 2100	2610 / 3540 / 5710
Chloromethane	0.066 / 0.13 / 0.23	0.0083 / 0.0098 / 0.013	0.0085 / 0.0099 / 0.013	1 / 1.2 / 1.6	1910 / 2240 / 2990
Cis 1,2 Dichloroethene	0.26 / 0.5 / 1	0.11 / 0.19 / 0.37	0.12 / 0.2 / 0.39	14 / 24 / 47	3940 / 6610 / 12900
Dichloromethane	0.1 / 0.19 / 0.34	0.58 / 0.98 / 1.7	2.1 / 2.8 / 4.5	270 / 360 / 560	7270 / 9680 / 15300
Diethyl Phthalate	19 / 41 / 94	120 / 260 / 570	1800 / 3500 / 6300	150000 / 220000 / 290000	13.7 / 29.1 / 65
Di-n-butyl phthalate	2 / 5 / 12	13 / 31 / 67	450 / 450 / 450	15000 / 15000 / 15000	4.65 / 11.4 / 27.3
Di-n-octyl phthalate	940 / 2100 / 3900	2300 / 2800 / 3100	3400 / 3400 / 3400	89000 / 89000 / 89000	32.6 / 81.5 / 196
Hexachloroethane	0.27 / 0.67 / 1.6	0.2 / 0.48 / 1.1	0.22 / 0.54 / 1.3	22 / 53 / 120	8.17 / 20.1 / 48.1
Isopropylbenzene	32 / 79 / 190	11 / 27 / 64	12 / 28 / 67	1400 / 3300 / 7700	390 / 950 / 2250
Methyl tert-butyl ether (MTBE)	23 / 44 / 90	49 / 84 / 160	73 / 120 / 220	7900 / 13000 / 24000	20400 / 33100 / 62700
Propylbenzene	34 / 83 / 200	34 / 82 / 190	40 / 97 / 230	4100 / 9700 / 21000	402 / 981 / 2330
Styrene	1.6 / 3.7 / 8.7	8.1 / 19 / 43	35 / 78 / 170	3300 / 6500 / 11000	626 / 1440 / 3350
Total Cresols (2-, 3- and 4-methylphenol)	12 / 27 / 63	80 / 180 / 400	3700 / 5400 / 6900	160000 / 180000 / 180000	15000 / 32500 / 73300
Trans 1,2 Dichloroethene	0.93 / 1.9 / 4	0.19 / 0.34 / 0.7	0.19 / 0.35 / 0.71	22 / 40 / 81	3420 / 6170 / 12600
Tributyl tin oxide	0.042 / 0.1 / 0.24	0.25 / 0.59 / 1.3	1.4 / 3.1 / 5.7	130 / 180 / 200	41.3 / 101 / 241

Units are mg/kg Dry Weight

Table 5: Tier 2 Criteria for the Assessment of Soils – Protection of Flora and Fauna

Parameter	ICRCL 70/90 [a]		SSVs [b]	Code of Practice for Agricultural Use of Sewage Sludge [c]	BS 3882:2015 Specification for topsoil and requirements for use
	Maximum				Phytotoxic contaminants
	Livestock	Crop Growth			
	mg/kgDW	mg/kgDW	mg/kgDW	mg/kgDW	mg/kgDW
Antimony			37		
Arsenic	500	1000		50	
Cadmium	30	50	0.6	3	
Chromium				400	
Cobalt			4.2		
Copper	500	250	35.1	80/ 100/ 135/ 200 [d]	<100/<135/<200 [e]
Fluoride	1000			500	
Lead	1000			300	
Mercury				1	
Molybdenum			5.1	4	
Nickel			28.2	50/ 60/ 75/ 110 [d]	<60/<75/<110 [e]
Selenium				3	
Silver			0.3		
Vanadium			2.0		
Zinc	3000	1000	35.6	200/200/200/300 [d]	<200/<200/<300 [e]
Benzo(a)pyrene			0.15		
Bis(2-ethylhexyl) phthalate			13		
Hexachlorobenzene			0.002		
Pentachlorobenzene					
Pentachlorophenol			0.6		
Perfluorooctanoic acid			0.022		
Perfluorooctane sulfonate			0.014		
Polychlorinated alkanes medium chain			11.9		
Tetrachloroethene					
Toluene					
Triclosan			0.13		

Parameter	ICRCL 70/90 [a]		SSVs [b]	Code of Practice for Agricultural Use of Sewage Sludge [c]	BS 3882:2015 Specification for topsoil and requirements for use
	Maximum				Phytotoxic contaminants
	Livestock	Crop Growth			
	mg/kgDW	mg/kgDW	mg/kgDW	mg/kgDW	mg/kgDW
Tris(2-chloroethyl)phosphate			1.1		
Tris(2-chloro-1-methylethyl) phosphate			1.8		

a. Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL) 70/90 Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing 1st edition 1990.
b. Soil screening values for assessing ecological risks, EA 2017a Report – ShARE id26
c. Maximum permissible concentration of potentially toxic elements for Arable land from the Sewage sludge in agriculture: code of practice.. There are also criteria for Grassland which are higher than for Arable.
d. Where four values are presented, concentrations are for soils with pH values 5.0-5.5/ 5.5-6.0/ 6.0-7.0/ >7.0 (and the soils contain more than 5% calcium carbonate)
e. Where three values are presented, concentrations are for soils with pH values <6.0/ 6.0-7.0/ >7.0

Table 6: Tier 2 Criteria for Screening Liquids

	Screening Concentration (mg/l)			
	Minimum Reporting Value	Human Consumption	Fresh Water/Inland	Salt Water/Other
Arsenic SP	-	0.01	0.05 (2)	0.025 (2)
Boron	-	1	-	-
Cadmium PS	0.0001	0.005	≤0.00008, 0.00008, 0.00009, 0.00015, 0.00025 (14)	0.0002
Chromium (total)	-	0.05	-	-
Chromium (III) SP	-	-	0.0047	-
Chromium (VI) SP	-	-	0.0034	0.0006
Copper SP	-	2	0.001 bioavailable	0.00376 bioavailable
Iron SP	-	0.2	1	1
Lead PS	-	0.01	0.0012 bioavailable	0.0013 bioavailable
Mercury compounds PS	0.00001	0.001	0.00007 max	0.00007 max
Manganese SP	-	0.05	0.123 bioavailable	-
Nickel PS	-	0.02	0.004 bioavailable	0.0086 bioavailable
Selenium	-	0.01	-	-
Zinc SP	-	5(3)	0.0109bioavailable(13)	0.0068bioavailable (13)
Chlorinated Compounds				
C10-13 chloroalkanes PS short chain chlorinated paraffins	-	-	0.0004	0.0004
Dichloromethane PS	-	-	0.02	0.02
1,2-Dichloroethane PS	0.001	0.003	0.01	0.01
Trichloroethene PS	0.0001	0.01(5)	0.01	0.01
1,1,1-Trichloroethane	0.0001	-	-	-
1,1,2-Trichloroethane	0.0001	-	-	-
Trichloromethanes PS	-	0.1(1)	0.0025	0.0025
1, 2, 4-Trichlorobenzene	0.00001			
Tetrachloroethene PS	0.0001	0.01(5)	0.01	0.01
Tetrachloromethane PS	0.0001	0.003	0.012	0.012
Tetrachloroethane SP	-		0.140	
Vinyl chloride	-	0.0005	-	-
Trichlorobenzene (TCB) PS	-	-	0.0004	0.0004
Chloroform	0.0001			
Chloronitrotoluenes(CNT)(11)	0.001	-	-	-
Hexachlorobutadiene PS	0.000005	-	0.0006 max	0.0006 max
Hexachlorocyclohexanes (HCH) PS	0.000001	-	0.00002	0.000002
Polycyclic Aromatic Hydrocarbons				
Acenaphthene	-	-	-	-

	Screening Concentration (mg/l)			
	Minimum Reporting Value	**Human Consumption**	**Fresh Water/Inland**	**Salt Water/Other**
Acenaphthylene	-	-	-	-
Anthracene PS	-	-	0.0001	0.0001
Benzo(a)anthracene	-	-	-	-
Benzo(b)fluoranthene PS	-	0.0001 (10)	0.000017 max (12)	0.000017 max (12)
Benzo(a)pyrene PS	-	0.00001	0.00000017	0.00000017
Benzo(k)fluoranthene PS	-	0.0001 (10)	0.000017 max (12)	0.000017 max (12)
Benzo(g,h,i)perylene PS	-	0.0001 (10)	0.0000082 max (12)	0.00000082 max (12)
Indeno(1,2,3-cd)pyrene PS	-	0.0001 (10)	- (12)	- (12)
Chrysene		-	-	-
Dibenzo(a,h)anthracene		-	-	-
Fluoranthene PS	-	-	0.0000063	0.0000063
Fluorene	-	-	-	-
Phenanthrene	-	-	-	-
Pyrene	-	-	-	-
Naphthalene PS	-	-	0.002	0.002
Polycyclic Aromatic Hydrocarbons		0.0001(10)		
Petroleum hydrocarbons				
Total petroleum hydrocarbons	-	0.01(3)	-	-
Benzene PS	0.001	0.001	0.01	0.008
Toluene SP	0.004	0.7(9)	0.074	0.074
Ethylbenzene	-	0.3(9)	-	-
Xylenes	0.003(4)	0.5(9)		
Methyl tert-butyl ether (MTBE)	-	0.015(7)	-	-
Pesticides and Herbicides				
Alachlor PS	-	-	0.0003	0.0003
Aldrin PS	0.000003	0.00003	0.00001(8)	0.000005(8)
Dieldrin PS	0.000003	0.00003		
Endrin PS	0.000003	0.0006(9)		
Isodrin	0.000003	-	-	-
2,4 dichlorophenol SP	0.0001	-	0.0042	0.00042
2,4 D ester SP	0.0001	-	0.0003	0.0003
op and pp DDT (each) PS		0.001(6)	0.000025 (6)	0.000025 (6)
op and pp DDE (each)				
op and pp TDE (each)				
Dimethoate SP	0.00001	-	0.00048	0.00048
Endosulfan PS	0.000005	-	0.000005	0.0000005
Hexachlorobenzene PS	0.000001		0.00005 max	0.00005 max
Permethrin SP		-	0.000001	0.0000002
Atrazine PS	0.00003	-	0.0006	0.0006
Simazine PS	0.00003	-	0.001	0.001
Linuron SP		-	0.0005	0.0005
Mecoprop SP		-	0.018	0.018
Trifluralin PS	0.00001	-	0.00003	0.00003
Total pesticides		0.0005		
Miscellaneous				
Ammoniacal nitrogen (as NH4+)	-	0.5	0.26 16 0.39 17	-
Ammoniacal nitrogen (as N)	-	0.39	0.2 16 0.3 17	-
Unionised Ammonia (NH3) SP	-	-	-	0.021
Chloride	-	250		
Chlorine SP			0.002	0.01 max
Cyanide SP (hydrogen cyanide)	-	0.05	0.001	0.001
Nitrate (as NO_3)	-	50	-	-
Nitrite (as NO_2)	-	0.1	-	-
Phenol SP	-	0.5 (3)	0.0077	0.0077
Pentachlorophenol PS	0.0001	-	0.0004	0.0004
PCBs (individual congeners)	0.000001	-	-	-
Sodium	-	200	-	-
Sulphate	-	250		-

	Screening Concentration (mg/l)			
	Minimum Reporting Value	Human Consumption	Fresh Water/Inland	Salt Water/Other
Tributyl and triphenyl tin compounds (each) PS	0.000001	-	0.0000002	0.0000002
Di(2-ethylhexyl)-phthalate PS	-	-	0.0013	0.0013

Substances highlighted in yellow are hazardous substances, PS = Priority Substances, SP = Specific Pollutants, '-' screening concentration is not available, 'max' – maximum allowable concentration used where no annual average provided

Notes:

1. Concentration for trihalomethanes is the sum of chloroform, bromoform, dibromochloromethane and bromodichloromethane.
2. Concentration is the dissolved fraction of a water sample obtained by filtration through a 0.45um filter.
3. Concentration is taken from Statutory Instrument 1989 No. 1147. The Water Supply (Water Quality) Regulations 1989, as amended.
4. Concentration for xylenes is 0.003mg/l each for o-xylene and m/p xylene.
5. Concentration is the Sum of TCE and PCE.
6. Concentration is for Total DDT. Para DDT on its own has a target concentration of 0.00001mg/l.
7. Concentration for MTBE is taken from Environment Agency guidance, dated 2006.
8. Concentration is the sum of aldrin, dieldrin, endrin.
9. Concentration is taken from WHO (2004) guidelines for drinking-water quality.
10. Sum of benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(ghi)perylene, indeno(1,2,3-cd)pyrene
11. Concentration is for 2,6-CNT, 4,2-CNT, 4,3-CNT, 2,4-CNT, 2,5-CNT
12. BAP can be considered as a marker of the other PAHs for comparison with the annual average
13. Concentration plus ambient background concentration (dissolved)
14. For cadmium and its compounds the EQS depends on the hardness of the water (Class 1: < 40 mg CaCO3/l, Class 2: 40 to < 50 mg CaCO3/l, Class 3: 50 to < 100 mg CaCO3/l, Class 4: 100 to < 200 mg CaCO3/l and Class 5: ≥ 200 mg CaCO3/l).
15. Manufactured and used in industrial applications, such as flame retardants and plasticisers, as additives in metal working fluids, in sealants, paints, adhesives, textiles, leather fat and coatings. Persistent, bioaccumulate and toxic to aquatic life (carcinogen in rat studies). Candidate Persistent Organic Pollutant (POP).
16. Acceptable 90th percentile concentration for a freshwater lake/river with "High" chemical quality standard and alkalinity (as mg/l CaCO3) < 50 mg/L or alkalinity < 200 mg/L where river elevation > 80 m above Ordnance Datum (mAOD). See the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 for further details.
17. Acceptable 90th percentile concentration for a freshwater lake/river with "High" chemical quality standard and alkalinity (as mg/l CaCO3) ≥ 50 mg/L where river elevation < 80 m mAOD or > 200 mg/l where river elevation > 80 mAOD. See the Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 for further details.

Table 7: Tier 2 Criteria for Screening Groundwater Vapour Generation Hazard

Chemical	CAS	GAC_{gwvap}(µg/l)[1,2]		Aqueous Solubility (µg/l)
		Residential	Commercial	
Petroleum Hydrocarbons				
1,2,4-Trimethylbenzene	95-63-6	24	2,200	559,000
Benzene [3]	71-43-2	210	20,000	1,780,000
Ethylbenzene [3]	100-41-4	10,000	*960,000 (sol)*	180,000
Isopropylbenzene	98-82-8	850	*86,000 (sol)*	56,000
Propylbenzene	103-65-1	2,700	*240,000 (sol)*	54,100
Styrene	100-42-5	8,800	*810,000 (sol)*	290,000
Toluene [3]	108-88-3	230,000	*21,000,000 (sol)*	590,000
TPH Aliphatic EC5-EC6 [3]		1,900	*190,000 (sol)*	35,900
TPH Aliphatic >EC6-EC8 [3]		1,500	*150,000 (sol)*	5,370
TPH Aliphatic >EC8-EC10 [3]		57	*5,700 (sol)*	427
TPH Aliphatic >EC10-EC12 [3]		37	*3,600 (sol)*	34
TPH Aromatic >EC5-EC7 [2,3]		210,000	*20,000,000 (sol)*	1,780,000
TPH Aromatic >EC7-EC8 [3]		220,000	*21,000,000 (sol)*	590,000
TPH Aromatic >EC8-EC10 [3]		1,900	*190,000 (sol)*	64,600
TPH Aromatic >EC10-EC12 [3]		6,800	*660,000 (sol)*	24,500
TPH Aromatic >EC12-EC16 [3]		39,000	*3,700,000 (sol)*	5,750
meta-Xylene [3,5]	108-38-3	9,500	*940,000 (sol)*	200,000
ortho-Xylene [3,5]	95-47-6	12,000	*1,100,000 (sol)*	173,000
para-Xylene [3,5]	106-42-3	9,900	*980,000 (sol)*	200,000
Polycyclic Aromatic Hydrocarbons (PAH)				
Acenaphthene	83-32-9	*170,000 (sol)*	*15,000,000 (sol)*	4,110

Chemical	CAS	GAC_{gwvap}(µg/l)[1,2]		Aqueous Solubility (µg/l)
		Residential	Commercial	
Acenaphthylene	208-96-8	*220,000 (sol)*	*20,000,000 (sol)*	7,950
Fluorene	86-73-7	*210,000 (sol)*	*18,000,000 (sol)*	1,860
Naphthalene	91-20-3	220	*23,000 (sol)*	19,000
Pesticides				
Aldrin	309-00-2	*47 (sol)*	*3,700 (sol)*	20
alpha-Endosulfan	959-98-8	*7,400 (sol)*	*590,000 (sol)*	530
beta-Endosulfan	33213-65-9	*7,500 (sol)*	*600,000 (sol)*	280
Halogenated Organics				
1,1,1,2-Tetrachloroethane	79-34-5	240	22,000	1,110,000
1,1,1-Trichloroethane	71-55-6	3,000	290,000	1,300,000
1,1,2,2-Tetrachloroethane	79-35-4	1,600	150,000	2,930,000
1,1,2-Trichloroethane	79-00-5	520	49,000	4,491,000
1,1-Dichloroethane	75-34-3	2,700	260,000	3,666,000
1,1-Dichloroethene	75-35-4	160	1,6000	3,100,000
1,2,3,4-Tetrachlorobenzene	634-66-2	240	*31,000 (sol)*	7,800
1,2,3,5-Tetrachlorobenzene	634-90-2	7.0	*600*	3,500
1,2,3-Trichlorobenzene	87-61-7	35	3,100	21,000
1,2,4,5-Tetrachlorobenzene	95-94-3	8.1	*700 (sol)*	600
1,2,4-Trichlorobenzene	120-82-1	68	7,200	41,400
1,2-Dichlorobenzene	95-50-1	2,000	*220,000 (sol)*	133,000
1,2-Dichloroethane	107-06-2	8.9	850	8,680,000
1,2-Dichloropropane	78-87-5	22	2,600	2,050,000
1,3,5-Trichlorobenzene	108-70-3	7.4	660	6,000
1,3-Dichlorobenzene	541-73-1	31	2,800	103,000
1,4-Dichlorobenzene	106-46-7	5,000	*460,000 (sol)*	51,200
Bromobenzene	108-86-1	220	20,000	388,040
Bromodichloromethane	75-27-4	17	1,600	3,000,000
Bromoform (Tribromomethane)	75-25-2	3,100	400,000	3,000,000
Chlorobenzene	108-90-7	98	15,000	387,000
Chloroethane	75-00-3	10,000	1,000,000	5,742,000
Chloroethene (Vinyl Chloride)	75-01-4	0.62	63	2,760,000
Chloromethane	74-87-3	14	1,400	5,350,000
cis-1,2-Dichloroethene	156-59-2	130	13,000	7,550,000
Dichloromethane	75-09-2	3,300	370,000	20,080,000
Hexachlorobenzene	118-74-1	*16 (sol)*	*1,400 (sol)*	10
Hexachlorobutadiene	87-68-3	1.7	230	4,800
Hexachloroethane	67-72-1	8.5	740	49,900
Pentachlorobenzene	608-93-5	140	*12,000 (sol)*	500
Tetrachloroethene	127-18-4	34	4,600	225,000
Tetrachloromethane (Carbon Tetrachloride)	56-23-5	5.3	770	846,000
trans-1,2-Dichloroethene	156-60-5	160	16,000	5,250,000
Trichloroethene	79-01-6	5.7	530	1,370,000
Trichloromethane (Chloroform)	67-66-3	790	85,000	8,950,000
Others (organic and inorganic)				
2-Chloronaphthalene	91-58-7	160	*14,000 (sol)*	11,700
Biphenyl (Lemonene)	92-52-4	*15,000 (sol)*	*1,300,000 (sol)*	4,060
Carbon Disulphide	75-15-0	56	5,600	2,100,000
Mercury, elemental	7439-97-6	1.1	*95 (sol)*	56
Methyl tertiary butyl ether (MTBE)	1634-04-4	83,000	7,800,000	48,000,000

Notes

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