Ground and Environmental Services Limited

Unit 2 Montpelier Business Park
Dencora Way
Ashford
Kent
TN23 4FG
01233 646237

Foxbury Farm, Stone Street
Sevenoaks, Kent TN15 0LW

Phase 2 Geo-Environmental Investigation

On behalf of Mr I Mitchell

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Site: Foxbury Farm, Stone Street, Sevenoaks, TN15 0LW

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Quality Management

Prepared by:	**MP**
Reviewed by:	**CSS**
Authorised by:	**KM**
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1 INTRODUCTION

Ground and Environmental Services Ltd (GES) was commissioned by Mr I Mitchell to undertake a Phase 2 Geo-Environmental Investigation on a redevelopment site at Foxbury Farm, Stone Street, Sevenoaks, TN15 0LW.

It was understood that the proposed redevelopment of the site would comprise the removal of existing warehouses with certain buildings to be retained and refurbished which include the oast building, cart lodge and small cold store building and the construction of a number of new two storey properties.

The purpose of the ground investigation was to determine the ground profile and to provide guideline recommendations for the design of foundations, ground floor slabs, temporary works and pavement design for new structures on the site.

In addition, contamination testing and a soil gas survey was carried out to provide a preliminary assessment of contamination issues based on current Contaminated Land Legislation.

This report should be read in conjunction with a Phase 1 study prepared for the site by GES in January 2015, reference 11374.

2 SITE LOCATION AND LAYOUT

The site is located off Stone Street Road, Sevenoaks, approximately 4.4km to the east of Sevenoaks centre and is centred on approximate ordnance survey grid reference centre: TQ 575 548.

The site is situated in a predominantly rural setting with land use in the vicinity mainly consisting of residential properties.

The site gently slopes downwards to the south with retaining walls and small banks towards the southern end of the site.

A walkover survey conducted as part of the Phase 1 study prepared for the site in January 2015 indicated the following:

To the immediate right upon entering the site was the oast building. This building has been shown on the historic maps since 1869 and with its current outline shape since 1896. This building has had a couple of usages. Initially the building was used for the drying and curing of hops in the late 1850's. By about 1952 it was used as a cold store for apples until the 1980's whereby it was no longer routinely used for agricultural purposes. The flooring was clean and intact and free from any obvious staining.

To the immediate north of the oast building was a small building with a single apex roof referred to as the cold store. This building was also used as a cold store since about 1952. The inside had cork insulation and some tar water proofing. The flooring was ostensibly clean and again was in good condition. To the immediate east of this building was an above ground fuel storage tank (AST). This was raised on concrete plinths and it was surrounded on three sides by a concrete wall, although the front was missing. The tank was no longer in use. Adjacent to this AST was the location of an old cesspit, this is no longer present and a newer main sewage run is in this location. Opposite this area adjacent to the oast building was the remains of old water settlement/circulation pit used for water cooling in the cold stores.

To the west of the oast was a square shaped warehouse style building, this was the farm workshop and has been since 1942. The inside housed tools, workbenches, small engineering machines (lathes), a couple old tractors, a small ramp to raise vehicles, an upstairs mezzanine floor, an old gas heater was mounted near the ceiling although this is no longer used and had been replaced by an electric fan heater. The flooring was again ostensibly clean and free from any obvious signs of contamination such as staining and significant spillages. The roofing appeared to be asbestos cement sheeting with side panelling being corrugated metal sheeting. To the west of this building (i.e. the rear) was a propane 'calor' gas storage tank, used to fuel the now disused heater within the workshop.

Adjacent to the workshop is a large roughly rectangular shaped warehouse building. It had asbestos cement roofing and corrugated metal sheeting on the sides. There is office space within the upstairs section. It is currently being used as a storage area for vehicles, tractors, trailers, empty wooden pallets. There is a small locked cold store for the storage of pesticides/chemicals which are no longer kept in large amounts as the need for them is reduced as activities have. Its historic usage since 1936 was for grading and washing of apples, via a floating conveyor belt, this is no longer undertaken. Part of the warehouse was used for cold storage via a brine cooled refrigerant system. A large square hole in the ground is where the water brine filler stood. A small part of the warehouse was sealed off from the rest and was used as store room for wooden log storage.

To the rear of this above building and at south western most end of the site is a structure known as the cart lodge. This is a single apex structure with a sheet metal roof and large stone sides with an open front. This was empty and free from any obvious signs of contaminative activities.

Just north of the above large warehouse were two AST's, one for diesel for the tractors and the other for gas oil. These were modern integrally bunded fuel tanks of about 2500 litres each. They were housed on top of a slightly raised concrete base, there were no obvious staining or signs of spillages. It was confirmed that these tanks have been empty for some time now. The hardstanding in this area was intact and in good condition. Opposite these AST's and slightly to the north was a 'calor' propane gas tank which was used for the fuelling of a gas power fork lift truck.

A residential house was present in the middle area of the site, known as Foxbury Farm Cottage. The majority of the site is covered in hardstanding which was in very good condition, there were no signs of cracks, splits, stains or evidence of any disrepair.

To the north of the site were three large warehouses, these had single apex roofs with suspected asbestos sheet roofing and breeze blocked sides. They were used as cold stores and fitted with refrigerated air fans. They are fairly modern and been in place since the 1990's, they were in good condition. Again the ground conditions were very good and wooden pallets were stored outside in one of the corners and towards the most northern point of the site.

To the west of the cart lodge and the south of the residential cottage was an old Gilbarco fuel pump. Adjacent to this was the underground fuel storage tank (UST). This has not been used since the 1970's and was for petrol, before the farm machinery switched to diesel power. The UST cover was lifted and the tank filling pipe opened and inspected for any contents. A measuring gauge was inserted and proved the tank to be dry and therefore empty of any fuel.

The following features surround the site:

- To the north the site is bound by Fish Pond Wood.
- To the south the site is bound by Stone Street Road, beyond which are residential properties.
- To the west the site is bound by residential properties along Church Road.
- To the east the site is bound by residential properties.

3 ENVIRONMENTAL SETTING

3.1 GEOLOGY

Reference to the British Geological Survey 1:50,000 scale geological map of the area indicates that the site is set upon a Bedrock geology comprising of the Folkestone Formation.

The geological memoir for the area described these strata as follows:

Folkestone Formation

The Folkestone Beds consist predominantly of poorly consolidated quartzose sands with seams of pebbles and clay and veins of hard ferruginous sandstone. The sands are fine to medium grained, occasionally white in colour but generally yellow to reddish brown as a result of limonite staining.

3.2 GROUNDWATER

Reference to the British Geological Survey 1:50,000 scale Aquifer Designation Dataset, shows the site to be set upon a Principal Aquifer within the Folkestone Formation.

Principal Aquifers are highly permeable formations. They are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

The site is not situated within an Environment Agency-designated Groundwater Source Protection Zone.

4 INTRUSIVE INVESTIGATION

4.1 FIELDWORK

The site works were carried out the between the 14th September 2018 and the 11th October 2018 and comprised the following:

- Window Sampling;
- Falling Head Soakage Testing;
- Soil Gas and Groundwater Monitoring.

The positions of the above works on the site are indicated on Figure 1, Exploratory Hole Location Plan.

When considering the sampling strategy for this supplementary investigation, GES consulted current guidance as stipulated within British Standard BS10175 – '*Investigation of Potentially Contaminated Sites – Code of Practice'.*

Window Sample Holes

Nine window sample holes (WS1 to WS9) were excavated using a Premier 110 window sampling rig to depths ranging between 3.0m and 5.0m. The soils and materials encountered in the holes were logged and representative samples recovered for laboratory analysis.

Upon completion of the window sample holes 35mm diameter dual purpose soil gas and groundwater monitoring standpipes were installed at locations WS1, WS3, WS7 and WS8. The remaining locations were backfilled with arisings.

Window sample hole logs and installation details are presented in Appendix 1.

Falling Head Soakage Tests

Falling head soakage testing was undertaken in the standpipes installed in window sample holes WS1, WS3 and WS7. The test involved recording the drop in water level with respect to time.

The field test data is summarised below in Section 7.4 below and the results presented in Appendix 2.

Soil Gas and Groundwater Monitoring

A soil vapour survey was undertaken across the site and comprised the monitoring of the atmosphere within the window sample hole standpipes installed at the site. Portable gas monitoring equipment (GA5000) was used to monitor the standpipes for concentrations of carbon dioxide (CO_2), methane (CH_4) and oxygen (O_2).

In addition, photo-ionisation detection equipment was used to monitor concentrations of total volatile hydrocarbon compounds.

The gas monitoring results and ground water level readings are presented in Appendix 3.

4.2 GROUNDWATER

Groundwater was not encountered during the period of fieldwork or post fieldwork monitoring undertaken as part of the GES investigation.

It should be noted that groundwater levels may vary due to seasonal fluctuations in rainfall, but in the shorter term, can be affected by antecedent weather conditions or other causes.

5 LABORATORY TESTING

5.1 GEOTECHNICAL TESTING

The following range of laboratory tests were scheduled and the results are presented in Appendix 4.

i. Determination of Natural Moisture Content (2 no.).
ii. Determination of Atterberg Limits (2 no.).
iii. Determination of Particle Size Distribution (5 no.).
iv. Determination of pH (14 No.). See Appendix 5.
v. Determination of water soluble sulphate (14 No.). See Appendix 5.

5.2 VOC ANALYSIS

During the intrusive investigation, excavated soils were subjected to PID screening techniques in order to determine the presence of Volatile Organic Compounds (VOCs) and Semi-Volatile Organic Compounds (SVOCs) which is considered an appropriate screen for organic contamination.

Confirmatory soil samples were taken from all six window sample holes. Headspace analysis to determine VOC concentrations was carried out using a PID on all soil samples retrieved as part of this investigation.

The results of the screening indicated that VOC concentrations were below the detection limit of 10 ppm in all samples.

5.3 ANALYTICAL TESTING

Nine soil samples were selected and scheduled for chemical analysis which was undertaken by QTS Environmental Ltd. All soil samples were analysed for a general screening suite of contaminants considered appropriate to the current usage and past history of the site and surrounding area.

Toxic Metals	Phytotoxic Metals	Inorganic Compounds	Organic Compounds
Arsenic Cadmium Chromium Lead Mercury Nickel Selenium	Water Soluble Boron Copper Nickel Zinc	Water Soluble Sulphate pH Asbestos	Total Polyaromatic Hydrocarbons (PAH) Mineral oils Total Petroleum Hydrocarbons (TPH)

Soil samples were stored in appropriate containers as specified within BS10175. The containers comprised of 1 kg capacity plastic containers with fitted lids.

Where organic compounds were to be determined, inert containers, which prevent loss by absorption, or volatilization, i.e. wide-mouthed amber glass containers, were used.

Samples were stored in appropriately cooled cool boxes and were transported to the laboratory as quickly as possible in order to minimize any potential for chemical and biological changes to take place.

The results of the analytical testing are presented in Appendix 5.

6 GROUND CONDITIONS

The ground investigation found a layer of Topsoil/Made Ground overlying soils of the Folkestone Formation.

Topsoil/Made Ground

A layer of topsoil/made ground was encountered across the majority of the site.

The topsoil was encountered at depths between 0.05m and 0.4m and comprised a mid brown sand with fine rootlets.

The Made Ground comprised a variable mix of concrete slab, tarmac over broken red brick and hardcore, beige to dark brown sand with gravel of concrete, brick and flint. The Made Ground was found to depths ranging from 0.18m to 0.65m.

Folkestone Formation

Underlying the Made Ground at all test locations were soils typical of the Folkestone Formation. The soils encountered comprised predominantly non-cohesive soils comprising orange brown fine to medium sand. At the location of WS8 which was excavated at the southern end of the development area, towards the top of a small bank, a layer of soft sandy clay was found between 1.05m and 2.55m. Below 2.55m at this location were the predominant granular soils as found across the remainder of the site.

The base of the Folkestone Formation was not found at the window sample locations which were excavated to depths ranging between 3.0m and 5.0m.

Standard penetration tests carried out throughout the formation generally recorded N values in the range 11 to 39 (medium dense to dense soils) (see Figure 2). At the location of WS6 which was located in the vicinity of the underground fuel storage tank N values were significantly lower with N values in the range 4 to 13 (loose to medium dense) recorded to a depth of 5m. These lower values are likely the result of ground disturbance during construction of the UFST. A test carried out at a depth of 5.45m in WS6 resulted in only partial penetration with the hammer bouncing after a penetration of 75mm.

Classification testing on two samples of the more cohesive material found at the location of WS8 indicated clay soils of low plasticity with plasticity indices of 12% recorded in both samples. The soils are classified as having a low shrink/swell potential.

Particle Size Distribution testing recorded silty very sandy fine to medium gravel, slightly silty fine to medium sand and slightly silty fine to coarse sand. Silt/clay fractions ranged from 5.9% to 11.1%.

For preliminary design of shallow foundations founding the following values may be used for foundations placed in the granular soils of the Folkestone Formation:

SPT N Value N = 10 (medium dense)

Angle of Shearing Resistance Ø' = 30° – (for SPT N = 10 blows)

7 ENGINEERING DESIGN

7.1 OUTLINE FOUNDATION DESIGN

It was understood that the proposed redevelopment of the site would comprise the removal of existing warehouses and construction of a number of two-storey residential properties.

At the time of reporting, applied structural loads from the proposed development were unknown. For preliminary foundation design purposes a line load of 60kN/m run has been adopted.

In deliberation of suitable foundation options consideration was given to the geotechnical hazards and risks as presented below:

Geotechnical Hazard	Qualitative Risk & Consequences	Possible Risk Reduction Measures
Ground disturbance from existing underground structures such as service runs and old footings	**High** Implication for foundation depth and economic feasibility of shallow foundations.	New foundations to be constructed in undisturbed ground or alternatively disturbed ground to be removed and replaced with suitable engineering fill.
Variations in stiffness of ground below foundation depth that could give rise to unacceptable total and differential settlement.	**Medium** Large span buildings would be particularly sensitive to differential settlement. Would result in cracking of superstructure if conventional brickwork or brick cladding is used.	Calculate likely magnitude of settlement and determine if within acceptable tolerances. Make foundations act as reinforced beams.
Groundwater	**Low** Implication for temporary works due to perched water.	None required

Based on the results of the ground investigation consideration has been given to the use of shallow foundations founding in the Folkestone Formation.

Preliminary Design of Strip Foundations

For preliminary design purposes strip foundations founded within the sands of the Folkestone Formation will provide a suitable foundation solution for the proposed new structure on the site.

Given the ground conditions encountered near surface, it is recommended that a minimum foundation depth of 1.0m is adopted.

It should be noted that foundation depths would need to be increased in areas previously disturbed from the historical development of the site.

Other forms of disturbance that may affect founding depths are:

- the removal of trees
- the removal of disused services
- the relocation of existing services
- the removal of other underground obstructions

Allowable Bearing Pressures

Based on field observations, in situ testing and laboratory test results, a maximum allowable bearing of 120 kN/m^2 is recommended for foundations placed at a minimum depth of 1.0m and within the fine sands of the Folkestone Formation.

Foundation widths

Adopting a line load of 60 kN/m run a minimum practicable foundation width of 0.50m is recommended for foundations placed at a depth of 1.0m.

Settlement

For foundations placed at a minimum depth of 1.0m preliminary settlement calculations indicated total settlements would be less than 25mm approximately half of which would be immediate.

7.2 GROUND FLOORS

NHBC guidance advises that suspended ground floors should be adopted when the plasticity index (PI) of the founding soils is greater than 10%. In addition where the depth of fill would be greater than 600 m within a self-contained area, the floor construction over the whole of that area is required to be self-supporting and independent of the fill.

Based upon the results of this ground investigation and in the knowledge that the proposed new structures overlay the footprints of the existing buildings it is recommended that suspended ground floor slabs should be adopted.

7.3 TEMPORARY WORKS

Excavations in excess of 1.2 m depth will be required in connection with the proposed development on this site. If there is a requirement for personnel to enter into excavations, then the need for trench side support should be considered for any depth of excavation and, therefore, appropriate equipment should be available on site prior to excavation proceeding. A site specific risk assessment should be carried out where man entry into excavations is required.

The base of foundation excavations should be inspected and any soft loose, organic or otherwise deleterious material at foundation level removed and replaced with lean mix concrete. The soils encountered will be liable to softening/loosening when exposed to surface water infiltration. In order to avoid deterioration of the prepared formation the base of foundations should be blinded with concrete as soon as practical after excavation and particularly if there is delay before placing foundation concrete.

7.4 SOAKAWAYS

The results of the falling head testing carried out in the standpipes installed in WS1, WS3 and WS7 are presented in Appendix 2. The results indicated a good and very good soakage potential within the near surface geology with unfactored infiltration rates in the range of 1.74×10^{-3} to 1.78×10^{-4} m/s calculated.

Based on the results obtained the use of shallow soakaways discharging into soils of the Folkestone Formation would be a viable option for the disposal of surface water.

Should soakaways be considered as part of the development then irrespective of other considerations they should be sited at least 5m away from any foundations. The Environment Agency and Local Authority must be consulted when planning soakaway installations.

7.5 CHEMICAL ATTACK ON BURIED CONCRETE

The results of the chemical testing indicated a concentration of water-soluble sulphate in the near surface soils in the range between <10 and 28 mg/l as SO_4. pH values were slightly acidic to neutral with a range between 5.5 and 7.8 pH units.

In accordance with BRE Special Digest 1 (SD1:2005) entitled 'Concrete in Aggressive Ground' a design sulphate class for the site of DS-1 is recommended. Using SD1 an ACEC (Aggressive Chemical Environment for Concrete) class of AC1 is recommended.

8 GROUND CONTAMINATION ASSESSMENT

The current guidelines used for this contamination assessment are presented within Appendix 6.

The contaminant concentrations encountered as part of this investigation have been compared against Land Quality Management Generic Assessment Criteria (LQM GAC) for a residential (with home grown produce) development, or where available against newly published Category 4 Screening Levels (C4SLs) for a residential (with home grown produce) end use. Where neither guidelines have limit values, Contaminated Land Exposure Assessment (CLEA) framework guideline limit values have been assessed.

Category 4 Screening Levels (C4SLs) have currently been published for six substances as per the table below.

Substance	Residential (with home-grown produce)	Residential (without home-grown produce)	Allotments	Commercial	Public Open Space 1	Public Open Space 2
Arsenic	37	40	49	640	79	170
Benzene	0.87	3.3	0.18	98	140	230
Benzo(a)Pyrene	5.0	5.3	5.7	77	10	21
Cadmium	22	150	3.9	410	220	880
Chromium VI	21	21	170	49	21	250
Lead	200	310	80	2300	630	1300

All concentrations expressed in mg/kg

This table should be read in conjunction with the Final C4SL R&D Report

8.1 SOIL QUALITY

In terms of the proposed redevelopment of the site, the results of the analysis of the selected soil samples recovered during the site investigation indicated that the concentrations of *metals and metalloids* considered to be potentially toxic to humans were below their respective guideline values in all samples tested.

*Organic contamin*ation across the site was generally low and concentrations which may be considered to pose an unacceptable risk to human health should any viable pathway exist were not encountered.

Asbestos contamination was not encountered.

A comprehensive description of the soil quality as measured as part of the intrusive site investigation is given below.

8.1.1 **Toxic Metals**

Concentrations of toxic metals arsenic, cadmium, chromium, mercury, nickel, lead, selenium, and zinc were all below their respective soil guidance values for either a residential development with plant uptake under the CLEA/LQM GAC guidelines and the C4SL/S4USL guideline values for a residential end use with plant uptake where appropriate in all samples tested.

8.1.2 **Phytotoxic Metals**

Concentrations of phytotoxic metals copper, zinc and nickel were compared against the maximum permissible concentration in the Sewage Sludge (Use in Agriculture) Regulations 1989.

All concentrations for nickel, copper, and zinc were found to be below the maximum permissible concentration for the relevant pH level.

8.1.3 **Organic Compounds**

Polycyclic Aromatic Hydrocarbons (PAH)

Concentrations of PAH below the inert waste acceptance criteria of 100 mg/kg as detailed in the Landfill (England and Wales) (Amended) Regulations 2004.

Total PAH concentrations in excess of the 2 mg/kg UKWIR threshold value for water pipes to be used in brownfield sites were generally not exceeded across the site with the exception of locations WS6 (0.3m), WS7 (0.4m) and WS8 (0.3m) with a maximum concentration of 7.4mg/kg at location WS8 (0.3m).

Benzo(a)pyrene (B(a)P)

All B(a)P concentrations were consistently below the C4SL guideline limit value of 5mg/kg for a residential end use.

All other speciated PAH compounds were below their relevant guideline values.

Total Petroleum Hydrocarbons

Concentrations of TPH were generally low and below the inert waste acceptance criteria of 500 mg/kg as detailed within the Landfill (England and Wales) Regulations 2004 and also within the UK Water Industry Research (UKWIR) in all soil samples tested with the exception of location WS7 (0.4m) at 856 mg/kg.

Generic Assessment Criteria (GAC) for total petroleum hydrocarbons according to both their molecular weight and chemical structure and also for a range of soil organic matter (SOM) content values have been derived using CLEA software. The LQM CIEH GACs

are presented according to their soil organic matter content and proposed end use of the land.

Comparison of the measured TPH data with the worst-case scenario constituent compounds and their GAC limit values was made to provide a conservative assessment of the organic contamination. The maximum TPH concentration recorded on site during the site investigation was 856 mg/kg total TPH comprising of 489mg/kg within the C16-C21 range which is below the relevant GAC limit for aliphatic compounds based on a residential end use.

Therefore the TPH concentrations recorded across the site were below the relevant GAC limit for their respective range and would therefore not be considered to pose a significant risk of significant harm to human health.

8.1.4 **Asbestos**

No asbestos contamination was encountered in the samples tested.

8.2 SOIL GAS

A short-term gas monitoring programme was undertaken across the site between the 25th September and 11th October 2018.

During the visits, a soil vapour survey was undertaken across the site and comprised the monitoring of the atmosphere within the installed Window Sample Hole standpipes. Portable gas monitoring equipment (GA 5000) was used to monitor the standpipes for concentrations of carbon dioxide (CO_2), methane (CH_4) and oxygen (O_2)

For determining the gas protection measures which may be required in low rise buildings with a beam and block floor there is published guidance from the NHBC for use on residential developments which utilises a traffic light system of classification. For larger buildings the guidance in CIRIA 665 and BS8485 is used.

Reference has also been made to the British Standard Code of Practice BS8485:2015, *Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings* and regard has been given to the recommendations presented therein. The processes set out in BS8485 represent good practice and is based on the CIRIA C665 document.

In addition CIRIA document C735, *Good practice on the testing and verification of protection systems for buildings against hazardous ground gases* has also been referenced.

The results obtained from the short-term soil gas monitoring undertaken indicated that elevated concentrations of soil gas are not present in the soils underlying the site. The soil gas results are attached at Appendix 3.

Measurement of both borehole pressure and gas emission rates indicates that no significant gas flows are present. The maximum gas flow rate measured on site was <0.5 l/hr.

9 CONTAMINATION RISK ASSESSMENT

This risk assessment has been undertaken with due regard to the advice relating to groundwater as provided in the Environment Agency's "Methodology for the Derivation of Remedial Targets for Soil and Groundwater to Protect Water Resources", the advice provided in the Contaminated Land (England) Regulations 2000, and the associated statutory guidance. The guidance defines contaminated land as any land that is in such a condition that by reason of substances in, on or under the land:

- significant harm is being caused or there is a significant possibility of such harm being caused; or

- pollution of controlled water is being, or is likely to be caused.

This definition is based on the principles of risk assessment defined as a combination of the probability (or frequency) of occurrence of a defined hazard and the magnitude (including the seriousness) of the consequences. Central to the risk assessment process is the concept of pollutant linkage, that is a linkage between a contaminant and a receptor by means of a pathway.

Statutory definitions relating to pollution linkage.	
Contaminant	"a substance which is in, on or under the land and which has the potential to cause harm or to cause pollution of controlled waters."
Receptor	"a living organism, a group of living organisms, and ecological system or a piece of property" which meets given criteria. "controlled waters which are, or could be, polluted by a contaminant".
Pathway	"one or more routes or means by, or through, which a receptor: • is being exposed to, or affected by, a contaminant, or • could be so exposed or affected".

The relationship between these components is discussed below in order to identify the existence of any source-pathway-receptor linkage on the site, and hence the potential risks associated with any contamination.

This risk assessment is based on the proposed redevelopment of the site for a residential (with home grown produce) end use.

The significance of the risks to the receptors/targets identified is based on an evaluation of the potential pathways between the contaminant source and receptors based on the most sensitive end use, i.e. a residential end use.

Potential receptors/targets at the site and in the area in which the site is located include:

- future occupants and the general public;
- construction/maintenance workers;
- groundwater resources;
- underground services in and around the site;
- plants in any proposed soft landscaped areas.

9.1 CONTAMINANT SOURCES

The site currently consists of a variety of agricultural and residential buildings with the site having been used since 1850s. A number of buildings are given over to workshop and storage areas. Two above ground fuel storage tanks, a propane gas tank and an underground fuel storage tank were present on the site.

The land immediately surrounding the site is a mixture of agricultural use and residential housing.

As such, the following potential contaminant sources have been identified at the site and in the surrounding area:

Potential Source	Source Description	Principal Contaminants of Concern
Current and Historic Site Use	Workshop/agricultural use.	PAH, TPH, Metals
	Fuel storage.	PAH, TPH
	Hazardous materials used within existing on-site outbuildings.	ACM

No visual or olfactory evidence of organic contamination was noted during the intrusive investigations or noted in the detailed soil sampling logs. The analytical testing of soils retrieved as part of the intrusive investigation did not reveal any significantly elevated organic contaminant concentrations present above their respective guideline values. The risks associated with these contaminants are discussed below.

9.2 RISK TO HUMAN HEALTH

Toxic Metals

Concentrations of toxic metals arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc were all below their respective soil guidance values for a commercial end use in all samples tested in this site investigation, therefore the risks to human health from these contaminants is considered to be low.

Organic Compounds

Concentrations of PAH and TPH were all below their respective soil guidance values in all samples tested. Therefore, the risks posed to human health from these contaminants are considered to be low.

Inorganic Compounds

No asbestos was encountered within the samples obtained from the site investigation and therefore there is not considered to be a significant risk of significant harm to human health.

On the balance of the toxicological risks posed by the ground contamination encountered as part of the intrusive investigation undertaken by GES, it is considered that the potential risks to site workers and future occupants could be adequately controlled as follows:

Site Workers

- Provision of appropriate personal protective equipment and hygiene facilities.
- Provision of appropriate dust suppression, to minimise the generation of potentially contaminated suspended particulates during site works.

Future Occupants

Elevated levels of contaminants which could potentially pose a health risk to future occupants of the site were not identified during the intrusive investigation, therefore no further remedial works, in terms of contaminated soils, is required upon the site as part of the proposed development.

Proposed areas of soft landscaping may require the importation of suitable subsoil and topsoil as limited suitable growth media is currently present on site.

Typically, 150 mm topsoil over approximately 150 mm clean free draining subsoils would generally be considered sufficient. Where deep rooting shrubs / trees are proposed in any landscaping it may be necessary to locally deepen the soils to accommodate a healthy root bowl.

9.3 RISKS TO WATER RESOURCES

The site is underlain by a bedrock geology comprising of the Folkestone Formation which is designated as a Principal Aquifer. The site is not located within a groundwater source protection zone.

However, significant levels of potentially soluble and therefore mobile organic contaminant sources were not measured on site within the samples tested. It is therefore considered risks to groundwater resources are considered to be classed as low.

9.4 RISKS TO PLANTS

Significantly elevated concentrations of phytotoxic metals which could be considered harmful to plants were not encountered on site.

9.5 RISKS TO BUILDINGS & SERVICES

Elevated levels of organic contaminants were generally not detected at depths corresponding to likely service run depths across the site. The risk to services from contamination degrading pipes is considered low.

Given the low concentrations encountered, the need to protect incoming water supplies, e.g. by the use of barrier pipes, is considered unlikely.

However, it is always advisable that confirmation from utility suppliers should be sought.

9.6 GAS RISK ASSESSMENT

The levels of soil gas underlying the site have been monitored as part of a short-term soil gas monitoring programme carried out across the site between the 25th September and 11th October 2018. The results obtained from the soil gas survey indicate that elevated levels of soil gas, which may require gas protection measures to be incorporated into the development, are not present on site. Furthermore, significant biodegradable material was not encountered in any of the window sample holes excavated at the site.

The highest carbon dioxide concentration encountered on site during this current investigation was measured in WS7 at 1.4% which is below the relevant guideline limit of 5%. Methane concentrations were below the detection limit of the monitoring equipment and therefore well below the relevant guideline limit of 1%.

Measurement of both borehole pressure and gas emission rates indicates that no significant gas flows are present. The maximum gas flow rate measured on site was below 0.5 l/hr. In order to allow for a worst-case scenario, GES have used a gas flow rate across the site of 2.0 l/h in the following calculations. It should be noted that the maximum gas flow rate detected on site during the short-term gas monitoring was less than 0.5l/h which was measured directly with a low flow meter.

Based on BS 8485:2015 and C716, we have assessed the site based on the gas monitoring undertaken as part of the site investigation in order to calculate a Characteristic Gas Situation (CS).

Based on the worst-case gas characteristic situation, the worst case implied CS derived by combining the maximum observed concentrations from different window sample standpipes during any monitoring event and a worst-case flow rate of 2.0 l/h are as follows.

Flow Rate (l/h)	CH4 (%)	CO2 (%)	GSV – CH4 (l/h)	GSV – CO2 (l/h)	Implied CH4 CS	Implied CO2 CS
1.0	0.0	1.4	0.00	0.014	1	1

On the basis of the measurements in the table above, the GSV is taken to be 0.014 l/h, which is the worst case for methane and carbon dioxide. A GSV of 0.014 l/h lies within the GSV values for **CS1** (<0.07 l/h) which has a very low hazard potential.

BS 8485:2015 enables the minimum level gas protection (score) for the site or zones to be determined based on the determined CS and the type of proposed building. Given the proposed end use of the site, a high-risk Type A building has been used for calculating the appropriate gas protection score.

Given that the site has an implied CS1, the minimum gas protection score required for a Type A building is 0, which means that gas protection measures would not be required as part of the proposed development based on current gas concentrations.

9.7 WASTE DISPOSAL

Should an excess volume of soil be required to be disposed of off-site then a waste classification may be required.

For a waste classification to be undertaken, materials may need to be subjected to chemical testing which would give an indication to the contaminants present and, therefore those most toxic to the environment in the waste. Following the assessment of the waste as hazardous or non-hazardous waste acceptance criteria leachate testing allows the appropriate disposal pathway to a suitably licensed disposal facility to be further determined.

As a preliminary waste assessment and based on the results of materials tested to date, it is considered that the majority of any surplus soils requiring off-site disposal would be classified as EWC 17 05 04 non-hazardous and likely to be acceptable at a waste facility licenced to accept inert material.

Should any asbestos be encountered within the fabric of the existing buildings, it is considered likely that dedicated skips provided by a suitably licensed asbestos handling company would prove sufficient.

10 CONCEPTUAL SITE MODEL

A conceptual site model (CSM) is a system diagram identifying contaminant sources, routes of exposure (pathways), and which receptors are affected by contaminants moving along those pathways.

The model is produced to identify the zones of the site with different potential contaminations characteristics (e.g. whether contaminants in the soil are likely to be on the surface or at depth, distributed over an entire area or in localised 'hot spots').

The conceptual site model presented in the table below is based on the findings of the site investigation undertaken.

Source	Pollutant		Pathway	Hazard		Receptor	Observations/ Recommendations	Assessed Risk
Contaminated ground	Metals, organic (hydrocarbons) could be present	→	Direct contact, ingestion, inhalation.	Health risks including skin irritation.	→	Humans: site workers	Normal health and safety precautions. No significantly elevated contaminants encountered on site.	Low based on absence of any significant contamination within on-site soils
			Surface run off.	Lateral movement to surface watercourses.	→	Aquatic resources, ecology and subsequent users including humans.	Significant contamination not encountered on site and there are no surface water courses in immediate vicinity of the site.	Low
			Leaching/ Dispersion.	Downward migration to groundwater.	→	Aquatic resources – Groundwater, abstraction wells) / surface waters.	Significant contamination not present in soils.	Low
			Uptake by plants.	Phytotoxic effects.	→	Soft landscaped areas / plants.	Elevated contaminant concentrations not present in soils.	Low
			Direct contact	Aggressive chemical attack	→	Building structures and services	It is considered that protection of services, notably potable water, is not required on this site. To be advised by Statutory Providers.	Low
Liquid contaminant sources	Diesel, Petrol and Oils.	→	Direct contact; ingestion, inhalation.	Health risks including skin irritation. Lateral and vertical migration of contaminants.	→	Humans: site workers. Groundwater and surface water.	No significant mobile organic contamination identified on site.	Low

Source	Pollutant		Pathway	Hazard		Receptor	Observations/ Recommendations	Assessed Risk
Asbestos	Asbestos fibres within made ground, buildings, and waste on site	➔	Inhalation.	Health risks including asbestosis, mesothelioma, and lung cancer.	➔	Humans: site workers and future occupants.	Appropriate PPE should be worn during site works. No significant asbestos containing material encountered within soil samples retrieved from site	Low
Landfill, madeground,	Ground Gases (CO_2, CH_4)	➔	Inhalation and ingress into buildings	Asphyxiation and explosions	➔	Buildings/humans/ future site users	Elevated ground gases have not been noted on site. Gas protection measures are therefore not recommended in new development.	Low
Redundant Waste, Demolition Waste		➔	Dermal Contact/ingestion. Potential for migration via surface water run-off	Health Risks	➔	Humans: Site workers	Any unwanted waste on site is to be removed from site during site preparatory works and disposed of in accordance with current legislation. Normal health and safety precautions.	Low

11 CONCLUSIONS AND RECOMMENDATIONS

Based on the site investigation, intrusive works and subsequent data assessment, the following conclusions and recommendations have been drawn in respect of Foxbury Farm, Stone Street, Sevenoaks, TN15 0LW.

Geotechnical

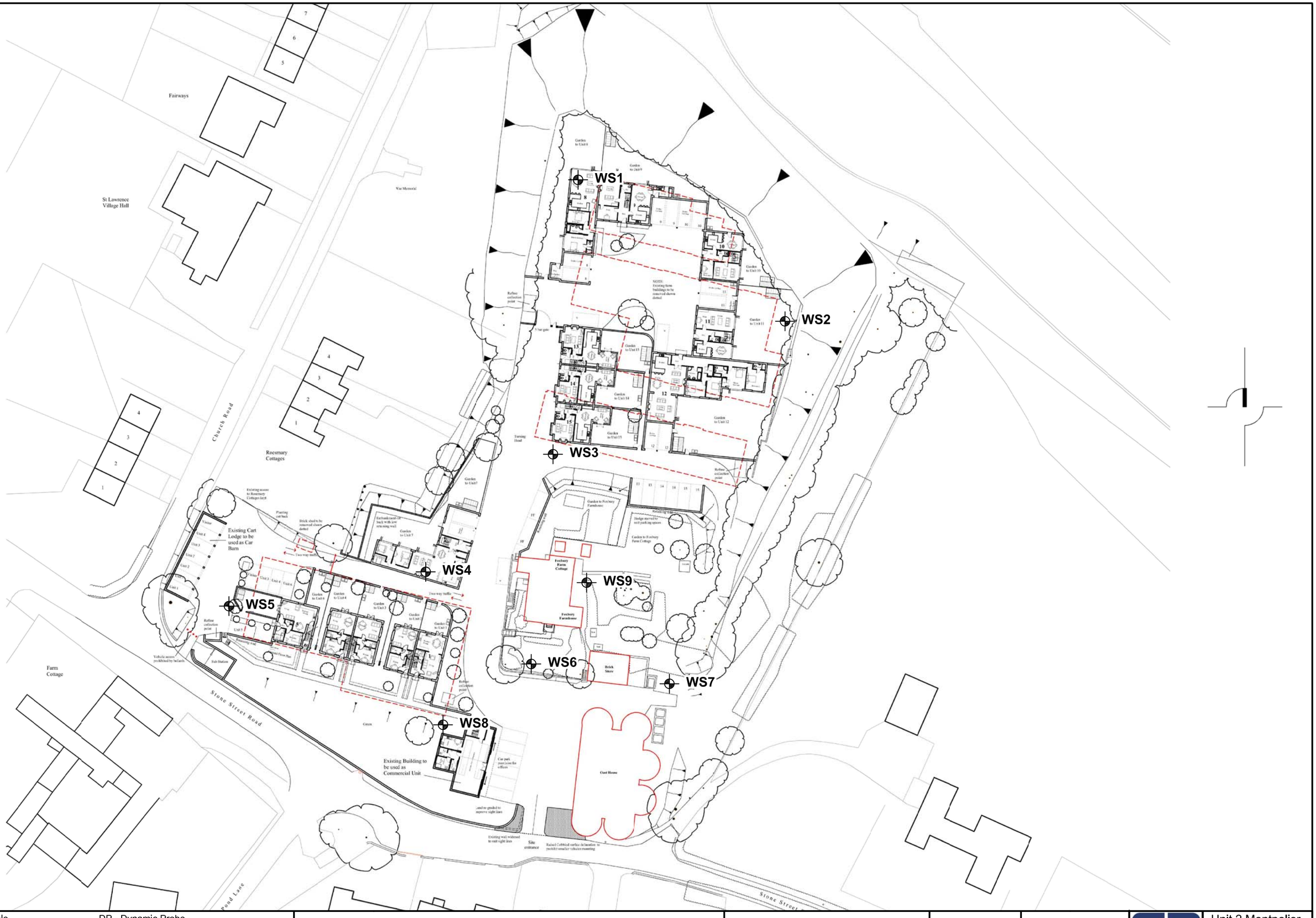
- The ground investigation generally found soils typical of the Folkestone Formation beneath a layer of Topsoil and Made Ground.
- It was understood that the proposed redevelopment of the site would comprise the construction of a number of two storey residential properties. Structural loads were unknown however for preliminary design purposes a line load of 60kN was adopted.
- A shallow foundation solution founding in the Folkestone Formation is recommended.
- The results of the falling head indicated that the use of shallow soakaways discharging into the Folkestone Formation would be a viable option for disposal of surface water.
- In accordance with BRE Special Digest 1 a design sulphate class for the site of DS-1 and an ACEC class of AC-1 is recommended.

Environmental

- The site is located above a Principal Aquifer within the bedrock geology comprising of the Folkestone Formation. The site is not located within an Environment Agency defined groundwater Source Protection Zone.
- No significant potential sources of contamination were identified on site on in the immediate vicinity.
- As part of the site investigation, concentrations of toxic metals were found to be below their respective soil guideline values and are therefore not considered to potentially pose a significant risk of significant harm to human health.
- No significant levels of mobile organic contamination were noted on site.
- No significantly elevated PAH concentrations, including Benzo(a)Pyrene were encountered within near surface soils from across the site and therefore these contaminants do not pose a significant risk of significant harm to human health.
- Asbestos Containing Material (ACM) was not identified with the soil samples retrieved. It is possible that ACM is present within the fabric of existing buildings which will need disposing of in line with current best practice.

- The risks posed to workers involved in any future redevelopment of the site are not considered significant providing standard health and hygiene practices are adopted.
- The protection of services, notably potable water, is unlikely to be required on this site. It is recommended that the advice of the service provider is sought confirming the most suitable options for the site.
- Based on gas monitoring results, the site has been given a classification of CS1 which has a very low hazard potential, based on BS 8485:2015, therefore it is not recommended that gas protection measures are incorporated into any new buildings constructed on the site.
- The risks to groundwater in the underlying Principal Aquifer are considered to be low due to the lack of any significant mobile organic contamination across the site.
- The majority of any surplus soil material to be removed off site is likely to be classified as non-hazardous and may be acceptable at a facility licensed to accept inert waste.

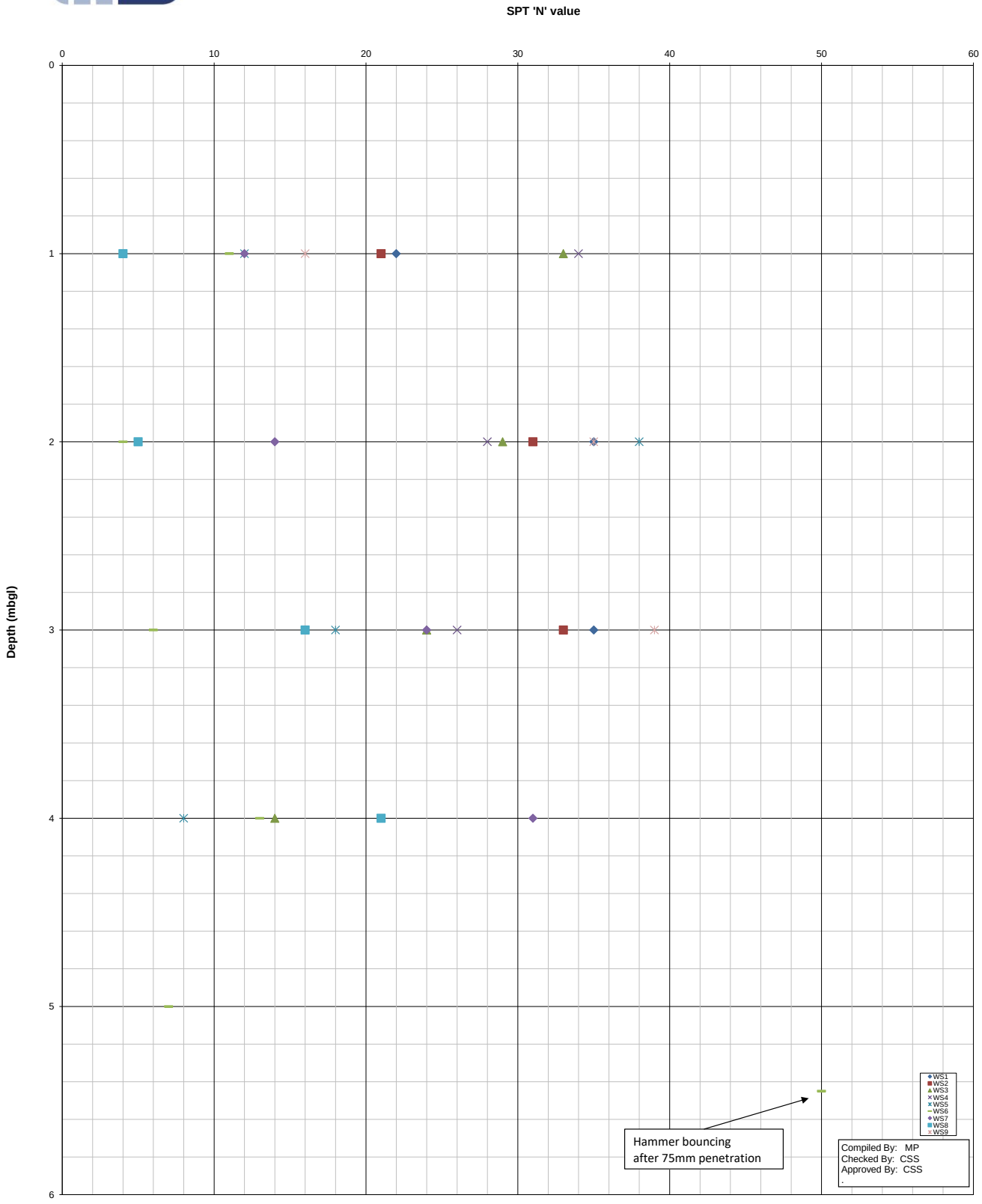
Based on the principles and definitions outlined under section 57 of the Environment Act 1995, the site would not be considered to be “Contaminated Land” based on its proposed residential redevelopment and following implementation of the above remedial measures.



WS - Window Sample	DP - Dynamic Probe
BH - Borehole	GM - Gas Monitoring Standpipe
TP - Trial Pit	SP - Soakage Pit
HDTP - Hand Dug Trial Pit	PT - Percolation Test
DCP - Dynamic Cone Penetration Test	S - Sample Location
HA - Hand Auger	

Site: Foxbury Farm, Stone Street Road, Sevenoaks	Client: Mr I Mitchell	Drawn: PJ	Rev.:	Unit 2 Montpelier Business Park, Dencora Way, Ashford, Kent TN23 4FG Tel: 01233 646 237
Title: FIgure 1. Exploratory Hole Location Plan	Project: 12044	Date: 09/2018	Scale:	

Figure 2: Foxbury Farm, Stone Street
SPT N-Depth Profile



APPENDIX 1

WINDOW SAMPLE LOGS AND INSTALLATION DETAILS

Ground and Environmental Services Limited

Unit 2 Montpelier Business Park Tel: 01233 646237
Dencora Way, Ashford
Kent TN23 4FG

Window
Sampler Log No. WS1
Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact _Backfill: 35mm Installation	Project Name: Foxbury Farm Project Location: Stone Street, Sevenoaks Client: Mr I Mitchell	Job No: 12044
Co-ordinates: E: N:	Ground Level (m):	Date Started:14-Sep-18 Date Completed:14-Sep-18

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
					Scrub over mid brown sandy TOPSOIL	-0.05		(0.05)
0.30		J TUB			Medium dense orange brown fine to medium SAND.			
0.70- 0.90		D						
			CN=22	2,5/5,5,6,6				
								(2.95)
1.70- 1.90		D						
			CN=35	4,6/8,9,9,9	...from 2.00 becoming dense			
2.70- 2.90		D						
			CN=35	5,8/8,9,9,9		-3.00		3.00

End of W/S 3.00 m
(Thickness of basal layer not proven)

Remarks:
Stability: Stable

Logged By:	Checked By:
MP	CSS
Scale: 1:30	Approved By:
FIG No.	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Ground and Environmental Services Limited
Unit 2 Montpelier Business Park
Dencora Way, Ashford
Kent TN23 4FG
T: 01233 646237

Hole ID. WS1

Installation Details & Readings

Sheet: 1 of 1

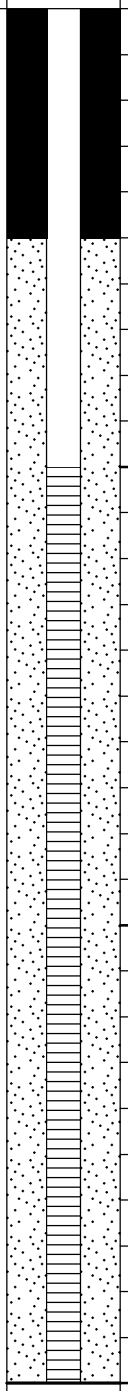
Equipment & Methods. Premier 110 Compact _Backfill: 35mm Installation	Project Name: Foxbury Farm Project Location: Stoen Street, Sevenoaks Client: Mr I Mitchell	Job No: 12044
Co-ordinates: E: N:	Ground Level (m):	Date Started:14-Sep-18 Date Completed:14-Sep-18

Installation Date :

Installation Type :

Depth to TOP Response Zone : (m)

Depth to BASE Response Zone : (m)



Installation Diagram	Depth Related Remarks (Elevation)
	Bentonite seal
	Plain pipe with gravel annulus
	Slotted standpipe with gravel annulus
	End of Hole 3.00 m

Compiled By:	Checked By:
MP	CSS
Scale:	Approved By:
FIG No.	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

GSG PIEZO/STANDPIPE LOG WS LOGS.GPJ GSG-AGS3-STD TEMPLATE.GDT 17-9-18

Ground and Environmental Services Limited

Unit 2 Montpelier Business Park Tel: 01233 646237
Dencora Way, Ashford
Kent TN23 4FG

Window
Sampler Log No. WS2
Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact _Backfill: Arisings	Project Name: Foxbury Farm Project Location: Stone Street, Sevenoaks Client: Mr I Mitchell	Job No: 12044
Co-ordinates: E: N:	Ground Level (m):	Date Started:14-Sep-18 Date Completed:14-Sep-18

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
					MADE GROUND. Concrete slab.	-0.18		(0.18)
0.30		J TUB			Medium dense orange brown fine to medium SAND.			0.18
0.70- 0.90		D						
			CN=21	2,4/5,5,5,6				
								(2.82)
1.70- 1.90		D						
			CN=31	2,6/7,8,8,8	...from 2.00 becoming dense			
2.70- 2.90		D						
			CN=33	4,7/8,9,8,8		-3.00		3.00

End of W/S 3.00 m
(Thickness of basal layer not proven)

Remarks:
Stability: Stable

Logged By: MP	Checked By: CSS
Scale: 1:30	Approved By:
FIG No.	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Ground and Environmental Services Limited
Unit 2 Montpelier Business Park Tel: 01233 646237
Dencora Way, Ashford
Kent TN23 4FG

Window
Sampler Log No. WS3
Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact _Backfill: 35mm Installation	Project Name: Foxbury Farm Project Location: Stone Street, Sevenoaks Client: Mr I Mitchell	Job No: 12044
Co-ordinates: E: N:	Ground Level (m):	Date Started:14-Sep-18 Date Completed:14-Sep-18

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
					TOPSOIL. Grass over mid brown sandy topsoil with frequent fine rootlets.	-0.05		(0.05)
0.30		J TUB			Dense orange brown fine to medium SAND			
0.80- 0.90		D	CN=33	4,6/8,9,8,8				
1.80- 2.00		D	CN=29	5,6/6,7,8,8	...from 2.00 becoming medium dense			(3.95)
2.70- 2.90		D	CN=24	5,6/7,7,6,4				
3.70- 3.90		D	CN=14	3,2/3,4,3,4		-4.00		4.00
					End of W/S 4.00 m (Thickness of basal layer not proven)			

Remarks:
Stability: Stable

Logged By:	Checked By:
MP	CSS
Scale: 1:30	Approved By:
FIG No.	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Ground and Environmental Services Limited
Unit 2 Montpelier Business Park
Dencora Way, Ashford
Kent TN23 4FG
T: 01233 646237

Hole ID. WS3

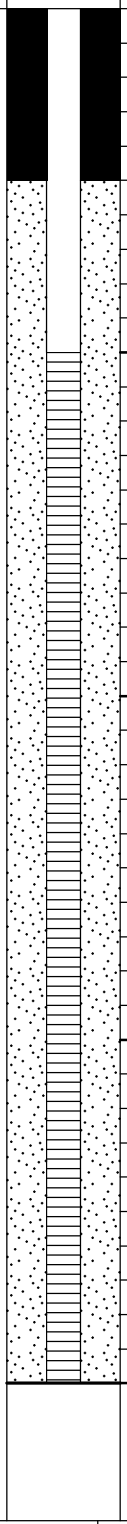
Installation Details & Readings

Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact _Backfill: 35mm Installation	Project Name: Foxbury Farm Project Location: Stoen Street, Sevenoaks Client: Mr I Mitchell	Job No: 12044
Co-ordinates: E: N:	Ground Level (m):	Date Started:14-Sep-18 Date Completed:14-Sep-18

Installation Date : 14-Sep-18
Installation Type : SP

Depth to TOP Response Zone : 1 (m)
Depth to BASE Response Zone : 4 (m)



Depth	Depth Related Remarks (Elevation)
	Bentonite seal
0.5	
	Plain pipe with gravel annulus
1	(-1.00)
	Slotted standpipe with gravel annulus
	End of Hole 4.00 m
	(-4.00)

Compiled By:	Checked By:
MP	CSS
Scale:	Approved By:
FIG No.	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

GSG PIEZO/STANDPIPE LOG WS LOGS.GPJ GSG-AGS3-STD TEMPLATE.GDT 17-9-18

Ground and Environmental Services Limited

Unit 2 Montpelier Business Park Tel: 01233 646237
Dencora Way, Ashford
Kent TN23 4FG

Window
Sampler Log No. WS4
Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact _Backfill: Arisings	Project Name: Foxbury Farm Project Location: Stone Street, Sevenoaks Client: Mr I Mitchell	Job No: 12044
Co-ordinates: E: N:	Ground Level (m):	Date Started:14-Sep-18 Date Completed:14-Sep-18

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
0.30		J TUB			Grass over dense orange brown fine to medium SAND.			
0.70- 0.90		D	CN=34	3,5/7,9,9,9				(2.50)
1.70- 1.90		D	CN=28	5,7/8,6,7,7	...from 2.00 becoming medium dense			
					Medium dense beige to light orange brown medium to coarse SAND.	-2.50		2.50
2.70- 2.90		D	CN=26	4,4/5,7,7,7				(0.50)
						-3.00		3.00

End of W/S 3.00 m
(Thickness of basal layer not proven)

Remarks:
Stability: Stable

Logged By: MP	Checked By: CSS
Scale: 1:30	Approved By:
FIG No.	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Ground and Environmental Services Limited

Unit 2 Montpelier Business Park Tel: 01233 646237
Dencora Way, Ashford
Kent TN23 4FG

Window
Sampler Log No. WS5
Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact _Backfill: Arisings	Project Name: Foxbury Farm Project Location: Stone Street, Sevenoaks Client: Mr I Mitchell	Job No: 12044
Co-ordinates: E: N:	Ground Level (m):	Date Started:14-Sep-18 Date Completed:14-Sep-18

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
					Grass over mid brown silty TOPSOIL with frequent fine rootlets.			(0.40)
						-0.40		0.40
0.50		J TUB			Medium dense light brown fine SAND with occasional coarse subangular to angular sandstone gravel.			
0.70- 0.90		D						(0.80)
			CN=12	3,4/4,2,3,3				
						-1.20		1.20
					Dense orange brown medium to coarse SAND with occasional medium to coarse sandstone gravel.			
1.70- 1.90		D						(1.30)
			CN=38	8,12/11,11,9,7				
						-2.50		2.50
					Medium dense orange brown fine to medium SAND.			
2.70- 2.90		D						(1.50)
			CN=18	3,5/5,5,4,4				
3.70- 3.90		D						
			CN=8	1,2/2,2,2,2	...from 3.80 becoming loose	-4.00		4.00

End of W/S 4.00 m
(Thickness of basal layer not proven)

Remarks:
Stability: Stable

Logged By: MP	Checked By: CSS
Scale: 1:30	Approved By:
FIG No.	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Ground and Environmental Services Limited

Unit 2 Montpelier Business Park Tel: 01233 646237
Dencora Way, Ashford
Kent TN23 4FG

Window
Sampler Log No. WS6

Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact _Backfill: Arisings	Project Name: Foxbury Farm Project Location: Stone Street, Sevenoaks Client: Mr I Mitchell	Job No: 12044
Co-ordinates: E: N:	Ground Level (m):	Date Started:14-Sep-18 Date Completed:14-Sep-18

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
					MADEGROUND. Tarmac over hardcore of red brick and Type 1.			(0.20)
						-0.20		0.20
0.30		J TUB			Firm reddish brown sandy CLAY.			
0.70- 0.90		D						(0.90)
			CN=11	1,2/3,3,2,2,3				
						-1.10		1.10
					Medium dense orange brown fine to medium SAND.			
1.70- 1.90		D						(1.40)
			CN=4	1,1/1,1,1,1				
					...from 2.00 becoming loose			
						-2.50		2.50
					Loose yellow brown fine to medium SAND.			
2.70- 2.90		D						(0.70)
			CN=6	1,1/2,1,2,1				
						-3.20		3.20
					Loose to medium dense orange brown SAND.			
3.70- 3.90		D						(1.80)
			CN=13	2,4/3,4,3,3				
4.70- 4.90		D						
			CN=7	2,2/2,1,1,1		-5.00		5.00
			C	4,-/-,-,-,-				
				Hammer bouncing after 75mm.				

End of W/S 5.00 m
(Thickness of basal layer not proven)

Remarks:
Stability: Stable

Logged By:	Checked By:
MP	CSS
Scale: 1:30	Approved By:
FIG No.	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Ground and Environmental Services Limited

Unit 2 Montpelier Business Park Tel: 01233 646237
Dencora Way, Ashford
Kent TN23 4FG

Window
Sampler Log No. WS7
Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact _Backfill: 35mm Installation	Project Name: Foxbury Farm Project Location: Stone Street, Sevenoaks Client: Mr I Mitchell	Job No: 12044
Co-ordinates: E: N:	Ground Level (m):	Date Started:14-Sep-18 Date Completed:14-Sep-18

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
					MADEGROUND. Beige to dark brown sand and gravel of broken yellow brick.	-0.20		(0.20)
0.40		J TUB			MADEGROUND. Dark orange brown moist fine to medium SAND.			0.20 (0.40)
0.70- 0.90		D			Medium dense orange brown fine to medium SAND.	-0.60		0.60
			CN=12	2,3/2,3,3,4				
1.70- 1.90		D						
			CN=14	2,4/4,3,3,4				(3.40)
2.70- 2.90		D						
			CN=24	4,4/5,7,6,6				
3.70- 3.90		D						
			CN=31	3,3/5,9,9,8	...from 3.80 becomes dense	-4.00		4.00
					End of W/S 4.00 m (Thickness of basal layer not proven)			

Remarks:
Stability: Stable

Logged By:	Checked By:
MP	CSS
Scale: 1:30	Approved By:
FIG No.	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Ground and Environmental Services Limited

Unit 2 Montpelier Business Park Tel: 01233 646237
Dencora Way, Ashford
Kent TN23 4FG

Window
Sampler Log No. WS8
Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact _Backfill: 35mm Installation	Project Name: Foxbury Farm Project Location: Stone Street, Sevenoaks Client: Mr I Mitchell	Job No: 12044
Co-ordinates: E: N:	Ground Level (m):	Date Started:14-Sep-18 Date Completed:14-Sep-18

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
0.30		J TUB			MADEGROUND. Overgrown grass over dark brown slightly gravelly fine to medium sand with occasional fine roots. Gravel is subangular to angular fine to coarse comprising concrete, brick and flint.			(0.65)
						-0.65		0.65
0.80- 1.00		D			Loose brown fine to medium SAND.			(0.40)
			CN=4	1,1/1,1,1,1		-1.05		1.05
1.50- 1.60		D			Soft brown very sandy CLAY. Sand is fine to medium.			(1.50)
			CN=5	1,1/1,2,1,1				
2.30- 2.50		D						
						-2.55		2.55
					Medium dense orange brown fine to medium SAND.			(1.45)
			CN=16	3,3/3,4,4,5				
3.00- 4.00		D						
			CN=21	3,5/5,5,5,6		-4.00		4.00

End of W/S 4.00 m
(Thickness of basal layer not proven)

Remarks:
Stability: Stable

Logged By:	Checked By:
MP	CSS
Scale: 1:30	Approved By:
FIG No.	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Ground and Environmental Services Limited
Unit 2 Montpelier Business Park
Dencora Way, Ashford
Kent TN23 4FG
T: 01233 646237

Hole ID. WS7

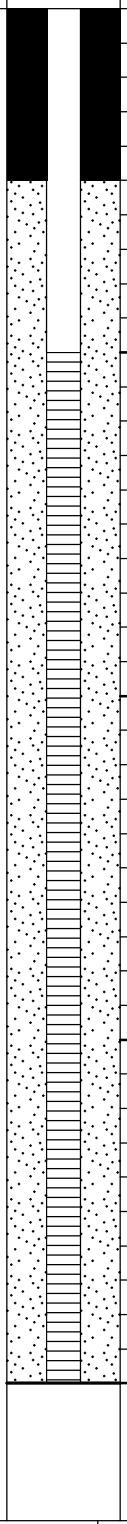
Installation Details & Readings

Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact _Backfill: 35mm Installation	Project Name: Foxbury Farm Project Location: Stoen Street, Sevenoaks Client: Mr I Mitchell	Job No: 12044
Co-ordinates: E: N:	Ground Level (m):	Date Started:14-Sep-18 Date Completed:14-Sep-18

Installation Date : 14-Sep-18
Installation Type : SP

Depth to TOP Response Zone : 1 (m)
Depth to BASE Response Zone : 2 (m)



Depth	Installation Diagram	Depth Related Remarks (Elevation)
		Bentonite seal
0.5		
		Plain pipe with gravel annulus
1		(-1.00)
		(-2.00)
		Slotted standpipe with gravel annulus
		End of Hole 4.00 m

Compiled By:	Checked By:
MP	CSS
Scale:	Approved By:
FIG No.	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

GSG PIEZO/STANDPIPE LOG WS LOGS.GPJ GSG-AGS3-STD TEMPLATE.GDT 17-9-18

Ground and Environmental Services Limited

Unit 2 Montpelier Business Park Tel: 01233 646237
Dencora Way, Ashford
Kent TN23 4FG

Window
Sampler Log No. WS9
Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact _Backfill: Arisings	Project Name: Foxbury Farm Project Location: Stone Street, Sevenoaks Client: Mr I Mitchell	Job No: 12044
Co-ordinates: E: N:	Ground Level (m):	Date Started:14-Sep-18 Date Completed:14-Sep-18

Samples and In situ Testing				Field Records	DESCRIPTION	Reduced Level (m)	Legend	Depth (Thick) (m)
Depth (m)	No.	Type	Result					
					Grass over dark brown fine to coarse sandy TOPSOIL.	-0.15		(0.15) 0.15
0.30- 0.40		J TUB			Medium dense orange brown fine to medium SAND.			
0.70- 0.90		D	CN=16	2,2/3,4,4,5				(2.85)
1.70- 1.90		D	CN=35	5,7/8,10,8,9	...from 2.00 becomes dense.			
2.70- 2.90		D	CN=39	7,8/9,11,10,9		-3.00		3.00

End of W/S 3.00 m
(Thickness of basal layer not proven)

Remarks:
Stability: Stable

Logged By:	Checked By:
MP	CSS
Scale: 1:30	Approved By:
FIG No.	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

Ground and Environmental Services Limited
Unit 2 Montpelier Business Park
Dencora Way, Ashford
Kent TN23 4FG
T: 01233 646237

Hole ID. WS8

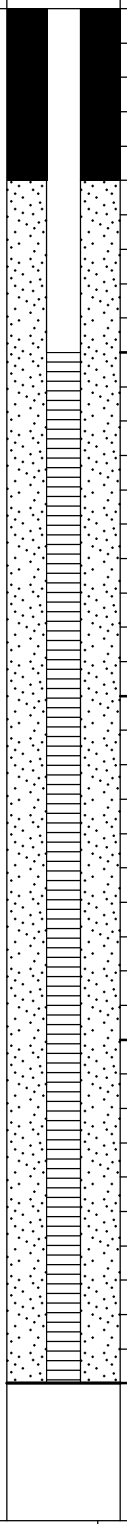
Installation Details & Readings

Sheet: 1 of 1

Equipment & Methods. Premier 110 Compact _Backfill: 35mm Installation	Project Name: Foxbury Farm Project Location: Stoen Street, Sevenoaks Client: Mr I Mitchell	Job No: 12044
Co-ordinates: E: N:	Ground Level (m):	Date Started:14-Sep-18 Date Completed:14-Sep-18

Installation Date : 14-Sep-18
Installation Type : SP

Depth to TOP Response Zone : 1 (m)
Depth to BASE Response Zone : 4 (m)



Depth	Depth Related Remarks (Elevation)
	Bentonite seal
0.5	
	Plain pipe with gravel annulus
1	(-1.00)
	Slotted standpipe with gravel annulus
	End of Hole 4.00 m
	(-4.00)

Compiled By:	Checked By:
MP	CSS
Scale:	Approved By:
FIG No.	

Notes: For explanation of symbols and abbreviations, see Key Sheet.

GSG PIEZO/STANDPIPE LOG WS LOGS.GPJ GSG-AGS3-STD TEMPLATE.GDT 17-9-18

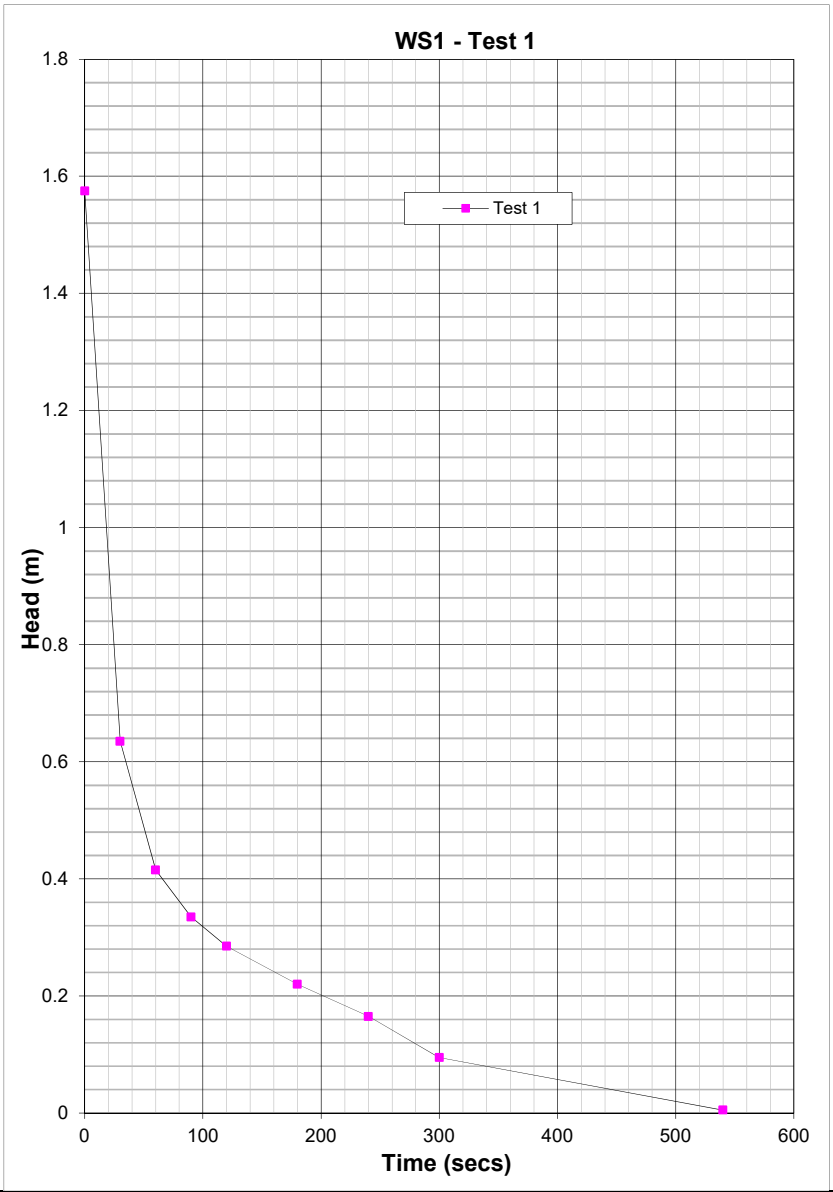
APPENDIX 2

FALLING HEAD SOAKAGE TEST RESULTS

Foxbury Farm Stone Street, Sevenoaks | **WS1**

Top section	0.5	m	Centre section	1.9375	m	Diameter of Hole	0.035	m
Bottom section	3.375	m	Diameter of test section	0.035	m	Length of test section	2.875	m
Water level	3.375	m						

Time (Seconds)	Depth	Head
0	1.8	1.575
30	2.74	0.635
60	2.96	0.415
90	3.04	0.335
120	3.09	0.285
180	3.155	0.22
240	3.21	0.165
300	3.28	0.095
540	3.37	0.005



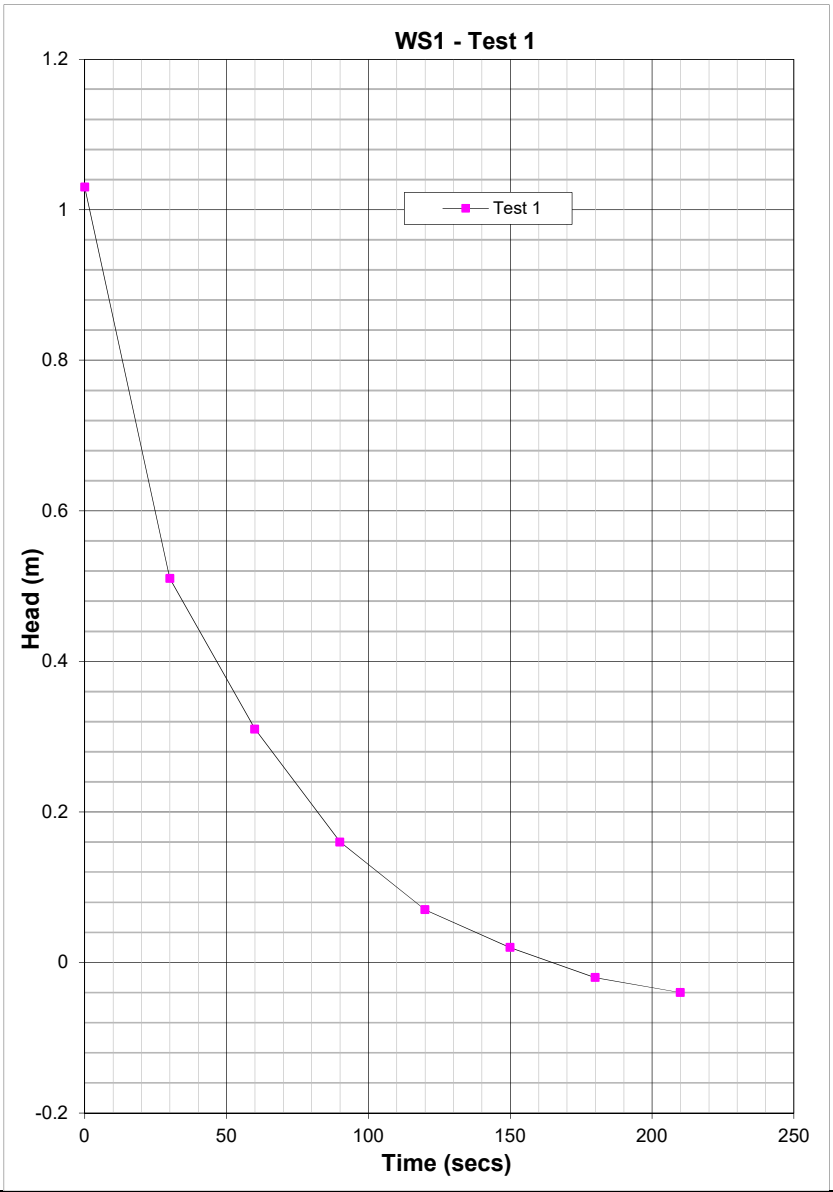
VERY GOOD SOAKAGE - Approx 25l water added in 40 secs

After BS5930:2015 k(approx) =1.74 x 10^{-3} m/s

Foxbury Farm Stone Street, Sevenoaks | **WS3**

Top section	1	m	Centre section	2.5	m	Diameter of Hole	0.035	m
Bottom section	4	m	Diameter of test section	0.035	m	Length of test section	3	m
Water level	4	m						

Time (Seconds)	Depth	Head
0	2.97	1.03
30	3.49	0.51
60	3.69	0.31
90	3.84	0.16
120	3.93	0.07
150	3.98	0.02
180	4.02	-0.02
210	4.04	-0.04



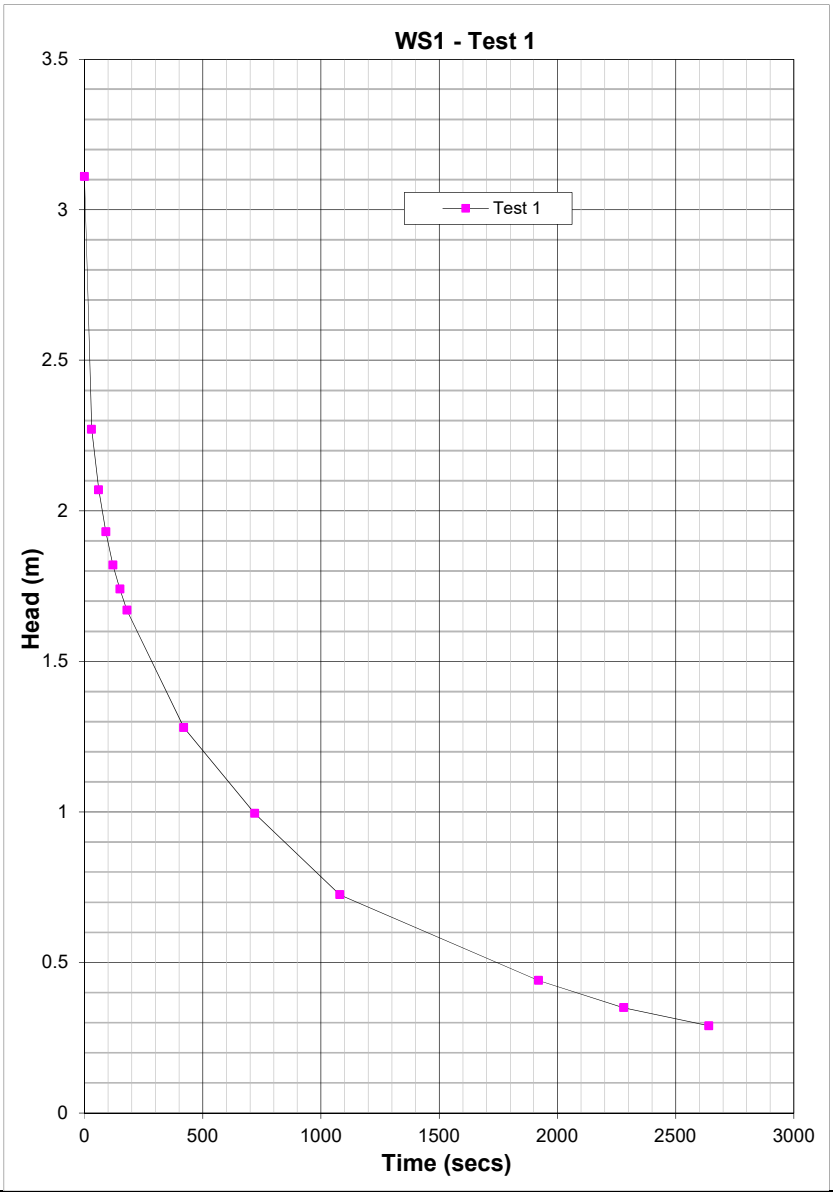
VERY GOOD SOAKAGE - Approx 25l water added in 40 secs

After BS5930:2015 **k(approx) = 1.75 x 10^{-3} m/s**

Foxbury Farm Stone Street, Sevenoaks | **WS7**

Top section	0.8	m	Centre section	2.4	m	Diameter of Hole	0.035	m
Bottom section	4	m	Diameter of test section	0.035	m	Length of test section	3.2	m
Water level	4	m						

Time (Seconds)	Depth	Head
0	0.89	3.11
30	1.73	2.27
60	1.93	2.07
90	2.07	1.93
120	2.18	1.82
150	2.26	1.74
180	2.33	1.67
420	2.72	1.28
720	3.005	0.995
1080	3.275	0.725
1920	3.56	0.44
2280	3.65	0.35
2640	3.71	0.29



GOOD SOAKAGE - Approx 25l water added in 40 secs

After BS5930:2015 **k(approx) = 1.78 X 10^{-4} m/s**

APPENDIX 3

SOIL GAS MONITORING RESULTS

SOIL GAS SURVEY

Project:	Foxbury Farm	Date:	25-09-18
Location:	Stone Street, Sevenoaks	Weather:	Clear blue sky
Job No.	12044	Temp:	8ºC

Equipment Used: GA 5000 and dipmeter

Monitoring Point No.	Time	O2 (% v/v)	CO2 (% v/v)	CH4 (% v/v)	H2S (PPM)	CO (PPM)	PID (PPM)	Flow (l/hr)	Water (mbgl)
WS1	8:20	20.4	0.3	0	0	0	NR	0	DRY
WS 3	7:55	20.3	0.7	0	0	0	NR	0	DRY
WS 7	8:45	20.2	1.4	0	0	0	NR	0	DRY
WS 8	9:05	20.2	0.9	0	0	0	NR	0	DRY

Site Observations/ Comments	
Time	Barometric Pressure
7:55	1019 mbar
Datum:	

NR - Not Recorded

Tested by: STP

Checked by: CSS

Ground and Environmental Services Limited

Accuracy and range of Gas Analyser 5000 (GA5000)

Gas	Accuracy: Gas Concentrations 0-5%	5-15%	0-FS	Range
CH_4	+/-0.5%	+/-3%		0-70% to specification, 0-100% reading
CO_2	+/-0.5%	+/-3%		0-40% to specification, 0-100% reading
O_2	+/-1%	+/-1%		0-25%
CO			+/-10%FS	0-500ppm
H_2S			+/-10%FS	0-200ppm
B.P.	+/- 5 mBar			700-1200 mBar
Flow:				

Notes:

CH4: methane in percent volume per volume (% v/v)

CO2: carbon dioxide in %v/v

O2: oxygen in % v/v

H2S: hydrogen sulphide in part per million (ppm)

CO: carbon monoxide in ppm

B.P.: Barometric pressure in mBar

Flow: Gas flow in litre per hour (l/h)

SOIL GAS SURVEY

Project:	Foxbury Farm	Date:	05-10-18	Equipment Used:	GA 5000 and dipmeter
Location:	Stone Street, Sevenoaks	Weather:	Clear blue sky		
Job No.	12044	Temp:	18°C		

Monitoring Point No.	Time	O2 (% v/v)	CO2 (% v/v)	CH4 (% v/v)	H2S (PPM)	CO (PPM)	PID (PPM)	Flow (l/hr)	Water (mbgl)
WS1		20.5	0.2	0	0	0	NR	0	DRY
WS 3		20.4	0.5	0	0	0	NR	0	DRY
WS 7		19.9	1.2	0	0	0	NR	0	DRY
WS 8		20.3	0.8	0	0	0	NR	0	DRY

Site Observations/ Comments	
	Barometric Pressure
Time	
12:00	1012 mbar
Datum:	

NR - Not Recorded

Tested by: MP

Checked by: CSS

Ground and Environmental Services Limited

Accuracy and range of Gas Analyser 5000 (GA5000)

Accuracy				Range
Gas	Gas Concentrations			
	0-5%	5-15%	0-FS	
CH_4	+/-0.5%	+/-3%		0-70% to specification, 0-100% reading
CO_2	+/-0.5%	+/-3%		0-40% to specification, 0-100% reading
O_2	+/-1%	+/-1%		0-25%
CO			+/-10%FS	0-500ppm
H_2S			+/-10%FS	0-200ppm
B.P.	+/- 5 mBar			700-1200 mBar
Flow:				

Notes:

CH4: methane in percent volume per volume (% v/v)

CO2: carbon dioxide in %v/v

O2: oxygen in % v/v

H2S: hydrogen sulphide in part per million (ppm)

CO: carbon monoxide in ppm

B.P.: Barometric pressure in mBar

Flow: Gas flow in litre per hour (l/h)

SOIL GAS SURVEY

Project:	Foxbury Farm	Date:	11-10-18	Equipment Used:	GA 5000 and dipmeter
Location:	Stone Street, Sevenoaks	Weather:	Overcast		
Job No.	12044	Temp:	10ºC		

Monitoring Point No.	Time	O2 (% v/v)	CO2 (% v/v)	CH4 (% v/v)	H2S (PPM)	CO (PPM)	PID (PPM)	Flow (l/hr)	Water (mbgl)
WS1	8:50	20.1	0.6	0	0	0	NR	0	DRY
WS 3	9:02	19.8	1.1	0	0	0	NR	0	DRY
WS 7	9:19	18.0	3.1	0	0	0	NR	0	DRY
WS 8	9:10	19.4	1.1	0	0	0	NR	0	DRY

Site Observations/ Comments

Time	Barometric Pressure
8:50	986 mbar

Datum:

NR - Not Recorded

Tested by: STP

Checked by: CSS

Ground and Environmental Services Limited

Accuracy and range of Gas Analyser 5000 (GA5000)

Gas	Accuracy: Gas Concentrations 0-5%	5-15%	0-FS	Range
CH_4	+/-0.5%	+/-3%		0-70% to specification, 0-100% reading
CO_2	+/-0.5%	+/-3%		0-40% to specification, 0-100% reading
O_2	+/-1%	+/-1%		0-25%
CO			+/-10%FS	0-500ppm
H_2S			+/-10%FS	0-200ppm
B.P.	+/- 5 mBar			700-1200 mBar
Flow:				

Notes:

CH4: methane in percent volume per volume (% v/v)

CO2: carbon dioxide in %v/v

O2: oxygen in % v/v

H2S: hydrogen sulphide in part per million (ppm)

CO: carbon monoxide in ppm

B.P.: Barometric pressure in mBar

Flow: Gas flow in litre per hour (l/h)

APPENDIX 4

LABORATORY TEST RESULTS

Ground and Environmental Services Limited
Unit 2 Montpelier Business Park
Dencora Way
Ashford
Kent
TN23 4FG

www.genvs.com
E: info@genvs.com
T: 01233 646237

Client: Mr. I Watson **Project No:** 12044

Site: Foxbury Farm, Sevenoaks **Date** 19/09/2018

Date Received: 17/09/2018

Date Tested: 18/09/2018

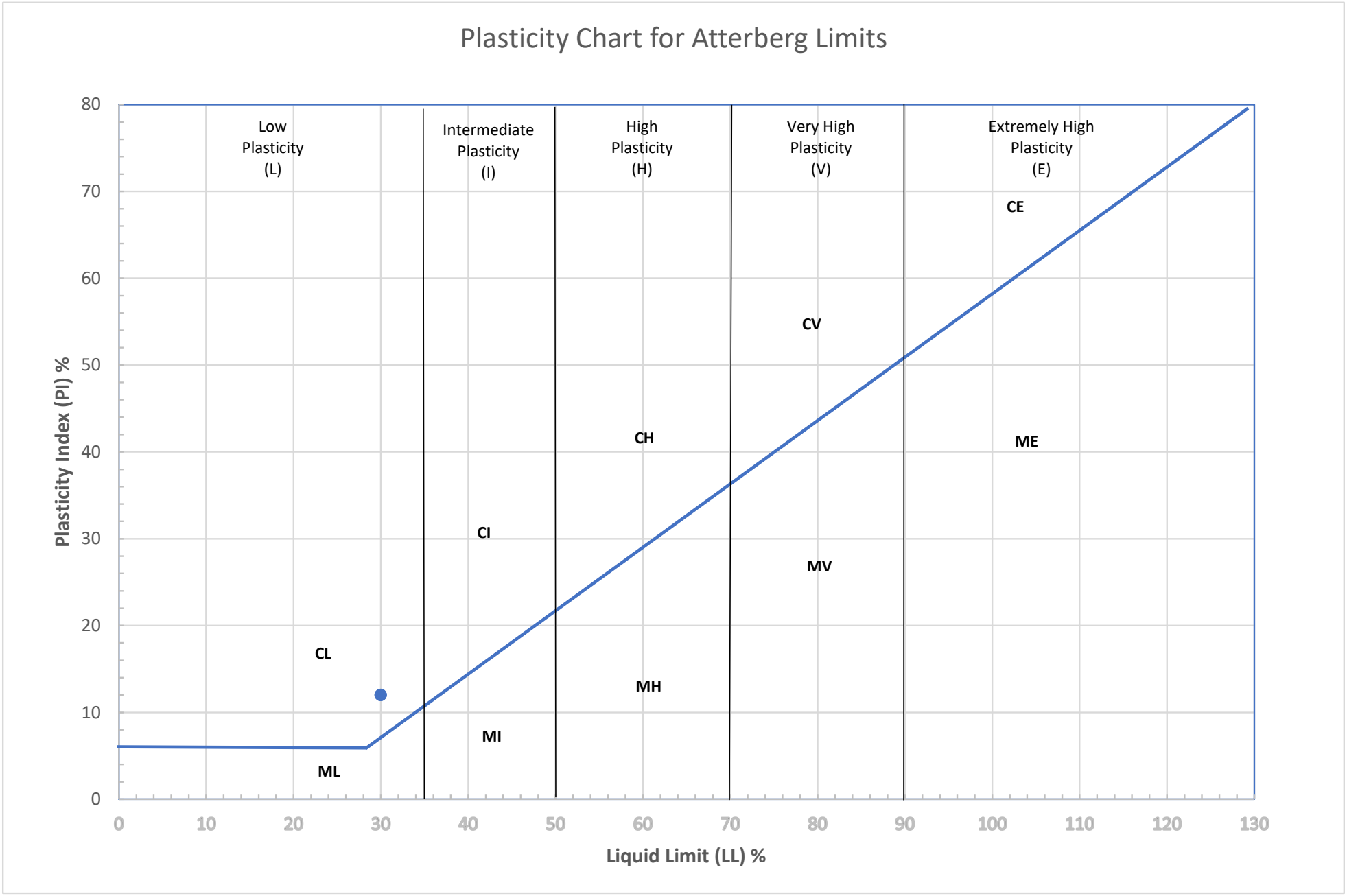
Test Results

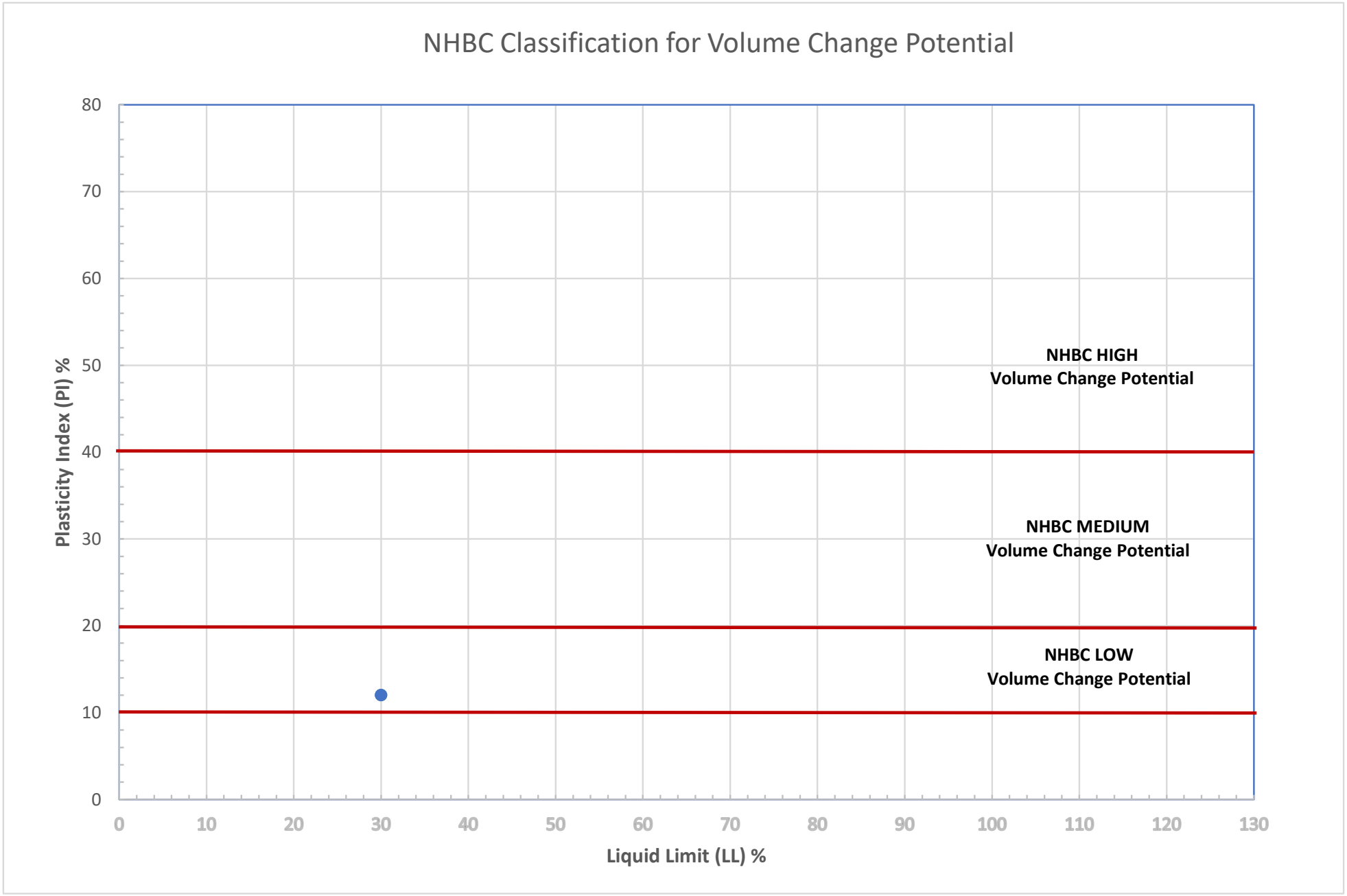
Location ID	Depth (m)	MC (%)	LL (%)	PL (%)	PI (%)	% passing 425 µm sieve	Classification	Sample type
WS 8	1.5-1.6	20	30	18	12	100	CL	D
WS 8	2.3-2.5	22	30	18	12	98	CL	D

Visual Descriptions

Location ID	Depth	Description
WS 8	1.5-1.6	Brown very sandy CLAY
WS 8	2.3-2.5	Brown very sandy CLAY

Tested by: STP Checked by: CSS Approved by: CSS

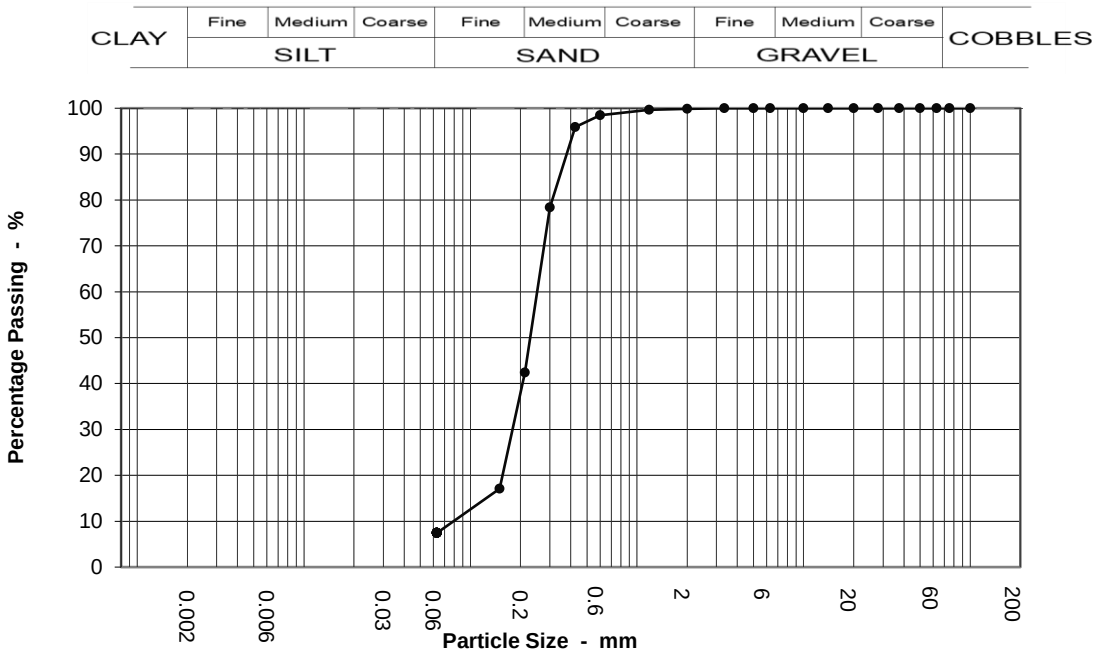

Plasticity Chart for Atterberg Limits
Low Plasticity (L)
Intermediate Plasticity (I)
High Plasticity (H)
Very High Plasticity (V)
Extremely High Plasticity (E)
CE
CV
CH
ME
CI
MV
CL
MH
MI
ML
Plasticity Index (PI) %
Liquid Limit (LL) %
0
10
20
30
40
50
60
70
80
90
100
110
120
130


NHBC Classification for Volume Change Potential
Plasticity Index (PI) %
Liquid Limit (LL) %
0
10
20
30
40
50
60
70
80
90
100
110
120
130
NHBC HIGH
Volume Change Potential
NHBC MEDIUM
Volume Change Potential
NHBC LOW
Volume Change Potential

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**12044**
		Borehole / Pit No	WS 1
Project	**Foxbury Farm, Sevenoaks**	Sample No	
		Depth	1.7-1.9 m
Soil Description	Light orange brown slightly silty fine to medium SAND	Sample type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	99		
0.425	96		
0.3	78		
0.212	42		
0.15	17		
0.063	7		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	0.1
Sand	92.4
Silt & Clay	7.5

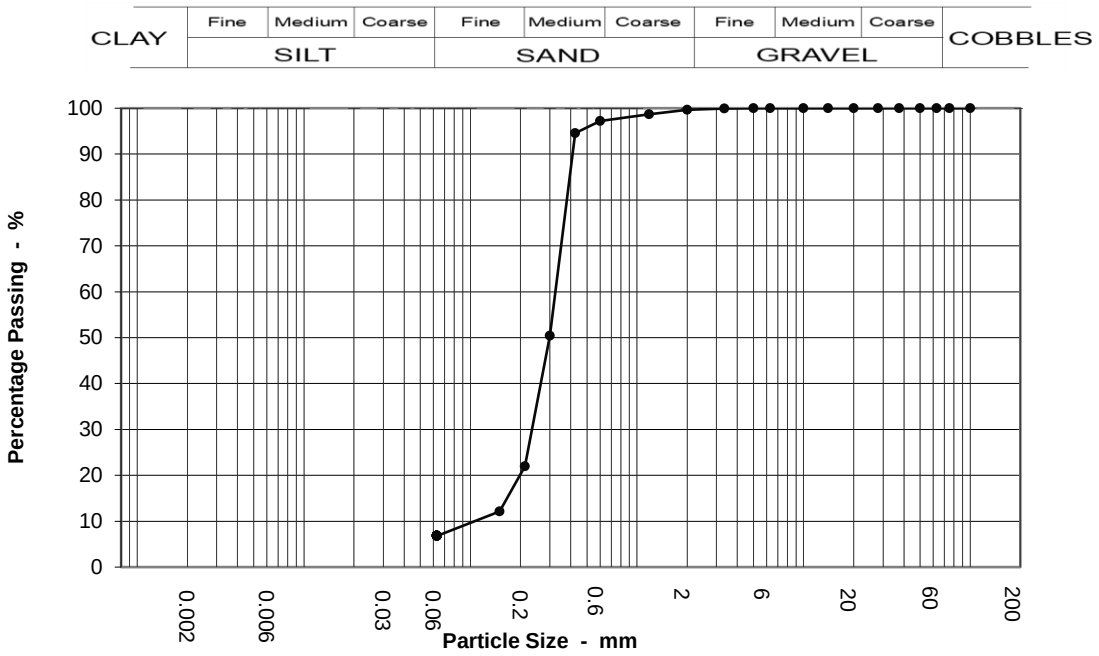
Grading Analysis	
D100	1.18
D60	0.255
D10	0.086
Uniformity Coefficient	3

Operator	Checked	Approved	Remarks
STP	CSS	CSS	

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**12044**
		Borehole / Pit No	WS 2
Project	**Foxbury Farm, Sevenoaks**	Sample No	
		Depth	1.7-1.9 m
Soil Description	Brown slightly silty fine to medium SAND	Sample type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	99		
0.6	97		
0.425	95		
0.3	50		
0.212	22		
0.15	12		
0.063	7		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	0.3
Sand	92.9
Silt & Clay	6.8

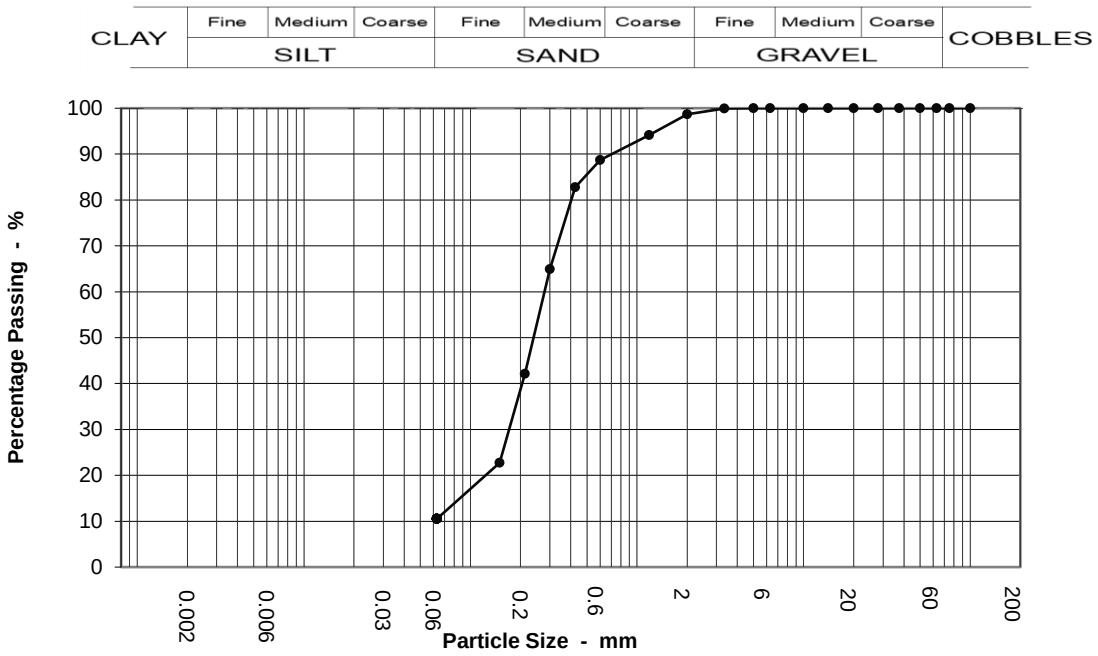
Grading Analysis	
D100	2.00
D60	0.327
D10	0.115
Uniformity Coefficient	3

Operator	Checked	Approved	Remarks
STP	CSS	CSS	

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**12044**
		Borehole / Pit No	WS 4
Project	**Foxbury Farm, Sevenoaks**	Sample No	
		Depth	0.7-0.9 m
Soil Description	Orange brown slightly silty fine to coarse SAND	Sample type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	99		
1.18	94		
0.6	89		
0.425	83		
0.3	65		
0.212	42		
0.15	23		
0.063	11		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	1.4
Sand	88.1
Silt & Clay	10.5

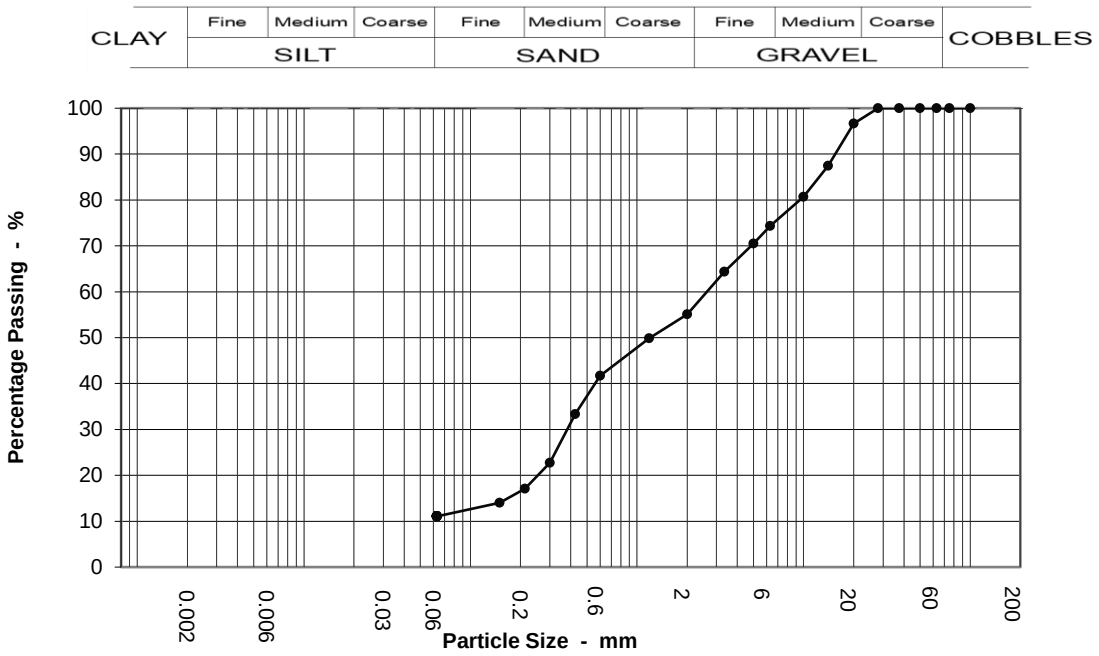
Grading Analysis	
D100	3.35
D60	0.281
D10	
Uniformity Coefficient	N/A

Operator	Checked	Approved	Remarks
STP	CSS	CSS	

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**12044**
		Borehole / Pit No	WS 5
Project	**Foxbury Farm, Sevenoaks**	Sample No	
		Depth	1.7-1.9 m
Soil Description	Orange brown silty very sandy fine to medium GRAVEL. Sand is fine to coarse	Sample type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	97		
14	87		
10	81		
6.3	74		
5	70		
3.35	64		
2	55		
1.18	50		
0.6	42		
0.425	33		
0.3	23		
0.212	17		
0.15	14		
0.063	11		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	44.9
Sand	44.1
Silt & Clay	11.1

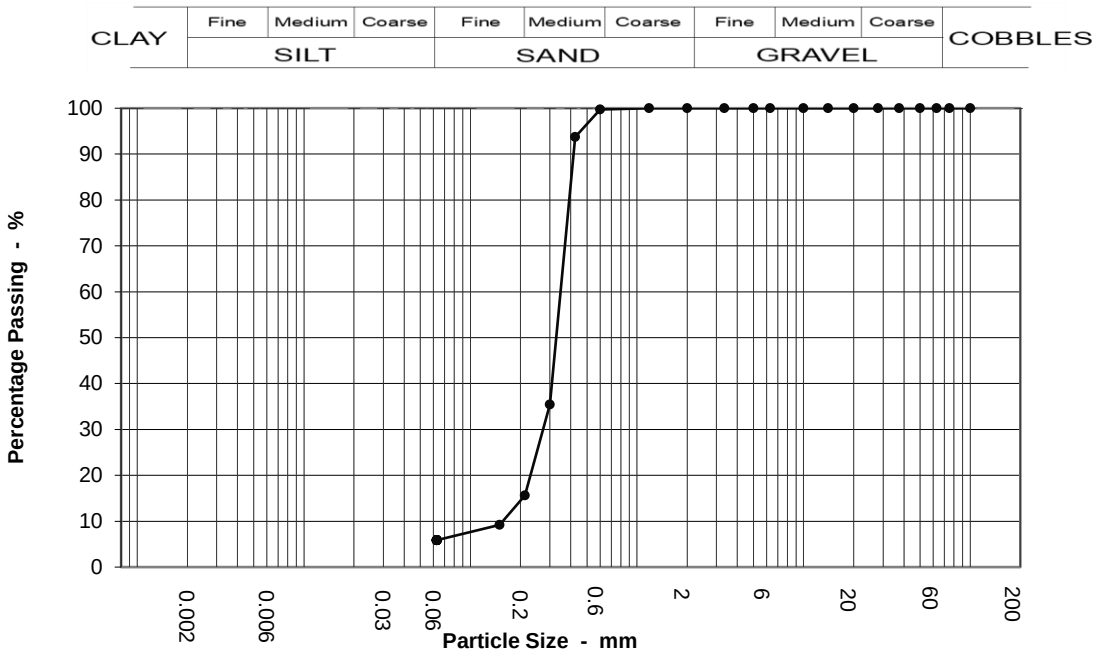
Grading Analysis	
D100	28.0
D60	2.715
D10	
Uniformity Coefficient	N/A

Operator	Checked	Approved	Remarks
STP	CSS	CSS	

PARTICLE SIZE DISTRIBUTION

BS 1377 : Part 2 : 1990 : Clause 9

		Job Ref	**12044**
		Borehole / Pit No	WS 7
Project	**Foxbury Farm, Sevenoaks**	Sample No	
		Depth	0.7-0.9 m
Soil Description	Orange brown slightly silty fine to medium SAND	Sample type	D



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100		
0.425	94		
0.3	35		
0.212	16		
0.15	9		
0.063	6		

Test Method	
BS 1377 : Part 2 : 1990	
Sieving	Clause 9.2
Sedimentation	N/A

Sample Proportions	
Cobbles	0.0
Gravel	0.0
Sand	94.1
Silt & Clay	5.9

Grading Analysis	
D100	0.600
D60	0.353
D10	0.157
Uniformity Coefficient	2

Operator	Checked	Approved	Remarks
STP	CSS	CSS	

APPENDIX 5

ANALYTICAL TEST RESULTS

4480

Marc Pearson
Ground & Environmental Services Ltd
Unit 2
Montpelier Business Park
Dencora Way
Ashford
Kent
TN23 4FG

DETS Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410
russell.jarvis@dets.co.uk

DETS Report No: 18-82261

Site Reference:	Foxbury Farm, Sevenoaks
Project / Job Ref:	12044
Order No:	GES/3280.12044
Sample Receipt Date:	17/09/2018
Sample Scheduled Date:	17/09/2018
Report Issue Number:	1
Reporting Date:	21/09/2018

Authorised by:

Russell Jarvis
Associate Director of Client Services

Authorised by:

Dave Ashworth
Deputy Quality Manager

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

4480

Soil Analysis Certificate							
DETS Report No: 18-82261	**Date Sampled**	14/09/18	14/09/18	14/09/18	14/09/18	14/09/18
Ground & Environmental Services Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Foxbury Farm, Sevenoaks	**TP / BH No**	WS1	WS2	WS3	WS4	WS5
Project / Job Ref: 12044	**Additional Refs**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: GES/3280.12044	**Depth (m)**	0.30	0.30	0.30	0.30	0.50
Reporting Date: 21/09/2018	**DETS Sample No**	360432	360433	360434	360435	360436

Determinand	**Unit**	**RL**	**Accreditation**					
Stone Content	%	< 0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Asbestos Screen (S)	N/a	N/a	**ISO17025**	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected
pH	pH Units	N/a	**MCERTS**	6.4	7.6	7.7	7.3	6.8
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	**MCERTS**	< 10	11	< 10	< 10	< 10
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	**MCERTS**	< 0.01	0.01	< 0.01	< 0.01	< 0.01
Organic Matter	%	< 0.1	**MCERTS**	0.4	0.3	0.2	0.2	2.4
Arsenic (As)	mg/kg	< 2	**MCERTS**	5	5	6	12	13
Barium (Ba)	mg/kg	< 5	NONE	< 5	< 5	< 5	< 5	14
Beryllium (Be)	mg/kg	< 0.5	NONE	< 0.5	< 0.5	< 0.5	< 0.5	0.6
W/S Boron	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	< 1
Cadmium (Cd)	mg/kg	< 0.2	**MCERTS**	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (Cr)	mg/kg	< 2	**MCERTS**	15	16	20	33	22
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	< 2
Copper (Cu)	mg/kg	< 4	**MCERTS**	< 4	< 4	< 4	< 4	7
Lead (Pb)	mg/kg	< 3	**MCERTS**	< 3	< 3	< 3	< 3	22
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	< 1
Nickel (Ni)	mg/kg	< 3	**MCERTS**	< 3	< 3	4	6	7
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	< 3	< 3
Vanadium (V)	mg/kg	< 2	NONE	32	30	51	56	42
Zinc (Zn)	mg/kg	< 3	**MCERTS**	10	7	10	14	48
Mineral Oil (C10 - C40)	mg/kg	< 10	**MCERTS**	< 10	< 10	< 10	< 10	< 10

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C

Subcontracted analysis (S)

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

4480

Soil Analysis Certificate							
DETS Report No: 18-82261	**Date Sampled**	14/09/18	14/09/18	14/09/18	14/09/18	14/09/18
Ground & Environmental Services Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Foxbury Farm, Sevenoaks	**TP / BH No**	WS6	WS7	WS8	WS9	WS1
Project / Job Ref: 12044	**Additional Refs**	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: GES/3280.12044	**Depth (m)**	0.30	0.40	0.30	0.30 - 0.40	1.70 - 19.00
Reporting Date: 21/09/2018	**DETS Sample No**	360437	360438	360439	360440	360441

Determinand	Unit	RL	Accreditation					
Stone Content	%	< 0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	
Asbestos Screen (S)	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected	Not Detected	
pH	pH Units	N/a	MCERTS	7.8	7.1	7.7	6.6	6.9
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	< 10	< 10	< 10	< 10	< 10
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Organic Matter	%	< 0.1	MCERTS	0.5	0.6	2.7	0.6	
Arsenic (As)	mg/kg	< 2	MCERTS	12	12	12	3	
Barium (Ba)	mg/kg	< 5	NONE	29	13	66	< 5	
Beryllium (Be)	mg/kg	< 0.5	NONE	0.6	0.5	0.8	< 0.5	
W/S Boron	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	< 0.2	< 0.2	0.3	< 0.2	
Chromium (Cr)	mg/kg	< 2	MCERTS	26	29	24	8	
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2	
Copper (Cu)	mg/kg	< 4	MCERTS	12	8	31	< 4	
Lead (Pb)	mg/kg	< 3	MCERTS	11	7	99	< 3	
Mercury (Hg)	mg/kg	< 1	NONE	< 1	< 1	< 1	< 1	
Nickel (Ni)	mg/kg	< 3	MCERTS	16	11	12	< 3	
Selenium (Se)	mg/kg	< 3	NONE	< 3	< 3	< 3	< 3	
Vanadium (V)	mg/kg	< 2	NONE	44	52	39	18	
Zinc (Zn)	mg/kg	< 3	MCERTS	45	32	144	15	
Mineral Oil (C10 - C40)	mg/kg	< 10	MCERTS	< 10	404	< 10	< 10	

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C

Subcontracted analysis (S)

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

4480

Soil Analysis Certificate							
DETS Report No: 18-82261	**Date Sampled**	14/09/18	14/09/18	14/09/18	14/09/18	
Ground & Environmental Services Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied	None Supplied	
Site Reference: Foxbury Farm, Sevenoaks	**TP / BH No**	WS3	WS5	WS7	WS8	
Project / Job Ref: 12044	**Additional Refs**	None Supplied	None Supplied	None Supplied	None Supplied	
Order No: GES/3280.12044	**Depth (m)**	0.80 - 0.90	1.70 - 1.90	0.70 - 0.90	1.50 - 1.60	
Reporting Date: 21/09/2018	**DETS Sample No**	360442	360443	360444	360445	

Determinand	Unit	RL	Accreditation					
Stone Content	%	< 0.1	NONE					
Asbestos Screen (S)	N/a	N/a	ISO17025					
pH	pH Units	N/a	MCERTS	7.2	5.5	6.7	6.4	
W/S Sulphate as SO_4 (2:1)	mg/l	< 10	MCERTS	< 10	28	< 10	< 10	
W/S Sulphate as SO_4 (2:1)	g/l	< 0.01	MCERTS	< 0.01	0.03	< 0.01	< 0.01	
Organic Matter	%	< 0.1	MCERTS					
Arsenic (As)	mg/kg	< 2	MCERTS					
Barium (Ba)	mg/kg	< 5	NONE					
Beryllium (Be)	mg/kg	< 0.5	NONE					
W/S Boron	mg/kg	< 1	NONE					
Cadmium (Cd)	mg/kg	< 0.2	MCERTS					
Chromium (Cr)	mg/kg	< 2	MCERTS					
Chromium (hexavalent)	mg/kg	< 2	NONE					
Copper (Cu)	mg/kg	< 4	MCERTS					
Lead (Pb)	mg/kg	< 3	MCERTS					
Mercury (Hg)	mg/kg	< 1	NONE					
Nickel (Ni)	mg/kg	< 3	MCERTS					
Selenium (Se)	mg/kg	< 3	NONE					
Vanadium (V)	mg/kg	< 2	NONE					
Zinc (Zn)	mg/kg	< 3	MCERTS					
Mineral Oil (C10 - C40)	mg/kg	< 10	MCERTS					

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C

Subcontracted analysis (S)

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

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Soil Analysis Certificate - Speciated PAHs							
DETS Report No: 18-82261	Date Sampled	14/09/18	14/09/18	14/09/18	14/09/18	14/09/18
Ground & Environmental Services Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Foxbury Farm, Sevenoaks	TP / BH No	WS1	WS2	WS3	WS4	WS5
Project / Job Ref: 12044	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: GES/3280.12044	Depth (m)	0.30	0.30	0.30	0.30	0.50
Reporting Date: 21/09/2018	DETS Sample No	360432	360433	360434	360435	360436

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Fluoranthene	mg/kg	< 0.1	MCERTS	0.14	< 0.1	< 0.1	< 0.1	0.15
Pyrene	mg/kg	< 0.1	MCERTS	0.12	< 0.1	< 0.1	< 0.1	0.13
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.16	< 0.1	< 0.1	< 0.1	0.17
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.16	< 0.1	< 0.1	< 0.1	0.17
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.13	< 0.1	< 0.1	< 0.1	0.14
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C

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

4480

Soil Analysis Certificate - Speciated PAHs							
DETS Report No: 18-82261	Date Sampled	14/09/18	14/09/18	14/09/18	14/09/18		
Ground & Environmental Services Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied		
Site Reference: Foxbury Farm, Sevenoaks	TP / BH No	WS6	WS7	WS8	WS9		
Project / Job Ref: 12044	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied		
Order No: GES/3280.12044	Depth (m)	0.30	0.40	0.30	0.30 - 0.40		
Reporting Date: 21/09/2018	DETS Sample No	360437	360438	360439	360440		

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.49	< 0.1	
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.13	< 0.1	
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
Phenanthrene	mg/kg	< 0.1	MCERTS	0.16	< 0.1	0.41	< 0.1	
Anthracene	mg/kg	< 0.1	MCERTS	0.13	< 0.1	0.17	< 0.1	
Fluoranthene	mg/kg	< 0.1	MCERTS	0.32	< 0.1	1.01	< 0.1	
Pyrene	mg/kg	< 0.1	MCERTS	0.28	0.29	0.92	< 0.1	
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.26	0.18	0.62	< 0.1	
Chrysene	mg/kg	< 0.1	MCERTS	0.16	< 0.1	0.59	< 0.1	
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.25	0.29	0.81	< 0.1	
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	0.14	0.14	0.38	< 0.1	
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.19	0.21	0.57	< 0.1	
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.33	0.40	0.55	< 0.1	
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.30	< 0.1	
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	0.22	0.29	0.42	< 0.1	
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	2.4	1.8	7.4	< 1.6	

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C

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

4480

Soil Analysis Certificate - EPH Banded (Type D)							
DETS Report No: 18-82261	Date Sampled	14/09/18	14/09/18	14/09/18	14/09/18	14/09/18
Ground & Environmental Services Ltd	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Site Reference: Foxbury Farm, Sevenoaks	TP / BH No	WS1	WS2	WS3	WS4	WS5
Project / Job Ref: 12044	Additional Refs	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Order No: GES/3280.12044	Depth (m)	0.30	0.30	0.30	0.30	0.50
Reporting Date: 21/09/2018	DETS Sample No	360432	360433	360434	360435	360436

Determinand	Unit	RL	Accreditation					
EPH (>C8 - C10)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	< 1
EPH (>C10 - C12)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	< 1
EPH (>C12 - C16)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	< 1
EPH (>C16 - C21)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1	< 1
EPH (>C21 - C35)	mg/kg	< 6	MCERTS	< 6	< 6	< 6	< 6	19
EPH (C8 - C35)	mg/kg	< 6	MCERTS	< 6	< 6	< 6	< 6	19

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C

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

4480

Soil Analysis Certificate - EPH Banded (Type D)							
DETS Report No: 18-82261	**Date Sampled**	14/09/18	14/09/18	14/09/18	14/09/18	
Ground & Environmental Services Ltd	**Time Sampled**	None Supplied	None Supplied	None Supplied	None Supplied	
Site Reference: Foxbury Farm, Sevenoaks	**TP / BH No**	WS6	WS7	WS8	WS9	
Project / Job Ref: 12044	**Additional Refs**	None Supplied	None Supplied	None Supplied	None Supplied	
Order No: GES/3280.12044	**Depth (m)**	0.30	0.40	0.30	0.30 - 0.40	
Reporting Date: 21/09/2018	**DETS Sample No**	360437	360438	360439	360440	

Determinand	**Unit**	**RL**	**Accreditation**					
EPH (>C8 - C10)	mg/kg	< 1	**MCERTS**	< 1	< 1	4	< 1	
EPH (>C10 - C12)	mg/kg	< 1	**MCERTS**	< 1	1	< 1	< 1	
EPH (>C12 - C16)	mg/kg	< 1	**MCERTS**	< 1	169	5	< 1	
EPH (>C16 - C21)	mg/kg	< 1	**MCERTS**	< 1	489	15	< 1	
EPH (>C21 - C35)	mg/kg	< 6	**MCERTS**	< 6	196	65	< 6	
EPH (C8 - C35)	mg/kg	< 6	**MCERTS**	< 6	856	88	< 6	

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30^{O}C

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

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Soil Analysis Certificate - Sample Descriptions	
DETS Report No: 18-82261	
Ground & Environmental Services Ltd	
Site Reference: Foxbury Farm, Sevenoaks	
Project / Job Ref: 12044	
Order No: GES/3280.12044	
Reporting Date: 21/09/2018	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
360432	WS1	None Supplied	0.30	2.5	Orange sandy clay
360433	WS2	None Supplied	0.30	6	Orange sandy clay
360434	WS3	None Supplied	0.30	6.3	Orange sandy clay
360435	WS4	None Supplied	0.30	8.1	Orange sandy clay
360436	WS5	None Supplied	0.50	5.1	Brown sandy clay with vegetation
360437	WS6	None Supplied	0.30	12.2	Brown sandy clay
360438	WS7	None Supplied	0.40	9.3	Brown sandy clay
360439	WS8	None Supplied	0.30	7.7	Black sandy clay with stones
360440	WS9	None Supplied	0.30 - 0.40	6.2	Orange sandy clay
360441	WS1	None Supplied	1.70 - 19.00	4.7	Orange sandy clay
360442	WS3	None Supplied	0.80 - 0.90	4	Orange sandy clay
360443	WS5	None Supplied	1.70 - 1.90	4.1	Brown sandy clay with stones
360444	WS7	None Supplied	0.70 - 0.90	7.3	Brown sandy clay with stones
360445	WS8	None Supplied	1.50 - 1.60	12.7	Brown sandy clay

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

Insufficient Sample I/S

Unsuitable Sample U/S

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

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Soil Analysis Certificate - Methodology & Miscellaneous Information
DETS Report No: 18-82261
Ground & Environmental Services Ltd
Site Reference: Foxbury Farm, Sevenoaks
Project / Job Ref: 12044
Order No: GES/3280.12044
Reporting Date: 21/09/2018

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

D Dried
AR As Received

APPENDIX 6

GUIDELINES ON CONTAMINANT LEVELS

Human Health

CLEA Soil Guideline values (SGV)

The UKs primary contaminated land guidance is contained within the Contaminated Land Exposure Assessment (CLEA) framework. Within this framework a number of Soil Guideline Values (SGVs) were published for key contaminants along with toxicological guideline values relating to intake thresholds. The soil guideline values provided by the CLEA model represent intervention values for end uses based upon potential human exposure and soil concentrations of a contaminant above these values might represent an unacceptable risk to the health of the site users. The Environment Agency had an ongoing programme of SGV publication with associated toxicological information for key contaminants. Where SGVs are available then they should be used as the basis for any human health risk assessment.

All CLEA SGVs were withdrawn for use by the Environment Agency in 2008 whilst they are under review and pending the availability of new toxicological data. To date, new SGV values have been set for benzene, toluene, ethylbenzene and xylene and mercury and selenium. In the absence of the new SGVs and toxicological report data, GES have used appropriate screening tools or Generic Assessment Criteria Levels as assessment criteria guidelines for those determinands not currently assigned SGVs. It should be noted that the former SGVs for metals were in general agreement with those site specific levels generated by RBCA and other similar computer model based risk assessment tools.

The GES screening assessment of contaminants within samples has been carried out using these model generated values in the absence of any other values or guidelines. The version of the CLEA model, v1.06, was used. The published SGVs are shown below. Nickel SGV has been withdrawn (2015) pending an assessment of the toxicological data used in the model for nickel. Published SGV values:

	Soil Guideline Value (mg kg^{-1})		
Land use	**Residential**	**Allotment**	**Commercial**
Inorganic arsenic	32	43	640
Nickel	130	230	1,800
Cadmium	10	1.8	230
Phenol	420	280	3200
Elemental Hg	1	26	26
Inorganic Hg	170	80	3600
Methyl Hg	11	8	410
Selenium	350	120	13,000
Benzene	0.33	0.07	95
Toluene	610	120	4400
Ethylbenzene	350	90	2800
o-Xylene	250	160	2600
r-Xylene	240	180	3500
m-Xylene	230	160	3200

Based on a sandy loam soil as defined in Environment Agency (2009b) and 6% SOM.

DEFRA Category four screening level (C4SL)

In addition to the SGVs, guideline screening values proposed in the DEFRA document SP1010-Development of Category 4 Screening Levels for Assessment of Land affected by Contamination Final Project Report (C4SL) are considered along with the suitable for use levels (S4USL) derived by the Chartered Institute of Environmental Health (CIEH) in partnership with the Land Quality Management Organization (LQM). The screening levels are given for residential, commercial, allotment or public open space end uses.

PARAMETER	Residential		Commercial	Allotment	Public open Space near residential POS_{resi}	Public park land POS_{park}	Sources
	With Plant uptake	Without Plant uptake					
Inorganics - mg/kg unless stated							
Arsenic (inorganic)	37	40	640	49	79	170	DEFRA C4SL
Beryllium	1.7	1.7	12	35	2.2	63	LQM/S4USL
Boron	290	11,000	240,000	45	21,000	46,000	LQM/CIEH
Cadmium	22	150	410	3.9	220	880	LQM/S4USL
Chromium III	910	910	8,600	18,000	1,500	33,000	LQM/CIEH
Chromium VI	21	21	49	170	21	250	LQM/S4USL
Copper	2,400	7,100	68,000	520	12,000	44,000	LQM/CIEH
lead	200	310	2,300	80	630	1,300	DEFRA C4SL
Mercury (Inorganic)	40	56	1,100	19	120	240	LQM/CIEH
Nickel	180	180	980	230	230	3,400	LQM/CIEH
Selenium	250	430	12,000	88	1,100	1,800	LQM/CIEH
Vanadium	410	1,200	9,000	91	2,000	5,000	LQM/CIEH
Zinc	3,700	40,000	730,000	620	81,000	170,000	LQM/CIEH
Total sulphate	2400	2400	2400	2400	2400	2400	BRE (2005)
Water-soluble sulphate (g/l)	0.5	0.5	0.5	0.5	0.5	0.5	BRE (2005)
pH	<5	<5	<5	<5	<5	<5	-

CLEA does not currently provide guidance for total Polycyclic Aromatic Hydrocarbons (PAHs). A standalone Defra C4SL for benzo(a)pyrene has been assigned and is shown below. In addition, the Chartered Institute of Environmental Health (CIEH) in partnership with the Land Quality Management Organization (LQM) used CLEA software to derive Generic Assessment Criteria (GAC) and Assessment Sub Criteria (ASC) for the following PAH compounds:

PARAMETER	Residential						Commercial			Allotment			POS	POS	Source
	With Plant uptake			Without Plant uptake											
SOM %	1	2.5	6	1	2.5	6	1	2.5	6	1	2.5	6	resi	park	
Organics - mg/kg unless stated															
Acenaphthene	200	490	1080	2000	3600	5200	75000	92000	100000	34	85	202			CLEA/LQM CIEH
Acenaphthylene	170	400	900	2000	3600	5200	76000	92000	100000	28	68	163			CLEA/LQM CIEH
Anthracene	2300	5400	10700	30000	34000	36000	520000	530000	540000	380	947	2230			CLEA/LQM CIEH
Benzo(a)anthracene	7.5	11	13	12	14	15	170	170	180	2.9	6.5	13			CLEA/LQM CIEH
Benzo(a)pyrene C4SL			5			5.3			77			5.7	10	21	DEFRA C4SL
Benzo(a)pyrene	2.2	2.7	3	3.2	3.2	3.2	3.6	3.7	3.7	35	35	36			CLEA/LQM CIEH
Benzo(b)fluoranthene	2.6	3.3	3.7	3.9	4	4	44	45	45	1	2.2	3.9			CLEA/LQM CIEH
Benzo(g,h,i)perylene	315	340	350	360	360	360	3900	4000	4000	290	480	646			CLEA/LQM CIEH
Benzo(k)fluoranthene	77	93	100	110	110	110	1200	1200	1200	37	76	129			CLEA/LQM CIEH
Chrysene	15	22	27	30	31	32	350	350	350	4.1	9.5	19			CLEA/LQM CIEH
Dibenzo(a,h)anthracene	0.24	0.28	0.3	0.31	0.32	0.32	3.5	3.6	3.6	0.14	0.27	0.44			CLEA/LQM CIEH
Fluoranthene	280	560	890	1500	1600	1600	23000	23000	23000	52	127	288			CLEA/LQM CIEH
Fluorene	165	390	850	2200	3400	4200	60000	67000	70000	27	67	158			CLEA/LQM CIEH
Indeno(1,2,3-cd)pyrene	27	36	41	45	46	46	500	510	510	9.5	21	40			CLEA/LQM CIEH
Naphthalene	1	2.3	5.5	1	2.4	6	100	260	600	4	9.8	23			CLEA/LQM CIEH
Phenanthrene	95	220	440	1300	1400	1500	22000	22000	23000	15	38	90			CLEA/LQM CIEH
Pyrene	620	1200	2000	3700	3800	3800	54000	54000	55000	11	271	620			CLEA/LQM CIEH

Petroleum Hydrocarbons represent a complex situation being a mixture of a range of compounds, the relative concentrations of which may change over time.

As discussed above, Generic Assessment Criteria (GAC) for total petroleum hydrocarbons according to both their molecular weight and chemical structure and also for a range of soil organic matter (SOM) content values have been derived using CLEA software.

The LQM CIEH GACs are again presented according to their soil organic matter content and proposed end use of the land. The generic assessment criteria for a 1%, 2.5% and 6% SOM content are tabulated below and presented according to the proposed end use.

It should be noted that the GAC values derived by CLEA are high for the longer chain length fraction TPH species and as such would not necessarily prove aesthetically acceptable if left on site. Therefore, any samples which were noted in excess of the 500 mg/kg inert waste threshold may be considered unacceptable for use on site where they may come in contact with people regardless of whether they were below the respective GAC value.

	LQM CIEH Generic Assessment Criteria (mg/kg dry weight soil)											
	Residential						Allotment Land Use			Commercial Land Use		
	With Plant Uptake			Without Plant Uptake								
SOM %	**1**	**2.5**	**6**	**1**	**2.5**	**6**	**1**	**2.5**	**6**	**1**	**2.5**	**6**
Aliphatic												
EC 5 – 6	24	40	80	24	40	80	752	1730	3900	2400	4000	8000
EC > 6 – 8	52	110	250	52	110	250	2304	5580	13000	5200	11000	25000
EC > 8 – 10	13	30	70	13	30	70	321	770	1700	1300	3000	7000
EC > 10 – 12	60	150	360	60	150	360	2153	4300	7150	6000	15000	32000
EC > 12 – 16	500	1200	2600	500	1200	2600	10800	12400	13200	42000	72000	90000
EC > 16 – 35	41000	69000	94000	41000	69000	94000	240000	260000	260000	140000	160000	180000
EC > 35 – 44	41000	69000	94000	41000	69000	94000	240000	260000	260000	140000	160000	180000
Aromatic												
EC 5 – 7 (benzene)	50	110	240	155	300	630	12	25	57	15000	28000	55000
EC > 7 – 8 (toluene)	100	240	550	370	800	1800	21	50	117	33000	68000	130000
EC > 8 – 10	20	50	110	20	53	125	8.6	21	50	2000	5000	120000
EC > 10 – 12	63	150	340	120	280	650	12.5	31	74	11000	22000	31000
EC > 12 – 16	140	320	660	1100	1900	2300	23	57	134	35000	37000	38000
EC > 16 – 21	260	540	930	1800	1900	1900	47	112	260	28000	28000	28000
EC > 21 – 35	1100	1400	1700	1900	1900	1900	370	820	1500	28000	28000	28000
EC > 35 – 44	1100	1400	1700	1900	1900	1900	370	820	1500	28000	28000	28000

													POS_{resi}	POS_{park}
Benzene DEFRA C4SL	0.06	0.13	0.3 (0.87)	0.16	0.3	0.64 (3.3)	0.016	0.033	0.073 (0.18)	15	28	57 (98)	140	230
Toluene	104	240	550	370	830	1800	22	50	117	33000	68000	130000		
Ethylbenzene	30	62	150	34	81	190	16	38	91	3200	7000	16000		
o-xylene	30	70	170	40	90	200	28	67	160	3700	8000	19000		
m-xylene	30	70	160	34	80	190	30	74	170	3400	8000	18000		
p-xylene	30	70	160	33	80	180	28	69	160	3200	8000	17000		

TPH values calculated using CLEA v1.06 with parameter changes in accord with DEFRA (2014) C4SL and LQM/CIEH (2015)

Inert Material

The Landfill (England and Wales) (Amendment) Regulations 2005 provides waste acceptance criteria, which set the limits of contaminants permitted in various waste categories going to landfill. These criteria are of particular use where CLEA guidance has not yet been provided.

For risk assessment purposes we would consider that any materials (soils) containing concentrations of potential contaminants that would result in them being classified as inert would be considered as uncontaminated and therefore representing a low risk to human health. Similarly such material would not be considered to represent a significant risk to water resources. Inert waste is defined as waste which contains insignificant potential for pollution and does not endanger the quality of surface water or groundwater. The Landfill Directive states that inert waste will not adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. Where CLEA values exist, these would always be used in preference to inert waste values when assessing risks to human health. For example the SGV and GAC levels for benzene are far lower than the inert waste threshold limit values and should be used for assessing human health risks. Selected inert waste acceptance criteria as detailed in The Landfill (England and Wales) (Amended) Regulations 2005 are provided below.

Landfill acceptance criteria for inert waste (mg/kg)	
Total organic carbon (TOC)	30,000
BTEX compounds	6
Mineral oils (C10 – C40)	500
pH	>6
PAH	100

This table is of particular value for assessing soil containing detectible concentrations of petroleum hydrocarbons. Petroleum Hydrocarbons represents a more complex situation being a mixture of a range of compounds, the relative concentrations of which may change over time. Where individual BTEX data is available then the CLEA SGVs should be used as the basis for the assessment.

Risks to Plants

The CLEA framework does not provide a method for the assessment of phytotoxic risks to plants. However maximum permissible concentrations have been published in the Sludge (Use in Agriculture) Regulations 1989 (SI 1989, No. 1263). This legislation enforces the provisions of the EC Directive 86/278/EEC for potentially toxic elements (PTEs) on soils for agricultural use where sewage sludge has been applied (see table below). These limits relate to the potential risk to plants and not human health for which CLEA is the overriding risk assessment model.

Maximum permissible concentration in agricultural soils following sewage sludge application (mg/kg).				
	pH 5.0<5.5	**pH 5.5<6.0**	**pH 6.0-7.0**	**pH >7.0**
Zinc	200	250	300	450
Copper	80	100	135	200
Nickel	50	60	75	110

Risks to buried concrete

The potential risks to buried concrete can be assessed by reference to the BRE Special Digest 1 (SD1) entitled 'Concrete in Aggressive Ground'. This document provides a methodology for the specification of concrete based on the ground conditions encountered and is based upon chemical analysis and associated factors (e.g. groundwater). The guidance provides a Design Sulphate Class (DS) based upon the ground conditions and it is considered that a low concentration of sulphate and pH (i.e. DS – 1 and DS – 2) is considered to represent a low risk to buildings.

Risks to buried services

In addition, where water is supplied in plastic pipes which could come into contact with contaminated ground then this can lead to premature failures, resulting in leakage and loss of water quality. Risks to water supply pipes are assessed using guidance published by the UK Water Industry Research (UKWIR) entitled '*Guidance for the Selection of Water Pipes to be used in Brownfield Sites'* (Report Ref. No. 10/WM/03/21). This is known as the UKWIR guidance.

Previous guidance from WRAS has been withdrawn but may still be in use by certain water supply companies. In general water companies have adopted a common set of guidelines as given in the ***Contaminated Land Assessment Guidance from January 2014.***

Additional threshold values for determining pipe material have also been published by certain water supply companies. If these threshold values are exceeded then consideration should be given to the selection of pipe material or to the use of barrier pipes. The UKWIR threshold values, together with those of certain water supply companies are presented in the table below for a range of potential hazards.

Substance[(1)]	Water UK Guidance	Thames Water
Total VOC	0.5	-
Total BTEX & MTBE	0.1	0.1 or either
Total SVOC	2	-
EC5-EC10 aliphatic and aromatic hydrocarbons	2	-
EC5-EC12 aliphatic hydrocarbons		0.5
EC5-EC12 aromatic hydrocarbons		0.5
EC10-EC16 aliphatic and aromatic hydrocarbons	10	-
EC12-EC21 aliphatic hydrocarbons		10
EC12-EC21 aromatic hydrocarbons		10
EC16-EC40 aliphatic and aromatic hydrocarbons	500	-
EC21-EC35 aliphatic hydrocarbons		500
EC21-EC35 aromatic hydrocarbons		500
Phenols	2	5*
Cresols and chlorinated phenols	2	2
Naphthalene	**-**	**5**
Ethers	0.5	-
Nitrobenzene	0.5	-
Ketones	0.5	-
Aldehydes	0.5	-
Amines	0	-
Corrosives pH and EC	# ##	

All units mg kg-1 in soil;
pH <7 for wrapped steel, pH <5 wrapped ductile iron and copper and ##EC >400µS/cm;
*Phenol limit at 2mg/kg in presence of BTEX.