Geo-Environmental

GROUND INVESTIGATION REPORT

for the site at

FORMER STANDEN LANDFILL,

EVERGREEN FARM, WEST HOATHLY ROAD,

EAST GRINSTEAD, WEST SUSSEX,

RH19 4NE

on behalf of

TJS SERVICES LIMITED

Report:	**GROUND INVESTIGATION REPORT**
Site:	**FORMER STANDEN LANDFILL, EVERGREEN FARM, WEST HOATHLY ROAD, EAST GRINSTEAD, WEST SUSSEX, RH19 4NE**
Client:	**TJS SERVICES LIMITED**
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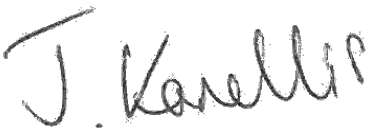
Prepared by:	
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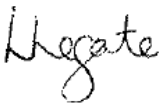
Reviewed by:	
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AMENDMENT RECORD

Revision ref.	Date	Reasons for amendment	Author's initials
1.0	19/08/18	Initial issue for client comment	JK
1.1	17/09/18	Updated to reflect client comments and updated leachate, surface water analysis and ground gas monitoring results	LL

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EXECUTIVE SUMMARY		
Site Details	Site Address	Former Standen Landfill, Evergreen Farm, West Hoathly Road, East Grinstead, West Sussex, RH19 4ND
	National Grid Reference	NGR 539018 136273
	Form of Development	The restoration of the former landfill on site, via an environmental permit application to improve the site condition to allow for future agricultural/pasture use. The construction of a residential dwelling on the south-west of the site and consideration of the potential conversion of former agricultural buildings for use as holiday let accommodation.
	Scope of works	The investigation included undertaking a review of a third party desk study previously undertaken for the site, followed by an intrusive investigation to confirm the ground and groundwater conditions on site and to determine the physical properties of the waste present within the former landfill identified on site. To support the development of geotechnical and geo-environmental assessments of the site in relation to the current land use, and proposed land use.
Encountered Conditions	Ground Conditions	**Former Landfill:** The investigations within the former landfill area, located outside of the ancient woodland (TP13 to TP15, TP18 to TP21, TP24 to TP32, TP35 to TP41, TP43, TP45 to TP50, WS02 to WS06, WS08 to WS12, HP01 to HP03, TP08/HP, TP16/HP, TP17/HP, TP33/HP, TP34/HP, TP42/HP and TP44/HP) encountered Made Ground up to 5.00m bgl (maximum depth of investigation). It should be noted that natural clays of the Wadhurst Clay Formation were encountered within WS02 at a depth of 3.00m bgl, WS08 at a depth of 4.20m bgl and within TP48 at a depth of 2.30m bgl, these positions were noted to be located along the anticipated edge of the landfill body. The depth of the waste mass was not proven during the investigations undertaken on the site. **Ancient Woodland:** Positions situated within the ancient woodland (HP04 to HP10) encountered natural clays of the Wadhurst Clay Formation beneath limited thicknesses of Topsoil, except for HP06 and HP10 in which Made Ground was encountered. **South West:** The majority of positions (TP01 to TP07, TP09 to TP12, WS01 and WS07) located on the south-west portion of the site (i.e. to the west and south of the existing buildings) encountered only natural soils of the Ardingly Sandstone Member beneath a thin mantle of Topsoil. The exception to this was TP05 in which a limited thickness of Made Ground was encountered to a depth of 0.80m bgl.
	Groundwater/Leachate	Perched water was only encountered during the intrusive investigation works within TP30, TP43, WS02, WS06 and WS12 at depths ranging from 2.8m to 4.88m bgl, this is considered to represent leachate, where water has infiltrated through the site and the underlying waste mass and is located over less permeable horizons. Leachate was also encountered within several the monitoring wells installed within WS01-WS12 across the site during the return monitoring undertaken to date. Four return visits have currently been undertaken from the 30th July to the 7th September with leachate encountered at depths between 0.9m and 4.9m bgl. Groundwater is considered to be present at depth beneath the site and has not been encountered within the investigation works undertaken on site to date. Leachate monitoring is ongoing with 12No. return visits proposed and the report will be updated on completion.

	Excavations	Excavations within the Made Ground may remain stable in the short term, but this would be subject to the proportions of waste encountered and depth of excavation. Excavations may require some form of temporary support or battering back to a safe angle. Both shallow and deeper excavations within the Natural Ground are unlikely to remain relatively stable in the short to medium term. All excavations taken below the groundwater table or where perched water or leachate ingress occurs will become highly unstable and some form of temporary support and dewatering will be necessary.
	Buried Concrete (south west)	The results of the sulphate and pH analysis undertaken on samples of the Topsoil and natural soils on this portion of the site found the soil samples tested to have a water-soluble sulphate concentration within design sulphate (DS) class DS-1 of BRE special digest 1. An aggressive environment for concrete (ACEC) classification of AC-1 is deemed appropriate for foundations within this stratum. However, it should be noted that an anomalous pH result (pH3.9) was encountered within WS01 which would render the ACEC classification as AC-2z. This aside, the sample tested was recovered from a depth of 4.50m bgl, i.e. significantly below the likely traditional foundation depth of a proposed low-rise building. The results of the sulphate and pH analysis undertaken on a single sample of the Made Ground encountered within TP05 found the soil samples tested to have water soluble sulphate concentration within design sulphate (DS) class DS-2 of BRE special digest 1. An aggressive environment for concrete (ACEC) classification of AC-2 is deemed appropriate for foundations extending through this stratum.
Environmental Considerations	Human Health	**Former Landfill:** Due to the elevated concentrations of benzo(a)pyrene identified across the site, it is recommended that a cover system be utilised to protect end users of the site. However, it should be noted that the risk to groundwater/surface water has been identified in relation to the waste mass on site. It is considered that measures proposed to be protective of controlled water would also be sufficient to be protective on human health. Where materials are proposed to be imported to site to provide a suitable capping to address the risk to human health and controlled waters imported materials should be both physically and chemically suitable for the proposed end use. This would also serve to be protective of any livestock which may subsequently utilised these areas as pasture. **South West:** Remedial measures would be necessary in parts of the site where any development proposals include the placement of private or communal soft landscaping over the isolated areas (i.e. TP05) of encountered Made Ground to provide a suitable growing medium within these areas.
	Groundwater/Surface Water	Elevated PAH has been identified within analysis of the leachate with the landfill mass and within the stream on site during the monitoring and analysis undertaken on the 30th July 10th and 24th August. Deep groundwater has not been encountered during the investigation works undertaken on site to date with the depth of intrusive investigation works currently undertaken on site limited to <5m bgl. The monitoring to date has indicated the presence of mobile

		contaminants within the waste mass on site such that remediation measures would be required to be protective of controlled waters.
	Radon Gas	No radon protection measures are required.
	Ground Gas	**Former Landfill/Ancient Woodland:** Methane was recorded in the range of 0.0% – 53.0% v/v, whilst carbon dioxide and oxygen were present in the range 0.0% – 9.9% v/v and 0% – 20.9% v/v respectively. Positive borehole flow up to 0.4l/hr were detected on the site with positive flow recorded in WS02 on the 10th August and WS12 on the 10th August and 7th September 2018. Negligible VOCs were recorded as ranging between 0.0ppm and 1.0ppm. The atmospheric pressure was recorded as ranging between 995mb and 1008mb. The highest methane concentrations recorded were noted to be within WS09 and WS12. Due to the elevated levels of Methane and Carbon Dioxide identified on the site any remediation measures will need to include consideration of ground gases and the potential for altering the ground gassing regime on the site as variation in the moisture content of the waste can alter the regime and capping may alter existing preferential pathways. Capping of the landfill is recommended to protect controlled water on site and any such capping layer should a gas venting layer or similar, and measure to mitigate further migration/build-up of the ground gases beneath the site. **South-West:** Methane was not recorded within the standpipe WS01, whilst carbon dioxide and oxygen were present in the range 0.0% – 2.0% v/v and 18.5% – 20.9% v/v respectively. No positive borehole flows were recorded during the monitoring visits. Negligible VOCs were recorded as ranging between 0.0ppm and 0.1ppm. The atmospheric pressure was recorded as ranging between 995mb and 1003mb. Based on the findings of the desk study and the results of the monitoring visits to date, it is considered that the risk to the south western portion of the site which is located up topographical gradient from the landfill mass on site is considered to be low, however the assessment should be updated on completion of the 12 monitoring visits proposed across the site and wider site.
	Built Environment	Barrier pipe is likely to be required for any development works on the site where services pass through or in close proximity to Made Ground/Infilled Ground, subject to the confirmation from the local water utility supplier.
	Waste Disposal	WAC testing has not currently been carried out on the site as current proposal do not include the excavation or disposal of materials from site. Should materials for disposal be identified WAC testing should be carried out in order to classify the materials for disposal.

Further Action:

- Updated Report on completion of the ground gas monitoring on site;
- Installation of deep monitoring wells on site to allow for monitoring and analysis of underlying groundwater at depth beneath the site.
- Provision of a Remediation Method Statement, landfill capping design (to include a gas venting layer and drainage layer, the design of which should be include a slope stability assessment;
- Provision of a Materials Management Plan should it be proposed to re-use of materials on site or import materials for re-use on site; or appropriate application for an Environmental Permit.
- If abnormal conditions are encountered, Geotechnical/Geo-Environmental advice should be sought to determine a suitable source of action.

This Executive Summary is intended to provide a brief summary of the main findings and conclusions of the investigation.

For further information, reference should be made to the main report ref. GE17326/GIRv1.1/SEPT18.

1.0 INTRODUCTION

1.1 General

Geo-Environmental Services Limited was instructed by TJS Services Limited, to undertake an investigation to determine the physical and chemical quality of the waste mass on site and to assess the geo-environmental factors pertaining to the site at the Former Standen Landfill, Evergreen Farm, West Hoathly Road, East Grinstead, West Sussex, RH19 4ND (National Grid Coordinates at centre: 539018, 136273), herein referred to as the 'site'. The site's location is presented in Figure 1.

1.2 Form of Development

It is understood that that proposals comprised the restoration of the former landfill on site, anticipated to be via an environmental permit application to improve the site condition of the site to allow for future agricultural/pasture use and to be protective of Human Health and controlled waters.

In addition, it is understood that the construction of a residential dwelling is proposed on the south-west portion of the site with consideration of the potential for conversion of former agricultural buildings for use as holiday let accommodation in due course.

1.3 Objectives

The investigation was to comprise a review of the existing desk study of the site and an assessment on the potential environmental impacts of the site in relation to the site current us and potential improvements to ensure the site remains protective of human health and controlled waters. Together with the consideration of the proposed development works (primarily south west portion of the site), adjacent land uses, and the wider environment, in the context of the immediate liabilities under the Environment Act 1990, and risks posed to Controlled Waters under the Water Resources Act from the site and potential development options.

1.4 Standards and References

Where practicable, the ground investigation and subsequent environmental assessments were undertaken in accordance with the following documents and guidance:

- British Standards Institute - Code of Practice for Site Investigations (BS5930:2015);
- British Standards Institute - Code of Practice for the Characterisation and Remediation from Ground Gas in Affected Developments (BS8485:2015);
- British Standards Institute - Eurocode 7 – Geotechnical Design - Parts 1 & 2 (BS EN1997-1:2004 & BS EN1997-2:2007);
- British Standards Institute - Guidance on investigations for ground gas. Permanent gases and Volatile Organic Compounds (VOCs) (BS8576:2013);
- British Standards Institute - Investigation of Potentially Contaminated Sites - Code of Practice, BSI 2013 (BS10175:2011+A1:2013);
- British Standards Institute - Soils for Civil Engineering Purposes (BS1377:1990);
- British Standards Institute - Specification for Topsoil and Requirements for Use (BS3882:2015);
- Building Research Establishment - The Performance of Building Materials in Contaminated Land (BRE255) (1994);
- Construction Industry Research and Information Association - Assessing risks posed by hazardous ground gases to buildings (C665) (2007);

- Department for Communities and Local Government - National Planning Policy Framework (2012);
- Department for Environment Food and Rural Affairs and CL:AIRE - Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination (SP1010) (2014);
- Department for Environment Food and Rural Affairs and Environment Agency - Model Procedures for the Management of Contaminated Land (CLR11) (2004);
- Department of Environment - Industry Profiles (1995 - 1996);
- Environment Agency - Guidance for waste destined for disposal in landfills (2006);
- Environment Agency - Guidance on Requirements for Land Contamination Reports (2005);
- National House Building Council, Environment Agency & Chartered Institute of Environmental Health - Guidance for the Safe Development of Housing on Land Affected by Contamination (R&D Publication 66) (2008);
- National House Building Council - Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present (10627-R01[04]) (2007);
- National House Building Council – Standards, Chapter 4.1 Land Quality - Managing Ground Conditions (2018);
- National Planning Policy Framework – March 2012;
- Planning Policy Statement 23 – Planning and Pollution Control.

1.5 Conditions

The data collected from the investigations have been used to provide an interpretation of the environmental conditions pertaining to the site. The recommendations and opinions expressed in this report are based on the data obtained. Geo-Environmental takes no responsibility for conditions that either have not been revealed in the available records, or that occurs between or under points of physical investigation. Whilst every effort has been made to interpret the conditions, such information is only indicative and liability cannot be accepted for its accuracy.

It should be noted that in particular the concentrations and levels of mobile liquid and gaseous materials are likely to vary with time. The results obtained may therefore only be representative of the conditions at the time of sampling. This report should not be taken as any guarantee that a site is free of hazardous or potentially contaminative materials.

Information contained in this report is intended for the use of the Client, and Geo-Environmental can take no responsibility for the use of this information by any party for uses other than that described in this report. Geo-Environmental makes no warranty or representation whatsoever express or implied with respect to the use of this information by any third party. Geo-Environmental does not indemnify the Client or any third parties against any dispute or claim arising from any finding or other result of this investigation report or any consequential losses.

Assessment criteria or other parameters developed for the evaluation of contamination on this site are based on a number of assumptions regarding exposure and toxicology, and exposure to contaminants and levels of adverse effects may therefore vary. Whilst every care and expertise has been employed in the development of such criteria, no liability is accepted in this respect. Other criteria or guidance on the development of assessment criteria may be published in the future, and no liability is accepted in this respect.

2.0 DESK STUDY SUMMARY

A desk study report has previously been undertaken for the site by Ged Duckworth Limited, dated May 2018. A review of this report was undertaken, and a summary of the key findings are presented in the following section. The factual correctness of third party reports and information is presumed and no liability is accepted for any errors or inaccuracies in such information.

Comments made in the following sections regarding possible ground conditions on the site are based purely on the previous desk study assessment undertaken and subsequent site walkover survey undertaken by Geo-Environmental. For Full details reference should be made to the full Desk Study Report.

2.1 Site Description

At the time of the intrusive investigation, the site was comprised an irregular shaped parcel of land and generally comprised undeveloped agricultural land with several equestrian buildings, barns, and a residential property with an associated garden situated on the central western part of the site. The north eastern portion of the site was occupied by a woodland (designated as 'ancient') which had several pathways and clearings which were in use as camping pitches. Access to the site was via a gateway to the west.

The south-west of the site generally comprised two fields, with the western-most comprising undeveloped grassland and the eastern field occupied by several mature trees. A concrete vehicle track was observed to the south of these two fields, leading from the gate in the west to the collection of buildings on the central western part of the site.

On the central western portion of the site, a single storey timber built residential property with associated private garden, timber built stable block and workshop, a two storey brick and timber barn and an equestrian sand school were observed.

The central and northern portions of the site comprised undeveloped grassland which had previously been used for pasture. This area sloped downwards from the south-west to the north-east with a significant slope downwards to the north-east on the central northern boundary of this parcel of land. Information from the desk study indicated the presence of a small, stream running along the north eastern boundary at the foot of the steep slope, which was understood to flow in a north easterly direction. It appeared that the majority of the flow entering the stream is anticipated to comprise run off and from surrounding areas together with shallow groundwater/leachate flowing through the site. During the site walkover in May 2018 there was noted to be a slight flow within the stream, however during the site investigation works this stream was noted to be dry with the investigation works being undertaken during a period of prolonged dry and hot weather. Subsequent flow has since been encountered during the return monitoring visits undertaken on the site between August and September 2018.

A number of mature and semi mature trees were noted to be present across the site, along the site boundaries, stream bed and associated with the ancient woodland. However, several trees along the north and north eastern boundary along the site boundary with the steam and along the boundary between the field and the ancient woodland were noted to be dead and completely stripped of leaves.

Site Photographs obtained as part of the site walkover are presented in Appendix A.

2.2 Geology, Hydrogeology and Hydrology

British Geological Survey geological mapping indicated the geology of the site to comprise sands of the Ardingly Sandstone Member (on the north eastern portion) and mudstone of the Wadhurst Clay Formation (on the south western portion).

A band of superficial Head deposits comprising clay, silt, sand and gravel was also recorded across the central portion of the site.
The site was recorded by the Environment Agency as comprising a former landfill site, which was evidenced across parts of the site during the site walkover survey and as such Made Ground/infilled ground is anticipated to be present on the site.

The desk study reported that the site was underlain by Unproductive Strata (Wadhurst Clay Formation) in the north eastern portion of the site and a Secondary 'A' Aquifer (Ardingly Sandstone Member) within the south western portion of the site. The head deposits identified within the centre of the site was also noted to comprise a Secondary Undifferentiated Aquifer, however it is likely that these materials may previously have been excavated on the site prior to the backfilling of the site as a former landfill.

The site has not been reported as falling within a groundwater Source Protection Zone, and no potable water abstraction licenses are reported within the site boundary. The closest abstraction point reported within the previous desk study was located approximately 2000m to the south of the site for Standen Farm.

A surface water stream was identified running along the valley along the northern boundary of the site with a north eastly flow, however this is likely to dry up during periods of warmer drier weather. A number of other streams were reported to flow in a similar direction within the valley features within the area which flow into a tributary of the River Medway. The site was reported as being located outside of an area at risk from flooding.

An area of ancient woodland was reported on the south east and eastern portion and boundaries of the site, referred to within the desk study as Rockingswood.

A historical landfill was reported to be present on the subject site referred to as Standen Landfill comprising inert waste. Several other areas of landfill and potentially infilled ground were also reported within 500m of the site. Given the age of the landfill, it is considered unlikely that any formal engineering or construction works was undertaken in relation to the landfill.

2.3 Preliminary Environmental Risk Assessment Summary

The PRA and CSM has been developed for the site based on the from the information gathered as part of the desk study (May 2018) and subsequent site walkover survey that has been carried out on the site. Through which several plausible pollutant linkages have been identified on site in relation to the existing land use and potential proposed development of the site across part of the site.

The potential pollutant linkages established within the desk study are not considered to prevent the continued use of the site or development on the subject site, but could require investigation and assessment to support further characterisation, calibration of the CSM and where/if necessary determine a remedial strategy to reduce, remove or otherwise control any risk within the site to key receptors, to include controlled waters, human health and the wider environment.

The desk study highlighted that there was a potential for a high risk to human health arising from the previous and current uses of the site with respect to the potential for landfill gas and a high risk to controlled water with respect to potential mobile contaminants leaching through the landfill mass.

It was reported that the existing on-site buildings and barn were built during the period in which the landfill

was operational and that the larger barn present on the site was potentially constructed into the waste mass on site (as reportedly evidenced by exposed waste in the adjacent embankment). There was also reported to be a potential risk to the adjacent woodland from potential ground gases, noted from trees along areas of the site boundary demonstrating some distress and dying back.

The desk study reported that the landowner has reported outbreaks of brown water at lower elevations on the site (possible leachate), photos of which are present in Appendix A. A high risk was reported with respect to controlled water (surface and groundwater) as a result of infiltration and leaching through the waste mass.

The former landfill was reported to have resulted in differential settlement across the site, which has restricted the use of the site with respect to land utilised for grazing. In addition, the presence of waste material within the near surface soils was considered to present a risk to end users (farm animals) from possible ingestion and trip hazard.

In order to progress this assessment in line with the National Planning Policy Framework, to provide further characterisation of the site and refinement of the PRA and CSM, it was recommended that intrusive investigation and associated testing is undertaken to confirm the findings of the desk study and to provide a robust risk assessment for the site with respect to the physical determination of the waste mass on site and to allow for consideration of the ongoing/future use of the site and proposed redevelopment.

2.4 Preliminary Geotechnical Risk Assessment Summary

Former Landfill Area
Whilst a detailed geotechnical assessment was outside the scope of the investigation works undertaken, consideration was given to the plausible linkages associated with the physical determination of the waste and associated gas generation and possible engineering solutions that may be required to reduce the potential risk to controlled water and human health from the site in its current status.

South West Area
It is understood that the south western portion of the site is proposed to be developed for a proposed residential land use. However, whilst some recommendations are presented herein a full geotechnical assessment was outside the scope of the proposed works on the site.

Investigation works were required across the entire site to determine the extent and boundaries of Made Ground or infilled materials across the site, which may affect the propose a short or ling terms risk and to allow for consideration of the location of such materials in relation to a potential proposed development.

2.5 Scope of Works

In summary, the following scope of works for the intrusive investigation was agreed with the Client:

- Up to 50 machine excavated trial pits to depths of between 1.00m bgl and 3.00m bgl.
- Construction of twelve window sample boreholes (referenced WS01 to WS12) to depths of up to 5.00m bgl together with in situ testing and sampling.
- Hand pits to a maximum depth of 1.00m bgl in restricted access areas due to ecology, woodland and access.
- Installation of combined ground gas and groundwater monitoring wells within all twelve window sample boreholes to facilitate return monitoring.

- Ground gas (spot monitoring) and groundwater monitoring of the well installations on twelve occasions.
- Geochemical laboratory testing of soils and water (surface) and leachate for a suite of commonly occurring brownfield contaminants following a review of the third party desk study for the site.
- Additional laboratory testing of soils and water for cyanides, volatile organic compounds (VOC), semi-volatile organic compounds (SVOC), ammoniacal nitrogen, pesticide screening, and asbestos quantification (where encountered).
- Provision of a Ground Investigation Report.

2.6 Investigation Strategy

All intrusive positions were located to provide broad coverage of the site and to delineate the existing landfill boundaries. Standpipes were installed within all window sample positions and will be utilised to measure concentrations of ground gases and to allow for groundwater/leachate sampling. The depth of the wells installed as part of this phase of works is noted to be limited to a maximum depth of 5.0m bgl (subject to drilling conditions and potential obstructions encountered), as such any water obtained is likely to represent rainfall infiltrating through the site and leachate as opposed to groundwater underlying the site.

41No. machine excavated trial pits (ref: TP01 to TP07, TP09 to TP15, TP18 to TP21, TP24 to TP32, TP35 to TP41, TP43, and TP45 to TP50) were undertaken to depths of between 0.50m below ground level (bgl) and 3.00m bgl. 12No. window sample boreholes (ref: WS01 to WS12) were undertaken to depths of between 0.80m bgl and 5.00m bgl, and 17No. hand pits (ref: HP01 to HP06, HP07A, HP07B, HP08 to HP10, TP08/HP, TP16/HP, TP17/HP, TP33/HP, TP34/HP, TP42/HP and TP44/HP) were undertaken to depths of between 0.05m bgl and 1.00m bgl. The hand pits were located in areas where access with an excavator was not possible due to health and safety and/or ecological constraints.

The investigation across the site has been spilt into three key areas:

- **Former Landfill -** TP13 to TP15, TP18 to TP21, TP24 to TP32, TP35 to TP41, TP43, TP45 to TP50, WS02 to WS06, WS08 to WS12, HP01 to HP03, TP08/HP, TP16/HP, TP17/HP, TP33/HP, TP34/HP, TP42/HP and TP44/HP.
- **Ancient Woodland** (to include areas utilised for camping) - HP04 to HP10.
- **South-West** (Area of proposed residential development) - TP01 to TP07, TP09 to TP12, WS01 and WS07.

It should be noted that all intrusive locations were subject to ecological constraints. An ecologist was present on site during the investigation work undertaken with designated routes for traversing the site agreed and investigation positions cleared for ecology prior to breaking ground. Some isolated areas of the site were noted to be completely off limits due to the presence of badger sets identified within an area of the woodland and the need to maintain a buffer zone from these areas. In addition to the above, all intrusive positions within the ancient woodland on the east and south-east of the site were limited to hand excavation within areas devoid of vegetation at the request of the ecologist.

All positions were also scanned for services by the engineer on site prior to breaking ground.

Soil, leachate and surface water samples were collected and placed into appropriate containing (amber jars, plastic tubs, amber bottle and plastic bottles with preservatives) and cool boxes on site for transit to the office, where they were stored under chilled conditions (<4oC) prior to final transportation in cool boxes to the laboratory by their in-house courier. Both the geotechnical and contamination (soil, leachate and surface

water) testing were undertaken by UKAS accredited laboratories. Contamination testing of soil samples was also undertaken in accordance with accredited MCERTs protocols. Samples were stored in temperature controlled conditions from sampling until receipt at the laboratory from which time sample preparation and storage was determined by testing requirements and in line with laboratory's protocols.

3.0 ENCOUNTERED CONDITIONS

A factual record of the conditions encountered during the physical investigation of the site is presented in the following sections.

For further details of the encountered ground conditions, reference should be made to the engineer's logs presented in Appendix B, the groundwater and gas monitoring assessment presented in Appendix C, and the chemical testing results (soil, leachate and surface water) presented in Appendix D.

The physical ground investigation works were undertaken between the 5th and 12th July 2018. Contamination testing was undertaken by a UKAS accredited laboratory.

Unless stated otherwise, all depths are reported as metres below ground level (m bgl).

3.1 Ground Conditions

The geology underlying the site was anticipated to comprise the Ardingly Sandstone Member on the south-west of the site, the Lower Tunbridge Wells Sand on the central portion with the remainder of the north and north-east of the site occupied by the Wadhurst Clay Formation. Superficial Head Deposits were also anticipated on the central portion of the site. With reference to the Desk Top Study, the majority of the site was anticipated to be underlain by a potentially significant thickness of Made Ground/infill ground associated with the former Standen Landfill.

Investigation positions located in the vicinity of the former landfill but outside the ancient woodland (TP13 to TP15, TP18 to TP21, TP24 to TP32, TP35 to TP41, TP43, TP45 to TP50, WS02 to WS06, WS08 to WS12, HP01 to HP03, TP08/HP, TP16/HP, TP17/HP, TP33/HP, TP34/HP, TP42/HP and TP44/HP) encountered Made Ground up to 5.00m bgl (which comprised the maximum depth of investigation position). It should be noted that natural clays of the Wadhurst Clay Formation were only encountered at depth beneath the Made Ground within WS02 at a depth of 3.00m bgl, WS08 at a depth of 4.20m bgl and within TP48 at a depth of 2.30m bgl.

Trial pits excavated on site were limited to a depth of 3.0m bgl and window sampler boreholes to a depth of 5.0m bgl (subject to drilling conditions. With the exception of WS02, WS08 and TP48 investigations in all other locations was unable to prove the vertical extent of the waste body. A generalised summary of the encountered ground conditions is presented in Tables 3.1.

Top (m bgl)	Base (m bgl)	Geology	Position
0.00	2.30 - 5.00+	MADE GROUND: Light/dark/yellowish brown to blue, black and green silty, clayey gravelly sand, and sandy silt gravelly clay matrix with abundant concrete, brick, metal, tarmacadam, clinker, carbonaceous inclusions, timber, plastic, metal, fabric and glass.	All
2.30 - 4.20	5.00	WADHURST CLAY FORMATION: Firm to stiff orangish brown, yellowish brown and grey mottled silty CLAY, sandy CLAY and CLAY with occasional roots.	WS02, WS08 & TP48

Table 3.1 Summary of Ground Conditions (Former Landfill)

Positions situated within the ancient woodland (HP04 to HP10) encountered natural clays of the Wadhurst Clay Formation beneath limited thicknesses of Topsoil, with the exception of HP06 and HP10 in which a

thickness of Made Ground was encountered. A generalised summary of the encountered ground conditions is presented in Tables 3.2.

Top (m bgl)	Base (m bgl)	Geology	Position
0.00	0.05 - 0.10	TOPSOIL: Orangish brown, light brown, dark brown and grey sandy silt and organic sandy silt with frequent rootlets.	HP04, HP05, HA07A & HP07B, HP08 & HP09
0.00	0.40 - 0.90*	MADE GROUND: Light greyish brown and dark brown sandy silt and sandy organic silt with frequent rootlets and concrete, occasional carbonaceous inclusions and brick.	HP06 & HP10
0.10 - 0.40	0.75 - 1.00	LOWER TUNBRIDGE WELLS SAND: Light greyish brown, orange, orangish brown and grey mottled sandy clayey SILT and sandy SILT with occasional siltstone inclusions and lenses, and roots.	HP04, HP05, HP08, HP09 & HP10
0.75	1.00	WADHURST CLAY FORMATION: Firm to stiff orangish brown and greyish blue mottled silty CLAY with frequent ferruginous specks and occasional siltstone inclusions and roots.	HP08

* Depth of Made Ground at HP06 potentially shallower than 0.90m bgl; concrete pushed down to base of intrusive position.

Table 3.2 Summary of Ground Conditions (Ancient Woodland)

The majority of positions (TP01 to TP07, TP09 to TP12, WS01 and WS07) located on the south-west portion of the site (i.e. to the west and south of the existing buildings) encountered only natural soils of the Ardingly Sandstone Member beneath a thin mantle of Topsoil. The exception to this was TP05 in which Made Ground was encountered to a depth of 0.80m bgl. A generalised summary of the encountered ground conditions is presented in Tables 3.3.

Top (m bgl)	Base (m bgl)	Geology	Position
0.00	0.20 - 0.50	TOPSOIL: Light greyish brown and brown sandy silt and silty sand with frequent rootlets, occasional roots, and rare brick.	TP01 – TP04, TP06, TP07, TP09 - TP12, WS01 & WS07
0.00	0.80	MADE GROUND: Greyish brown sandy silt with abundant brick, concrete, plastic, slate, wire and metal.	TP05
0.20 - 0.80	4.70	ARDINGLY SANDSTONE MEMBER: Light orangish brown, light brown, light yellowish brown and grey mottled silty and clayey fine to medium SAND and sandy SILT with occasional sandstone inclusions and rare roots.	All

Table 3.3 Summary of Ground Conditions (South-West)

It was not possible to extend all the window sampler boreholes to the full proposed depth of 5.0m bgl on the site due to the nature of the waste mass encountered and refusals on concrete within the investigation locations across areas of the site.

In addition during the site walkover a fragment of potential asbestos boarding was noted at ground level within the field area of the site where waste materials were evident at surface level. However no further evidence of this material was identified within the investigation positons excavated across the site.

For further details of the ground conditions encountered, reference should be made to the trial pit, hand pit and borehole logs presented in Appendix B.

3.2 Leachate

Groundwater was not encountered within the intrusive positions undertaken due to the limited depth of investigation works on the site (maximum depth of 5.0mbgl) with groundwater expected to be present at depth beneath the site.

However, limited leachate was encountered within the Made Ground within several positions during the intrusive investigation works as summarised in Table 3.4. It is considered that this represent water that has infiltrated through site and passed through the waste mass, potentially leaching contaminants and has then become contained on lower permeability bands within the waste mass.

Position	Depth of strike (m bgl)
TP30	2.00
TP43	1.80
WS02	2.90
WS06	4.88
WS12	3.20

Table 3.4 Summary of leachate depths encountered during intrusive investigation works (m bgl)

It should be noted that intrusive investigation works were undertaken following and during a period of warm dry weather. In addition, no surface water was noted within the stream bed running along the northern boundary of the site or seepages on site at the time of the investigation.

Monitoring standpipes were installed within all twelve window sample positions (WS01 to WS12) to depths of between 0.80m bgl and 5.00m bgl. Four of the planned twelve monitoring visits have currently been undertaken on site at the time of reporting on the 30th July 10th, 24th August and 7th September 2018, with the results of the monitoring presented in Table 3.5.

Position	Standpipe Depth (m bgl)	30/07/18	10/08/18	24/08/18	7/09/18
		Depth (m bgl)	Depth (m bgl)	Depth (m bgl)	Depth (m bgl)
WS01	4.40	Dry	Dry	Dry	Dry
WS02	4.40	2.33	2.32	2.36	2.40
WS03	2.56	Dry	Dry	Dry	Dry
WS04	4.70	Dry	Dry	Dry	Dry
WS05	4.87	4.75	4.86	4.85	4.75
WS06	2.78	Dry	Dry	Dry	Dry
WS07	1.95	Dry	Dry	Dry	Dry
WS08	4.83	4.05	4.27	4.26	4.31
WS09	3.55	Dry	Dry	Dry	Dry
WS10	0.70	Dry	Dry	Dry	Dry
WS11	4.86	2.26	2.65	2.65	2.68
WS12	4.80	0.88	1.00	1.15	1.31

Table 3.5 Summary of encountered leachate depths within standpipes to date (m bgl)

It should be noted that the water encountered within the standpipes on site are not considered to be the true groundwater underlying the site and is likely to represent perched accumulations of water (leachate) which have infiltrated through the waste mass on the site. The installation of deeper monitoring wells on site to enable the collection of groundwater samples at depth beneath the site if required will form a separate phase of works on the site.

Although the stream was noted to have been dry during the intrusive works, flowing water was observed within parts of the stream running along the site's north western boundary during the return monitoring visits between the 30th July and 7th September 2018.

During the return monitoring undertaken leachate and surface water samples have been collected for analysis on the 30th July 10th August and 24th August 2018 where sufficient volume of water/leachate was available. The results of this analysis are discussed in Section 4.0.

3.3 Ground Gases & Vapours

Ground gas monitoring standpipes were installed within Boreholes WS01 to WS12. These positions were monitored for methane, carbon dioxide, oxygen and borehole gas flow on four occasions between July and September 2018. Twelve monitoring visits are currently proposed for the site.

During the monitoring visits, methane was recorded at concentrations ranging between 0.0% v/v and 53.0% v/v, whilst carbon dioxide and oxygen were present in the range 0.0% – 11.4% v/v and 0.0% – 20.9% v/v respectively. A maximum borehole flow of 0.4l/hr was recorded. Negligible VOCs were recorded as ranging between 0.0ppm and 1.0ppm. The atmospheric pressure was recorded as ranging between 955mb and 1008mb.

The findings of the ground gas monitoring to date have been discussed in Section 4.0. The ground gas assessment will be updated on completion of the monitoring.

3.4 Obstructions

Artificial impenetrable obstructions were only encountered within areas occupied by the former landfill/waste body on site, with several of the window sample positions refusing on concrete at depths of between 0.80m bgl and 3.60m bgl.

As such, the presence of obstructions elsewhere on site (within the boundary of the encountered landfill) should not be discounted.

3.5 Geochemical Analysis

In order to assess the general chemical quality of the strata encountered, samples of soils recovered from the exploratory holes were submitted for analysis for a range of potential contaminants selected on the basis of the findings of the desk study and supported by the joint National House Building Council (NHBC), Environment Agency (EA) and Chartered Institute of Environmental Health (CIEH) publication, '*Guidance for the Safe Development of Housing on Land Affected by Contamination*' (2008).

45No. soil samples were placed into plastic containers for general inorganic analysis and into amber jars for organic analysis. Samples were stored in temperature controlled conditions from sampling until receipt at the

laboratory from which time sample preparation and storage was determined by testing requirements and in line with the laboratory's protocols.

Soil samples were submitted for analysis for a comprehensive suite of common zootoxic and phytotoxic elements based upon determinands listed within the above guidance including speciated petroleum hydrocarbon analysis and asbestos screens.

In addition, 14No. samples of soil were submitted for a suite of volatile organic compounds (VOC) and semi-volatile organic compounds (SVOC).

Furthermore, 12No. samples of soil were submitted for analysis for ammoniacal nitrogen, seven samples for a suite of cyanides, and five samples for a suite of organochlorine pesticides.

Leachate analysis was undertaken on 16No. samples of the soils encountered on site to determine the potential for leachable contaminants.

The soil analysis undertaken was scheduled to provide a spread of coverage across the site and across the depth profile of the waste mass encountered on the site.

Four samples of leachate and one sample of the stream water were also collected and submitted for analysis of a similar suite to the soils on the 30th July 10th August and 24th August 2018, albeit augmented with dissolved oxygen (DO), electrical conductivity (EC), biological oxygen demand (BOD) and biochemical oxygen demand (BOD). Analyses for cyanides, VOC, SVOC, ammoniacal nitrogen, ammonium, nitrate and nitrite were also scheduled. The results of which are discussed in Section 4.0.

4.0 ENVIRONMENTAL CONSIDERATIONS

A Generic Quantitative Risk Assessment (GQRA) incorporating the results of the previous third party desk study and subsequent ground investigation was undertaken in accordance with CLR11, the findings of which are presented in the following sections.

Site workers involved in the preparation and construction of any works or development on site have not been considered further in this assessment as the Principal Contractor is duty bound under the current CDM Regulations to undertake their own risk assessments with respect to their employees.

4.1 Outline Risk Assessment

A number of plausible pollutant linkages were identified as part of the previous third party desk study undertaken for the site, as summarised in Section 2.7. The intrusive investigation works did not encounter conditions that warranted a revision of the preliminary Conceptual Site Model.

4.2 Soil Contamination vs. End Users

The presence of a possible contaminant does not necessarily imply that a site or area is contaminated or that there is any unacceptable risk to human health. A Preliminary Quantitative Risk Assessment has been undertaken in accordance with CLR11, in order to evaluate any unacceptable risks posed to human health with respect to the proposed redevelopment. It should be noted that this assessment is protective of the chronic long-term effects of contaminants, which is also likely to be protective of any possible immediate acute effects.

A quantitative risk assessment has been undertaken by comparing the results of the laboratory chemical testing of shallow soils against Atkins' ATRISK Soil Screening Values (SSV) generated using the Contaminated Land Exposure Assessment (CLEA) model v1.06 published by the Environment Agency, or against the Category 4 Screening Levels (C4SLs) published by DEFRA or the Land Quality Management (LQM) Chartered Institute of Environmental Health (CIEH) S4ULs. Although the C4SLs were released for Part 2A use, the associated policy companion document for the C4SLs indicated that they may also be used for planning. Although the C4SLs represent a marginally higher risk level than the SSACs (low risk rather than minimal risk) it is considered that the risk levels remain very low. Therefore, the final C4SLs are considered to be suitable to assess soils under the planning regime.

Where appropriate, statistical analysis of the samples within the datasets was undertaken in accordance with guidance contained in the CIEH/CL:AIRE report '*Comparing Soil Contamination Data with a Critical Concentration*' (May 2008). If the contamination status of the soils is considered in a planning context, the null hypothesis tested by the analysis is whether the true mean concentration is equal to or greater than the critical concentration for a given determinant, with the critical concentration being the relevant SSAC or GAC (the soil screening value) for that determinant in the context of the intended end use of the site. If the analysis shows that the true mean concentration is less than the critical concentration the null hypothesis can be rejected. The guidance recommends that for the null hypothesis to be rejected the analysis should show that there is a 95% (or higher) likelihood that the true mean concentration is below the critical concentration. Where this is the case the site is considered to be acceptable for the planned end use without any necessary remedial measures. However, a statistical assessment is not considered representative where targeted sampling and analysis has been undertaken.

The results of the analysis undertake have been separated into the three key areas for assessment:

1) Former Landfill
2) Ancient Woodland
3) South-West Area

4.2.1 Former Landfill

This portion of the site is currently comprises open space and going forward is proposed to be used for pasture and amenity space for the existing residential property and for campers using the adjacent ancient woodland camp site.

The dataset has been broken down into each type of material encountered to include existing landfill cover material, deeper landfill material, and natural soils beneath the landfill materials (where encountered at the edges of the waste mass), in order to allow for appropriate analysis.

Existing Landfill Cover Material

The statistical analysis undertaken on samples of the existing landfill cover material encountered within the intrusive positions on this portion of the site utilised either C4SL (soil organic matter [SOM] of 6%) for Public Open Space 1, S4UL (SOM of 1% where appropriate) for residential public open space or Atkins' ATRISK SSVs for a 'Public Open Space (residential)' (SOM of 1%). Atkins ATRSK SSVs have been utilised on the site as they allow the assessment against a SOM of 1% which is considered to be more representative of the site as opposed to a SOM of 6%.

The results of the statistical analysis undertaken on samples of the existing landfill cover material indicated that the null hypothesis could be rejected for all the determinands examined with the exception of benzo(a)pyrene which indicated an evidence level of 69%. It should be noted that a single outlier for benzo(a)pyrene was encountered within WS03 at a depth of 0.20m bgl (26.8mg/kg). When removed from the dataset the null hypothesis for benzo(a)pyrene can be rejected. However, there were no visual differences between the materials encountered within WS03 and those encountered elsewhere on this portion of the site, as such the outlier could not be treated as a hot spot and removed from the dataset.

All samples submitted for asbestos screens were returned with no asbestos fibres identified.

Furthermore, samples submitted for organochlorine pesticide suites, all indicated results below the laboratory detection limits.

Deeper Landfill Material

Table 4.1 summarises the laboratory results for samples of the deeper landfill materials (>1.0m bgl) encountered on this portion of the site.

Determinand	Unit	Minimum concentration	Maximum Concentration
Arsenic	mg/kg	4.5	30.4
Barium	mg/kg	23	473
Beryllium	mg/kg	<1.0	2.8
Cadmium	mg/kg	<0.5	5.5
Chromium	mg/kg	8.9	42.2
Copper	mg/kg	8.2	341
Lead	mg/kg	13.9	788
Mercury	mg/kg	<0.5	0.9

Nickel	mg/kg	6.4	54
Selenium	mg/kg	<1.0	1.3
Vanadium	mg/kg	11.8	57.7
Zinc	mg/kg	18.3	546
Elemental Sulphur	mg/kg	<20	1810
Total Sulphide	mg/kg	<2.0	130
Total Cyanide	mg/kg	<1.0	8.1
Water Soluble Boron	mg/kg	<0.5	2.9
pH	pH	5.2	11.1
Total Organic Carbon	%	0.26	6
Total Phenols	mg/kg	<6	13
Naphthalene	mg/kg	<0.1	10.9
Acenaphthylene	mg/kg	<0.1	3.9
Acenaphthene	mg/kg	<0.1	30.8
Fluorene	mg/kg	<0.1	33.8
Phenanthrene	mg/kg	<0.1	350
Anthracene	mg/kg	<0.1	116
Fluoranthene	mg/kg	<0.1	403
Pyrene	mg/kg	<0.1	324
Benzo(a)anthracene	mg/kg	<0.1	151
Chrysene	mg/kg	<0.1	153
Benzo (b) fluoranthene	mg/kg	<0.1	124
Benzo(k)fluoranthene	mg/kg	<0.1	113
Benzo (a) pyrene	mg/kg	<0.1	123
Indeno (1,2,3-cd) pyrene	mg/kg	<0.1	79.1
Dibenzo(a,h)anthracene	mg/kg	<0.1	18.8
Benzo[g,h,i]perylene	mg/kg	<0.1	79.1
Total PAH(16)	mg/kg	<0.1	2100
Toluene	µg/kg	<10	305
>C8-C10 Aliphatic	mg/kg	<1.0	101
>C10-C12 Aliphatic	mg/kg	<1.0	136
>C12-C16 Aliphatic	mg/kg	<1.0	1080
>C16-C21 Aliphatic	mg/kg	<1.0	1400
>C21-C35 Aliphatic	mg/kg	<1.0	1350
>C35-C40 Aliphatic	mg/kg	<1.0	309
>C7-C8 Aromatic	mg/kg	<0.01	0.31
>C8-C10 Aromatic	mg/kg	<1.0	83.3
>C10-C12 Aromatic	mg/kg	<1.0	144
>C12-C16 Aromatic	mg/kg	<1.0	1050
>C16-C21 Aromatic	mg/kg	<1.0	1510
>C21-C35 Aromatic	mg/kg	<1.0	1880
>C35-C40 Aromatic	mg/kg	<1.0	499
Total (>C5-C40) Ali/Aro	mg/kg	<0.01	9240

Table 4.1 Summary of Laboratory Results (deeper landfill materials)

The VOC and SVOC analysis undertaken from the soils at depth within the waste mass have also identified the presence of volatile contaminants comprising primarily PAH and Phenols. In additional ammoniacal nitrogen concentrations identified within the soils are noted to have the potential to become leached, mobilised to groundwater (at depth) or surface water receptors with concentrations reported between 1.2mg/kg to

137mg/kg, with the high concentrations generally present at depth within the waste mass.

In addition, all samples submitted for asbestos screens were returned with no asbestos fibres identified.

Furthermore, samples submitted for organochlorine pesticide suites, all indicated results below the laboratory detection limits.

Given the maximum concentrations of contaminants of concern identified at depth within the waste mass it is considered that there is the potential that these contaminants may be mobilised and as such pose a risk of leaching and a risk to surface water and underlying groundwater on the site through surface water infiltration and the creation of leachate throughout the waste body on the site.

It is considered that remediation measures would be required with respect to controlled waters which in turn would serve to be protective of Human health.

Former Landfill - Remedial Measures

Due to the elevated concentrations of benzo(a)pyrene identified across the site, it is recommended that a cover system be utilised to protect end users of the site and to prevent leaching of the contaminants contained within the waste body. In addition, this would further mitigate the risk associated with the physical quality of the encountered near surface soils (brick, tarmacadam, metal, glass, etc.). Imported materials should be both physically and chemically suitable for the proposed end use. This would also serve to be protective of any livestock which may subsequently utilised these areas as pasture.

Whilst the risk to controlled water is discussed further in Section 4.6, it is considered that remediation measures will be required on the site. At this time it is proposed that this comprises a minimum thickness of 1.1m to comprise an impermeable clay cap in order to reduce infiltration through the site together with the construction of a gas venting layer and drainage layer, to channel surface water runoff over land to the stream located in the valley at the north of the site and to reduce infiltration through the waste body. In addition to an impermeable layer the cap should be overlain by suitable subsoil and topsoil to provide a suitable growing medium on the site. Imported materials should be both physically and chemically suitable for the proposed end use. This would also serve to be protective of any livestock which may subsequently utilised these areas as pasture.

It is considered that the installation of a capping system on site and review of site drainage to increase overland through rather than direct infiltration and flow through the waste mass may help be protective of controlled waters by limiting the potential leaching of the elevated contaminants of concern identified at depth beneath the site.

It is should be noted that the installation of a capping system and associated drainage design to reduce infiltration may also results in a change to the gassing regime beneath the site and further monitoring should be undertaken following any remediation works to reassess the risk with respect to ground gases. Any capping design for the site will need careful consider ground gases and the potential changes that may occur in the gassing regime due to changes in moisture content of the waste and the changes in existing flow paths.

Certification for all imported materials used to create the cover system should include laboratory analysis for determinands known to pose a risk to human health (i.e. heavy metals, poly-aromatic hydrocarbons [PAHs], total petroleum hydrocarbons [TPH] and asbestos).

Design of an appropriate capping for the site will also need to take into consideration the stability of the material placed and the underlying waste mass. Consideration will need to be given to the potential long terms movement and settlement of the waste mass and the impact this may have on any capping system installed. An element of flexibility will need to be designed into the cap to ensure that movement does not results in fissuring or cracking of the impermeable capping materials. Consideration will also need to be given to the impact of weathering on any cap in terms of the potential for shrinking and swelling where a clay material is utilised.

4.2.2 Ancient Woodland

The analysis undertaken within the ancient woodland across the site has not identified any contaminants concentrations of concern above the respective screening criteria for open space. It is noted that slightly higher ammoniacal nitrogen were noted in the samples collected from HP07A at 0.05m bgl compared to HP7B at 0.10m bgl. Analysis was targeted within this area to locations where iron oxide staining had been noted. The results support the possibility that leachate may be migrating out of bands within the shallow soils located within the ancient woodlands. Based on these results this is likely to present a higher risk as overlain flow to the surface water body located down topographical gradient.

As such whilst it is considered that no specific remediation measures are required with respect the soils quality within the ancient woodland, remediation measures to address the landfill on the wider site would also serve to be protective of this area and likely reduce the leachate migrating.

4.2.3 South-West

The proposals for this portion of the site include the construction of a residential property within the south western-most field with associated private gardens and areas of soft landscaping.

The results of the analysis undertaken on samples of the Topsoil encountered within the intrusive positions on this portion of the site were compared individually against either C4SL (soil organic matter [SOM] of 6%) or Atkins' ATRISK SSVs for a 'residential with consumption of home-grown vegetables' land use (SOM of 1%). The average SOM content for the encountered Topsoil was 1.8%, as such the use of the ATRISK SSVs was considered to be appropriate and to present a conservative assessment.

The results indicated that all determinands were either below the laboratory detection limits of the relevant thresholds with the exception of barium in both samples of Topsoil. Concentrations of barium within WS03 and TP03 were 57.9mg/kg and 67.9mg/kg respectively. The ATRISK SSV for barium ranged between 56.8mg/kg (1% SOM) and 110mg/kg (6% SOM). Given the average SOM for the Topsoil on this parcel of land was 1.8%, it is considered likely that a site-specific threshold would be higher than the maximum recorded concentration of barium.

The results of the analysis undertaken on the sample of Made Ground encountered within TP05 were compared individually against either C4SL (soil organic matter [SOM] of 6%) or Atkins' ATRISK SSVs for a 'public open space 1' land use (SOM of 1%). The SOM content for the encountered Made Ground was 1.5%, as such these thresholds were considered to be conservative.

The results indicated that all determinands were either below the laboratory detection limits of the relevant thresholds.

The results of the statistical analysis undertaken on samples of natural soils encountered on this portion of the

site indicated that the null hypothesis could be rejected for all the determinands examined.

A single outlier for cyanide was identified within the dataset, however the concentration was well below the relevant threshold.

In addition, all samples submitted for asbestos screens were returned with no asbestos fibres identified.

As such, remedial measures are not considered necessary within the south western portion of the site to protect future end users of any proposed residential development from soils this area. However, remedial measures would be necessary in parts of the site where any development proposals include the placement of private or communal soft landscaping over the isolated areas (i.e. TP05) of encountered Made Ground in order to provide a suitable growing medium within these areas.

4.3 Soil Contamination vs. Adjacent Land Users

Surrounding land uses mostly residential, agricultural and open space. Elevated contaminant concentrations were identified on the site, primarily at depth associated with the landfill materials, with concentrations of potentially harmful mobile contaminants identified which are considered to represent a risk to controlled waters and to a lesser degree (due to depth) to human health.

However given the topography of the site and the presence of a stream flowing within the valley along the northern boundary of the site it is considered that adjacent land users are unlikely to come into contact with the soil/waste identified on site and that the primary receptor in this respect would be the stream which would be expected to intercept any potential flow and leachate migration on the site. Therefore, no remedial action is considered necessary to protect adjacent land users from soils on site over and above the measures already proposed for the end users and controlled waters on the subject site itself.

It is recommended that dust suppression techniques, e.g. damping down exposed soils, are employed during the construction phases on site in order to minimise the potential for airborne migration of specific hazards and to manage potential nuisance issues for adjacent land users.

4.4 Soil Contamination vs. Soft Landscaping

4.4.1 Former Landfill

The results of the chemical analysis for determinants known to pose a potential phytotoxic risk to plant growth are summarised in Table 4.2, together with the respective adopted Generic Assessment Criteria (GAC) for plant growth. The compliance criteria set out in BS3882:2015 are pH dependent and thus the GAC used relate to the pH range measured on samples recovered from the site.

Determinand	Phytotoxicity GAC (mg/kg)			GAC Exceedances
	pH <6.0	pH 6.0-7.0	pH >7.0	
Zinc	200	200	300	Yes
Copper	100	135	200	No
Nickel	60	75	110	No

Table 4.2 Summary of Plant Phytotoxicity Assessment (Former Landfill)

Although the phytotoxicity assessment did identify exceedances of the relevant threshold for zinc, the recommended remedial measures to protect end users (to comprise a capping system on the site) would

effectively negate the need for any specific remedial measures with regards to new planting on this portion of the site.

4.4.2 Ancient Woodland

The results of the chemical analysis for determinants known to pose a potential phytotoxic risk to plant growth are summarised in Table 4.3, together with the respective adopted Generic Assessment Criteria (GAC) for plant growth. The compliance criteria set out in BS3882:2015 are pH dependent and thus the GAC used relate to the pH range measured on samples recovered from the site.

Determinand	Phytotoxicity GAC (mg/kg)			GAC Exceedances
	pH <6.0	pH 6.0-7.0	pH >7.0	
Zinc	200	200	300	No
Copper	100	135	200	No
Nickel	60	75	110	No

Table 4.3 Summary of Plant Phytotoxicity Assessment (Ancient Woodland)

The phytotoxicity assessment did identify any exceedances of the relevant thresholds as such no specific measures are considered to be required in this respect.

4.4.3 South-West

British Standard BS3882:2015 *Specification for topsoil and requirements for use* provides assessment criteria for a number of potentially phytotoxic contaminants in terms of new planting.

The results of the chemical analysis for determinants known to pose a potential phytotoxic risk to plant growth are summarised in Table 4.4, together with the respective adopted Generic Assessment Criteria (GAC) for plant growth. The compliance criteria set out in BS3882:2015 are pH dependent and thus the GAC used relate to the pH range measured on samples recovered from the site.

Determinand	Phytotoxicity GAC (mg/kg)			GAC Exceedances
	pH <6.0	pH 6.0-7.0	pH >7.0	
Zinc	200	200	300	Yes
Copper	100	135	200	Yes
Nickel	60	75	110	No

Table 4.4 Summary of Plant Phytotoxicity Assessment (South-West)

Although the phytotoxicity assessment did identify exceedances of the relevant thresholds for zinc and copper, the exceedances were limited to the Made Ground encountered within TP05. As such, remedial measures to protect proposed soft landscaping would only be required when situated over the localised areas of Made Ground encountered on the portion of the site. These remedial measures would be limited to an appropriate thickness of 'clean' cover to sustain plant growth.

4.5 Soil Contamination vs. Building Materials

South-West – Potable Water Supply Pipes

The current guidance on selection of materials for water supply pipes to be laid in contaminated land is contained in UK Water Industry Research's (UKWIR) report reference 10/WM/03/21 (re-issued 2010).

However, the guidance is not mandatory and there have been concerns raised by various industry technical associations regarding the document and the methodologies proposed.

Although there are concerns regarding the document, in lieu of any further guidance in the first instance the results of this investigation have been compared with the proposed thresholds published in UKWIR Table 3.1. The results of the relevant chemical analyses did not indicate exceedances of the thresholds within the encountered Topsoil or natural soils. Based on the chemical testing results, it barrier pipe will not be required for potable water supply pipes on site. However, should potable water supplies pass through any encountered Made Ground (i.e. TP05) then these will require protection (barrier pipe). However, it is recommended that the water supply company be contact to confirm their specific requirements in this respect.

As a matter of good practice, it is recommended that clean, granular backfill is used in service runs and that marker tapes are used for all buried services.

South-West – Sulphates (Buried Concrete)

The results of the sulphate and pH analysis undertaken on samples of the Topsoil and natural soils on this portion of the site found the soil samples tested to have a water soluble sulphate concentration within design sulphate (DS) class DS-1 of BRE special digest 1. An aggressive environment for concrete (ACEC) classification of AC-1 is deemed appropriate for foundations within this stratum. However, it should be noted that an anomalous pH result (pH3.9) was encountered within WS01 which would render the ACEC classification as AC-2z. This aside, the sample tested was recovered from a depth of 4.50m bgl, i.e. significantly below the likely traditional foundation depth of a proposed low-rise building.

It should also be noted that the results of the sulphate and pH analysis undertaken on a single sample of the Made Ground encountered within TP05 found the soil samples tested to have water soluble sulphate concentration within design sulphate (DS) class DS-2 of BRE special digest 1. An aggressive environment for concrete (ACEC) classification of AC-2 is deemed appropriate for foundations extending through this stratum.

The advice of the above publication should be taken for the design and specification of all sub-surface concrete.

Landfill – Potable Water Supply Pipes

Although no proposed construction works are due to take place on the landfill portion of the site, it should be noted that any potable water supply pipes passing through the Made Ground on this portion of the site should be protected (barrier pipe). Should it be required to install pipework through this area of the site it is recommended that the local water company supplier be contacted to confirm their specific requirements in this respect.

4.6 Soil Contamination vs. Surface Water

A small, north easterly flowing stream was observed running along the north eastern boundary at the foot of the steep slope on site, within the valley. Although the stream was noted to be dry during the intrusive works undertaken these were noted to correspond with a period of warm and dry weather. However, flowing water was observed across part of the stream bead during the return monitoring visits undertaken between the 30th July and 7th September 2018 and samples were taken for laboratory analysis on three occasions during this period.

The results of the laboratory analysis undertaken on the sample of surface water encountered in the stream

from the 30th July 10th August and 24th August were compared against the Environmental Quality Standards (EQS) for a freshwater stream. The results of the poly-cyclic aromatic hydrocarbon (PAH) analysis indicated several exceedances of the thresholds, as summarised in Table 4.4.

Determinand	Threshold (µg/l)	Result (µg/l)
Fluoranthene	0.02	0.10-0.98
Benzo (b) fluoranthene	0.03	0.07-0.48
Benzo (k) fluoranthene	0.03	0.07-1.82
Benzo (a) pyrene	0.05	0.09-0.50
Indeno (1,2,3-cd) pyrene	0.02	0.05-0.28
Benzo(ghi)perylene	0.002	0.05-0.34

Table 4.4 Summary of Stream Water Analysis (30th July to 24th August 2018)

The results of the phenol, TPH and VOC analysis undertaken on the sample of stream water taken on the 30th July 10th August 2018 were all noted to be below the laboratory detection limits. With TPH on the 24th August 2018 recorded at 14.7ug/l, Toluene at 12ug/l and Chlorobenzene at 2ug/l.

With respect to the PAH concentrations identified within the stream over the monitoring period the analysis has shown a general increase over each of the three visits where sampling and analysis was undertaken. It is considered that this relates to the change in weather, with further rainfall and infiltration occurring, passing through he landfill body and leaching contaminant out to the adjacent surface water as we move away from the hot dry summer months.

The analysis supports the assessment that the contaminants within the waste mass on the site are mobile, leaching and impacting controlled waters, as such It is considered that remediation measures area required with respect to the former landfill area to reduce the ongoing risk to controlled waters.

Leachate within Monitoring Wells

The results of the analysis undertaken on samples of leachate taken from standpipes installed within WS02, WS08, WS11 and WS12 from the 30th July 10th August and 24th August 2018 were compared individually with the Environmental Quality Standards (EQS) for a freshwater stream (perceived as the most sensitive receptor). The results of the analysis indicated several exceedances of the relevant thresholds, as summarised in Table 4.5.

Determinand	Threshold (µg/l)	Result Range (µg/l)
Barium	100	121 - 273
Naphthalene	10	15.9 - 4.45
Fluoranthene	0.02	0.28 - 1200
Anthracene	0.1	0.12 - 171
Benzo (b) fluoranthene	0.03	0.22 - 547
Benzo (k) fluoranthene	0.03	0.18 - 431
Benzo (a) pyrene	0.05	0.24 - 779
Indeno (1,2,3-cd) pyrene	0.02	0.15 - 316
Benzo(ghi)perylene	0.002	0.16 - 369

Table 4.5 Summary of Leachate Analysis (from installed monitoring wells) - July to August 2018

In addition to the above, total petroleum hydrocarbon (TPH) concentrations within the four samples analysed

ranged between <5µg/l and 501 µg/l.

Laboratory Leachate from Soils

The results of the leachate analysis undertaken on samples of deeper Made Ground encountered within the former landfill were also compared individually with the Environmental Quality Standards (EQS) for a freshwater stream (perceived as the most sensitive on site receptor). The results of the analysis indicated several exceedances of the relevant thresholds, as summarised in Table 4.6.

Determinand	Threshold (µg/l)	Result Range (µg/l)
Vanadium	20	<5 - 87
Anthracene	0.1	0.01 - 0.61
Fluoranthene	0.02	0.02 - 0.37
Benzo (b) fluoranthene	0.03	<0.01 - 0.21
Benzo (k) fluoranthene	0.03	<0.01 - 0.24
Benzo (a) pyrene	0.05	<0.01 - 0.26
Indeno (1,2,3-cd) pyrene	0.02	<0.01 - 0.15
Benzo(ghi)perylene	0.002	0.01 - 0.23

Table 4.6 Summary of Laboratory Leachate Analysis (from soils)

In addition to the above, a single sample (TP37 at 3.00m bgl) indicated a leachate total petroleum hydrocarbon (TPH) concentration of 18.7µg/l.

Based on the results of the surface water monitoring, leachate analysis from monitoring installations and laboratory leachate analysis to date, it was considered that contaminants of concern from within the soil and waste mass within the former landfill area on the site are likely to be impacting on controlled waters (surface water stream) and the remedial measures are recommended to protect the surface water feature on site.

However, the implementation of the recommended cover system (Section 4.2.2) would aid in the reduction of contaminated run-off and infiltration of rainwater passing through the waste mass, is considered to serve a reduction on the existing infiltration and mobilidation on contaminants beneath the site to the adjacent surface water. As such, the requirement for any other specific remedial measures to protect the surface water feature is not considered necessary.

4.7 Soil Contamination vs. Groundwater

It should be noted that the water encountered within the standpipes on site is not considered to be deep groundwater within the underlying nature soils on site and is likely to represent perched accumulations of water (leachate) which has infiltrated through the waste mass.

Given the concentrations of contaminants within the leachate encountered and the leachate analysis undertaken on samples from within the former landfill there is the potential for downward leaching of contaminants into the underlying aquifer. Given the relatively shallow extent of the investigation to date, the impact upon groundwater has not been possible to verify. Additional intrusive investigation utilising cable percussive or rotary coring techniques would be required to install deep groundwater monitoring installations. Any such additional deep investigation should also target locations such that the groundwater quality up-gradient of the site where possible can also be determined in order to assess the general background quality of groundwater within the area.

4.8 Ground Gases & Vapours vs. End Users

In assessing the ground gases on the site, the site has been zoned to assess the south west portion where a new residential development is proposed separately from the reminder of the site which is associated with the area of infilled land and associated gas risk.

4.8.1 Landfill Area

The desk study identified the former Standen Landfill across the majority of the site, which was being utilised as open space, recreation ground for campers, pasture for livestock and as such it was considered that there was a potential risk with respect to ground gases associated with the infilled materials.

The monitoring wells WS02 and WS012 were located across the site to provide general coverage of the waste mass identified and to target boundaries of the waste. WS07 and WS08 were located in areas where natural ground was encountered however WS07 was noted to be located on the boundary of the former waste area and as such has been assessed with the landfill area.

To date the standpipes within WS02 to WS12 have been 'spot' monitored for methane, carbon dioxide, oxygen, VOC and borehole gas flow on four occasions on the 30th July and 10th August 24th August and 7th September 2018. Further monitoring is proposed to comprise a total of 12No. visits) and the assessment with be undated in due course and completion of the monitoring.

During the monitoring visits, methane was recorded in the range of 0.0% – 53.0% v/v, whilst carbon dioxide and oxygen were present in the range 0.0% – 11.1% v/v and 0% – 20.9% v/v respectively. Positive borehole flow up to 0.4l/hr were detected on the site with positive flow recorded in WS02 on the 10th August and WS12 on the 10th August and 7th September 2018. In addition negligible VOCs were recorded as ranging between 0.0ppm and 1.0ppm. The atmospheric pressure was recorded as ranging between 955mb and 1008mb. The highest methane concentrations recorded were noted to be within WS09 and WS12.

It should be noted that any remediation works comprising the installation of a cap to the former landfill area (subject to the materials utilised) to be protective of human health and controlled water will also need to be designed to take account of the high levels of methane being identified within monitoring wells on the site. Changes in the capping system in this area and any reduction in infiltration through the site are likely to affect the existing gassing regime of the site. Any cap will need to be designed to take account of any potential changes to prevent the build-up of gases or the creation of migrations pathways. Further monitoring should be undertaken following any remediation works on the site.

It is recommended that the capping system installed include a gas venting layer is order to mitigate some on the issue that may arise in terms of a potentially changing gassing regime

This assessment will be updated following and on completion of the additional gas monitoring on the site
.

4.8.2 South-West

The desk study did not identify any potential sources of ground gases within the area of the proposed residential development with the exception of an isolated area of Made Ground, however there remaindered a potential risk associated from landfill gas generated from the adjacent are of former landfill.

WS01 and WS07 monitoring wells were located in areas where natural ground was encountered however WS07 was noted to be located on the boundary of the former waste area and as such has been assessed with the landfill area.

To date the standpipe within WS01 has been 'spot' monitored for methane, carbon dioxide, oxygen, VOC and borehole gas flow on four occasions between the 30th July and 7th September 2018. Further monitoring is proposed and the assessment with be undated in due course and completion of the monitoring.

During the monitoring visits, methane was not recorded within the standpipe WS01, whilst carbon dioxide and oxygen were present in the range 0.0% – 3.1% v/v and 17.4% – 20.9% v/v respectively. No positive borehole flows were recorded during the monitoring visits. In addition, negligible VOCs were recorded as ranging between 0.0ppm and 0.1ppm. The atmospheric pressure was recorded as ranging between 995mb and 1003mb. WS01 was also noted to be dry during the monitoring visit undertaken to date.

Based on the findings of the desk study and the results of the monitoring visits, it is considered that the risk to the site which is located up topographical gradient from the landfill mass on site is considered to be low, however the assessment should be updated on completion of the 12 monitoring visits proposed across the site and wider site.

4.9 Ground Gases & Vapours vs. Adjacent Land Users

The ground gas monitoring undertaken on the site has identified the presence of ground gases at concentrations requiring remediation measures with respect to human health and potentially soft landscaping and public open space. As such it is considered that a potential pollutant linkages exist. However it should be noted that the highest concentrations of ground gases have been identified within the former landfill area within the site with substantially lower concentrations detected at or close to the waste boundaries and reducing further within natural soils suggesting that ground gases are not currently migrating off the site at concentrations which could pose a risk to adjacent land uses which comprise a mix of open space, residential housing, road network.

Further ground gas monitoring is proposed on the site to include a further period of spot monitoring and as such the assessment will be updated once further data have been gathered for the site.

However, In line with best practice, measures should be undertaken on site to ensure that any proposed development or remediation measures do not create potential migration pathways in relation to adjacent land users.

4.10 Ground Gases & Vapours vs. Soft Landscaping

Several trees on the boundaries of the landfill site were noted to be in a poor state of health and this is considered to be potentially associated with the presence of Methane and Carbon Dioxide identified in relation to the landfilled materials on the site.

A potential source of ground gases has been identified on the subject site itself associated with historical infilling activities on the site. In addition, VOCs up to 1.0ppm have currently been recorded. Concentrations of carbon dioxide up to 11.1% have been identified beneath the site, whilst methane has been at concentrations up to 53%.

It is understood that improvement proposals are looking to utilise the former infilled area as open space and pasture on the site. At this stage it is understood that the primary venting of land gases on the site is through the limited capping system and directly to atmosphere with some limited migration through the sub-surface on the site. The nature of the capping system on the site currently is considered to be inadequate for a proposed end use and it is likely that the capping system on the site will need to be re-engineered on the sites. At such time re-engineering of the capping system will need to be carefully considered to ensure that the gas migration pathways and current gassing regime are not significantly altered on site. Such measures should account for soft landscaping as well as human health. It is recommended that consideration be given to installing gas vents across the area of the landfill waste body to create preferential low pathways that can be located away from key receptors to include vegetation.

Further gas monitoring is proposed on the site and the updated ground gas assessment will be issued once further data has been gathered and on completion of the monitoring.

4.11 Waste Disposal

Waste Acceptance Criteria (WAC) testing was outside the scope of investigation works undertaken on the site as it is understood that works that may require the excavation or removal of the waste materials identified on the site are unlikely to be required.

Based on the analysis undertaken from representative samples of the shallow natural soils across the site it is considered the natural soils beneath the site would be likely to comprise inert waste for the purpose of disposal. However, should soils for disposal be identified, Waste Acceptance Criteria (WAC) should be carried out to classify them for the purpose of disposal.

4.11.1 Reuse of Material

Where remediation measure are proposed that include the installation of a capping across the area of the former landfill to reduce infiltration through the site, consideration should be given to utilising the definition of waste Code of Practice (DoWCoP) to source materials for these works in line with an agreed Remediation Method Statement for the site.

In accordance with CL:AIRE Code of Practice (2011) materials are only considered waste if 'they are discarded, intended to be discarded or required to be discarded by the holder'.

The Code of Practice therefore allows soils to be reused on site where the following criteria are met:

- Pollution of the environment and harm to human health is prevented in reusing the excavated materials;
- The material are suitable for use (without any further processing);
- There is certainty of use; and
- The quantity that is absolutely necessary (and no more) is used.

In order to comply with the Code of Practice, a material management plan that confirms the above criteria are met has to be prepared. The material management plan must be reviewed by a 'Qualified Person' who then issues a declaration to the Environment Agency. Geo-Environmental can provide this service should it be required.

Where materials do not meet the required criteria, it may be possible to treat them under an environmental

permit so that they may be re-used on site.

4.11.2 Reuse of Waste

Where material is discarded as waste, it may still be possible to reuse the waste on site under a standard rules environmental permit or a U1 waste exemption. However, strict limits on the volumes that can be reused apply in these cases.

4.11.3 Disposal to Landfill

Under current legislation, where wastes are to be disposed of to landfill they may, depending on their classification, require pre-treatment. Pre-treatment shall comprise a chemical, physical (including sorting), thermal or biological process. The pre-treatment is required to change the characteristics of the waste, reduce its volume, reduce its hazardous nature, and facilitate its handling and enhance its recovery.

4.12 Discovery Strategy

Whilst an intrusive investigation has been undertaken on the site, it remains possible that unexpected soil conditions may be encountered during the process of construction.

Should previously undiscovered conditions be encountered during construction by the ground workers, this should be reported to the site manager immediately in order that any necessary inspection may be made. Records should be kept, and samples submitted for analysis where conditions encountered are not as anticipated. The results of any such testing should be sent to the authorities for consultation.

A copy of the discovery strategy should be lodged on site, and provisions made to ensure that all workers are made aware of their responsibility to observe, report, and act on any potentially suspicious or contaminated materials they may encounter.

Depending on the type, nature and extent of any such 'discovery', it may be necessary to halt works in that location until such time as the assessment has been completed. This should be reviewed on a 'discovery' specific basis and in conjunction with regulatory consultation.

As a general guide, where such unexpected conditions are encountered the following approach is recommended:

- All discoveries are to be reported to the Site Manager immediately and works at that location are to halt until further notice;
- The Site Manager is to report any such discoveries to the Client and the Environmental Consultant;
- Following notification from the Site Manager, the Environmental Consultant shall discuss the discovery with the Local Authority and if considered necessary, arrange to meet an Officer on site to view the discovery;
- The Environmental Consultant shall attend the site to record the location, extent and nature of the discovery and implement an appropriate sampling and analysis regime, taking due account of the type and nature of the discovery, known and probable land uses in that area of the site;
- Where remedial action is required, regulatory consultation and approval will be sought;
- A record will be produced by the Environmental Consultant and held on site (with copies held by the Environmental Consultant, Client and Local Authority), detailing the discovery, assessment works undertaken, findings thereof, confirmation either of no action required or detailing the

remedial action taken and validation thereof.

The process is shown below.

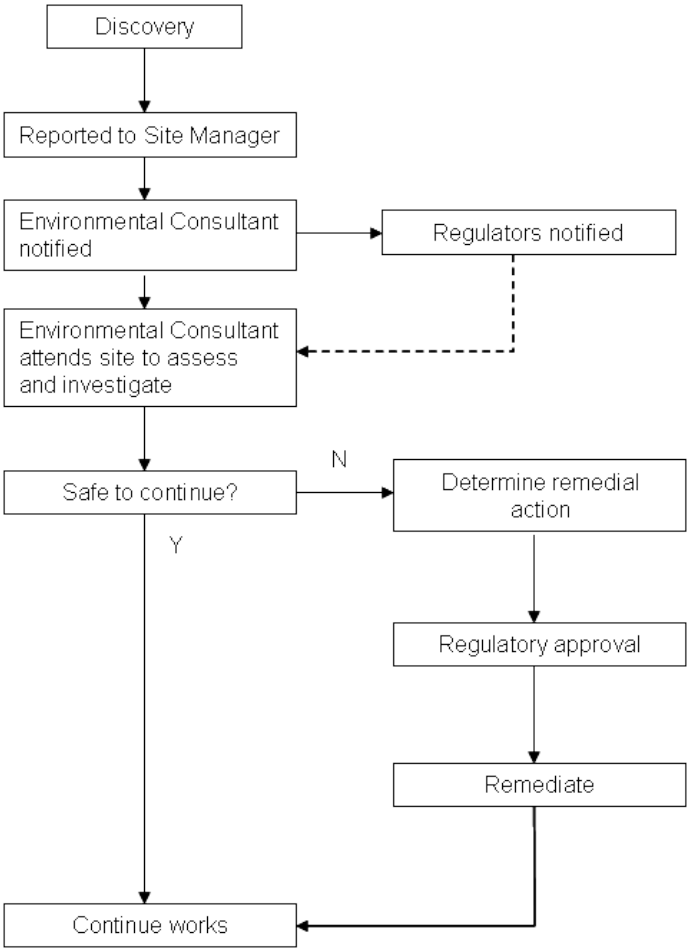


Chart 1 Discovery Strategy Process

Caveat

The data collected from the investigations have been used to provide an interpretation of the geo-environmental conditions pertaining to the site. The recommendations and opinions expressed in this report are based on the data obtained.

Geo-Environmental Service Limited takes no responsibility for conditions that either have not been revealed in the available records, or that occurs between or under points of physical investigation. Whilst every effort has been made to interpret the conditions, such information is only indicative and liability cannot be accepted for its accuracy.

Information contained in this report is intended for the use of the client and their agents, and Geo-Environmental Services Limited can take no responsibility for the use of this information by any third party for uses other than that described in this report.

It should be noted that in particular the concentrations and levels of mobile liquid and gaseous materials are likely to vary with time. The results obtained may therefore only be representative of the conditions at the time of sampling. Such reservations have been indicated in the text where such conditions are considered to apply.

Geo-Environmental Services Limited does not indemnify any third parties such as the vendor against any dispute or claim arising from any finding or result of this investigation or any claim or dispute arising as a result of any decisions made thereof.

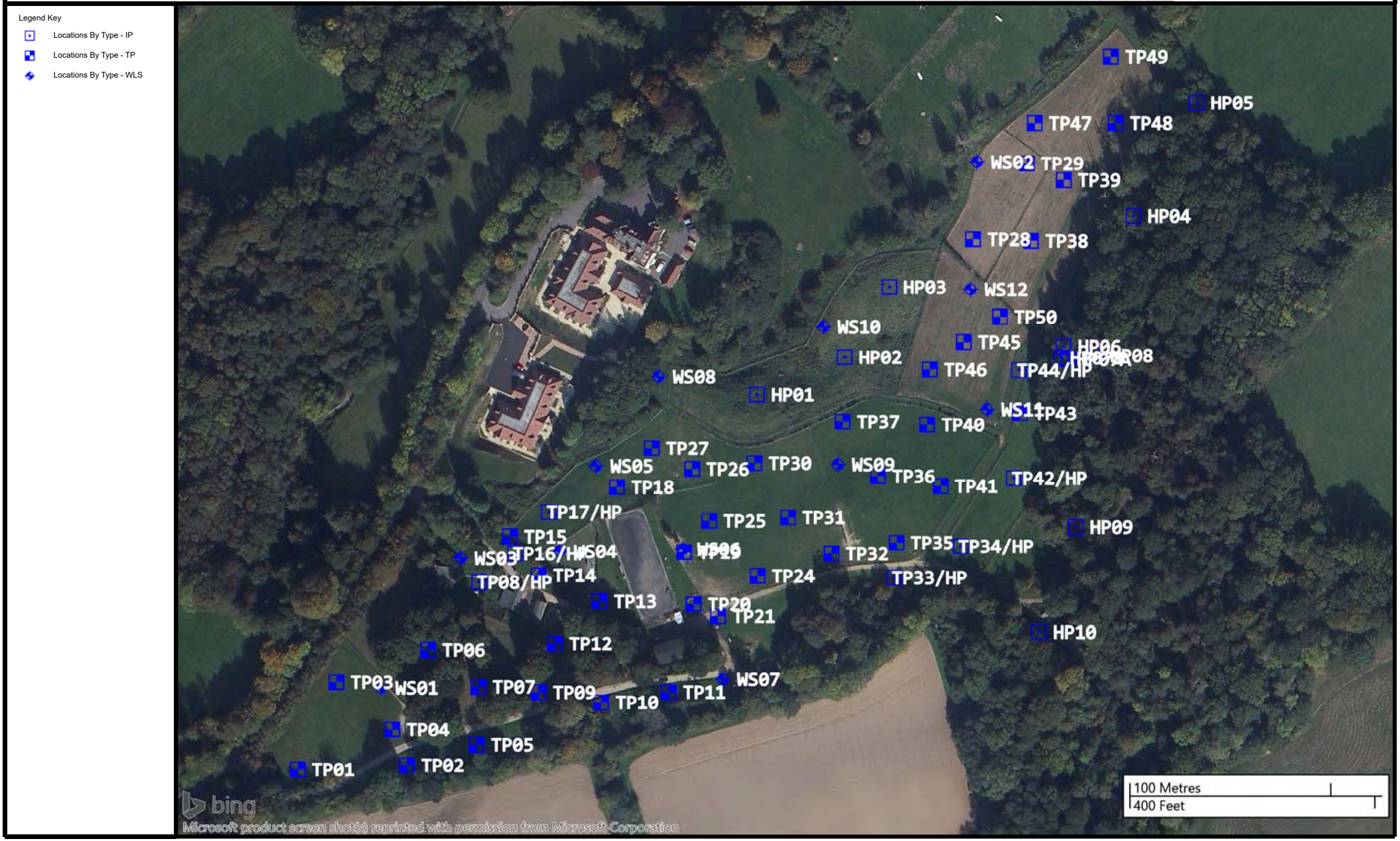
FIGURES

Project:	Evergreen Farm, East Grinstead			**Title**	Site Location Plan
Client:	TJS Services Limited			**Geo-Environmental Services Ltd** **Unit 7 Danworth Farm, Cuckfield Road** **Hurstpierpoint, West Sussex BN6 9GL** **+44(0)1273 832972 www.gesl.net**	Geo-Environmental
Ref No:	GE17326	**Revision:**	0		
Drawn:	LL	**Date:**	15/06/2018		
Figure:	1	**Scale:**	Not To Scale		

Project:	Evergreen Farm, East Grinstead			**Title**	Site Plan
Client:	TJS Services Limited			**Geo-Environmental Services Ltd** **Unit 7 Danworth Farm, Cuckfield Road** **Hurstpierpoint, West Sussex BN6 9GL** **+44(0)1273 832972 www.gesl.net**	Geo-Environmental
Ref No:	GE17326	**Revision:**	0		
Drawn:	LL	**Date:**	15/06/2018		
Figure:	2	**Scale:**	Not To Scale		

Project Title:	Evergreen Farm,	**Title :**	Figure 3 - Exploratory Hole Location Plan
Location :	West Hoathly Road, East Grinstead	**Scale:**	1:2500
Project No. :	GE17326	**Engineer:**	Laura Legate
Client :	TJS Services Limited		

Geo-Environmental

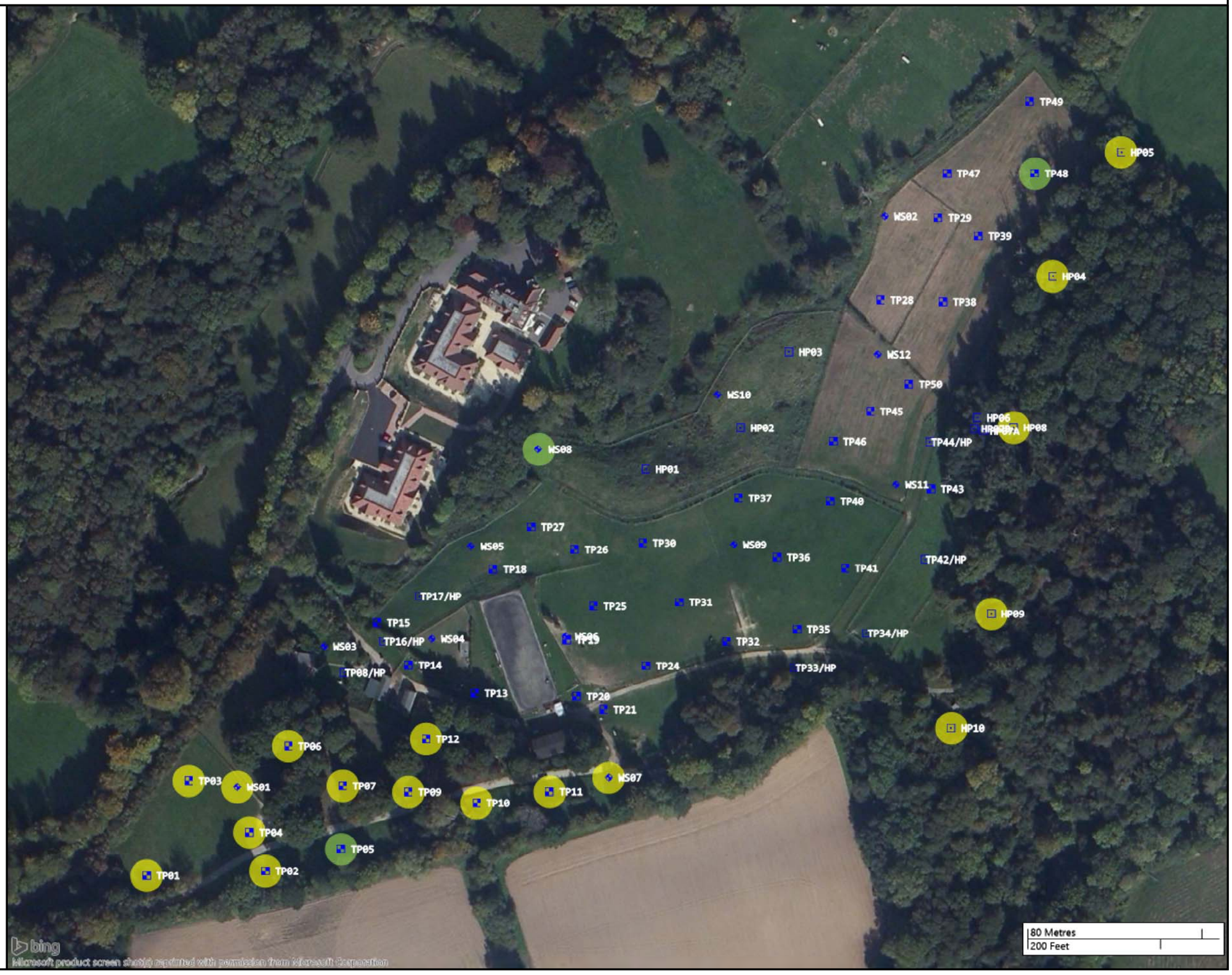


Project Id:	GE17326	Title:	Figure 4 - Plan showing location of Natural Soils encountered
Project Title:	Evergreen Farm,	Scale:	1:1750
Location:	West Hoathly Road, East Grinstead	Engineer:	Laura Legate
Client:	TJS Services Limited		

Geo-Environmental

Legend Key

- Locations By Type - IP
- Locations By Type - TP
- Locations By Type - WLS
- Natural Soils - Natural Soils
- Natural Soils at Depth - Natural Soils at Depth



APPENDIX A

Site Photographs

Site Photographs provided by the client showing the stream, iron oxide and leachate.

Plate 1

Plate 2

Plate 3

Plate 4

Plate 5

Plate 6

Plate 7

Photographs taken during site walkover on the 10th May 2018

Plate 8

Plate 9 – View looking north east

Plate 10

Plate 11 - Vegetation along the stream bed

Plate 12 – Evidence of ecology on site, appears to be a burrow

Plate 13

Plate 14 – View of exposed ground on slope down towards stream

Plate 15 - Evidence of Made and waste material at ground surface

Plate 16 – Site boundaries and neighbouring land

Plate 17 - Evidence of vegetation clearance on site

Plate 18 – View looking north east half way up slope

Plate 19 – View looking north on the eastern portion of the site

Plate 20 – Stream bed looking west from eastern end of the site

Plate 21

Plate 22 – Evidence of iron staining within the soils

Plate 23 – Evidence of Iron staining of soils

Plate 24 – Evidence of exposed ground within grassed areas of site

Plate 25

Plate 26 – Stream located on norther portion of site flowing west to east

Plate 27

Plate 28

Plate 29

Plate 30

Plate 31 - Eastern area of site

Plate 32 – Evidence of destressed trees

Plate 33 – Services on site

Photos taken during site investigation works on 12th July 2018

Plate 34 – Drilling within the woodland

Plate 35 – Embankment behind wood Store

Plate 36 – Embankment next to wood store

Plate 37 – Embankment next to wood store

Plate 38– Embankment next to wood store