Currie & Brown Limited

LAND AT BROOKLAND ROAD, RISCA

Site Investigation Report

14147/OTJ/23/SI

Intégral
Géotechnique

CLIENT: **Currie & Brown Limited**

PROJECT: **Land at Brookland Road, Risca**

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CONTENTS

CONTENTS (CONTINUED)

1.0 INTRODUCTION

1.1 GENERAL

Currie & Brown Limited are promoting the site off Brookland Road, Risca as a candidate site within the Caerphilly County Borough Council Local Development Plan (LDP) for residential end-use.

The location of the site is presented in Figure 1.

Intégral Géotechnique (Wales) Limited have been appointed as the Geotechnical Engineers to undertake a site investigation to enable a geotechnical and geoenvironmental appraisal of the site and provide a basis for design.

A Phase 1 Desk Study Report has previously been undertaken for the site by Intégral Géotechnique and reference should be made to the following report:

- Desk Study Report ref. 14147/LW/22/DS dated January 2023.

This site investigation report should be read in conjunction with the Desk Study Report in order to gain a full understanding of the site.

This report presents the findings of the site investigation and gives recommendations for the design of foundations, floor slabs and other geotechnical and geoenvironmental aspects of the project.

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1.2 PROPOSED DEVELOPMENT

Development plans are not available at this stage, however, it is considered that the proposed development will likely comprise of low rise residential units with associated access roads and areas of hardstanding. The development will also likely include private gardens and areas of soft landscaping.

1.3 SCOPE OF WORKS

Information included within the Desk Study Report was used to make an initial assessment of the site and to design an investigation to be carried out by Intégral Géotechnique. The site investigation was designed in accordance with BS 5930:2015+A1:2020, the Code of Practice for Site Investigations, BS10175:2011+A2:2017, the code of practice for investigation of potentially contaminated sites, and 'Development of Land Affected by Contamination: A Guide for Developers' prepared by Welsh Local Government Association (WLGA)/Natural Resources Wales (NRW) Land Contamination Working Group, 2017.

The site investigation included:

- An intrusive investigation, carried out during August 2023, comprising the excavation of a total 6 No. trial pits and soil infiltration test pits (referenced TP01 to TP06),
- Soil infiltration testing,
- Sampling of soil/fill for laboratory chemical and geotechnical testing.

1.4 LIMITATIONS

This document is intended to be a working document for further development in discussion with all concerned including the Local Planning Authority, Natural Resources Wales, and the NHBC as appropriate.

"Contamination" is taken throughout the report to mean the "presence of one or more potentially harmful substances as a result of human activity". The use of the term in this way does not imply that harm is being or might be caused by the contamination. It should be noted that "contamination" can have different meanings under different regulatory regimes, for example, planning, building control and Part IIA of the Environmental Protection Act 1990. Naturally elevated concentrations of potentially harmful substances may also be of concern and the significance of any that have been found is also evaluated in this report.

It is important to recognise that there may be areas of contamination that have not been found, or that contaminants are present at concentrations above those that have been found. It is also important to recognise that contamination may be localised and that no investigation, however comprehensive, is capable of finding such occurrences other than by chance.

It should also be noted that vertical and lateral changes in ground conditions may be present between exploratory hole locations.

1.4 LIMITATIONS (Continued)

Access to the northwestern area of the site was restricted due to the active building (Risca Youth & Community Centre) that occupies this area. Investigation of the buildings or beneath the building floor slabs at the time of the site investigation was outside the scope of works of this report.

2.0 THE SITE

2.1 SITE LOCATION AND DESCRIPTION

The site is located near the centre of Risca, approximately 7km northwest of Newport, at a National Grid Reference of 324180, 190200 (see Figure 1).

The site is rectangular in shape and occupies an area of approximately 0.53 hectares. The boundaries of the site are defined by residential properties to the north and west, a community resource centre to the south and Brookland Road, with residential properties beyond to the east. A site plan is presented in Figure 2.

The site is situated on generally level ground at an approximate elevation of 46/47m AOD.

A building occupied by Risca Youth & Community Centre is located in the northwest corner of the site.

An access road/lane is located along the western and northern site boundary. The centre of the site is occupied by a grassed area, surrounded by metal fencing. The remaining site area in the west and east is occupied by rough grass and vegetation.

Areas of hardstanding associated with the former buildings are located in the eastern area of the site.

The site boundary is lined by a combination of brick walls and metal fencing.

A Cornerstone Utilities Search Report has been obtained for the site and a copy is presented in Appendix A of the Desk Study Report. The plans included within the report indicate that a combined sewer and electricity cables cross beneath the western area of the site. Overhead BT lines extend across the northeast corner of the site.

2.2 SITE OPERATIONS

The site is currently occupied by Risca Youth & Community Centre.

2.3 SURROUNDING LAND USE

The surrounding areas are mainly developed for residential use.

2.4 AVAILABLE SITE INVESTIGATION DATA

There is no available site investigation data to our knowledge.

2.5 CONSULTATIONS WITH REGULATORS

The regulators have not been contacted at this stage.

3.0 PRELIMINARY CONCEPTUAL SITE MODEL

3.1 RISK ASSESSMENT FRAMEWORK

In order to be consistent with current UK government policies and legislation, it is necessary to identify, assess, estimate, evaluate, and take appropriate action to deal with land contamination, in accordance with the procedures specified in the Environment Agency guidance Land Contamination Risk Management (LCRM) published in October 2020. This replaces the now withdrawn 'Model Procedures for the Management of Land Contamination CLR-11' (Environment Agency 2004).

The risk assessment process is designed to provide a reasoned, structured, and pragmatic mechanism for the identification of any potential human health and controlled waters risks associated with land contamination and where necessary to develop a robust remediation strategy to ensure protection of the sensitive receptors (human health of future residents, controlled waters, etc).

In accordance with LCRM, the term 'land contamination' is defined as:

- All land affected by contamination – land that might have contamination present which may, or may or may not, meet the statutory definition of contaminated land,
- Land determined as contaminated land under Part 2A of the Environmental Protection Act 1990.

LCRM provides a tiered approach to risk assessment, comprising a preliminary risk assessment (including the development of an initial conceptual site model), a generic quantitative risk assessment and a detailed quantitative risk assessment. For each tier of risk assessment, the following steps must be followed:

1. Identify the hazard - establish contaminant sources,
2. Assess the hazard – use a source-pathway-receptor linkage approach to determine if there is potential for unacceptable risk,
3. Estimate the risk – predict what degree of harm or pollution may result and how likely it is to occur, and
4. Evaluate the risk – decide whether a risk is unacceptable.

LCRM also provides definitions of the following terms:

- Hazard – a property or situation that in particular circumstances could lead to harm or pollution,

3.1 RISK ASSESSMENT FRAMEWORK (CONTINUED)

- Risk – a combination of the probability, or frequency of occurrence of a defined hazard and the magnitude of the consequences of the occurrence,
- Risk assessment – the formal process of identifying, assessing and evaluating the health and environmental risks that may be associated with a hazard,
- Risk management – the formal process to identify, assess and determine the risks, and to select and take action to mitigate them.

The three essential elements to any risk are defined by LCRM as follows:

- A contaminant, or pollutant, that is in, on, or under the land and that has the potential to cause harm, or pollution (Source)
- A route by which a receptor is, or could be affected by a contaminant (Pathway)
- A receptor, i.e., something that could be adversely affected by a contaminant, for example a person, controlled waters, an organism, an ecosystem, or Part 2A receptors such as buildings, crops or animals (Receptor).

In order for there to be a potential risk, all three of the above elements must be present. If there is a source of contamination and a receptor (for example a resident or site user), then there is only a potential risk if there is a pathway linking the two. Such an active pathway is known as a relevant pollutant linkage. It is possible for the same contaminant to be linked to a receptor via a number of pathways, and hence it is important that all relevant pollutant linkages, to both human health and controlled waters, are separately identified on a site in order that a comprehensive conceptual model can be formed and ultimately a robust remediation strategy designed.

Current practice during Generic Quantitative Risk Assessment of land affected by contamination is to use generic soil screening values based on the appropriate proposed end use. These usually comprise risk-based Soil Guideline values (SGVs) or Generic Assessment Criteria (GACs) derived by the Environment Agency's Contaminated Land Exposure Assessment Model (CLEA). The SGVs and the supporting technical guidance were developed in order to assist in the assessment of long-term risk to human health from the exposure to contaminated soils.

Revised Statutory Guidance, published in 2012, to support Part 2A of the Environmental Protection Act 1990, introduced a new four category system for classifying land under Part 2A. Category 1 includes land where the level of risk is clearly unacceptable, and Category 4 includes land where the level of risk posed is considered to be acceptably low. Under Part 2A, land would be determined as contaminated if it falls within Categories 1 or 2.

3.1 RISK ASSESSMENT FRAMEWORK (CONTINUED)

The revised Part 2A Statutory Guidance was accompanied by an Impact Assessment that identified a role for new 'Category 4 Screening Levels' (C4SLs) that would provide a simple test for determining when land is suitable for use and definitely not contaminated land. A Policy Companion Document including the C4SLs was published in March 2014 (England) and May 2014 (Wales).

The C4SLs have been based on the CLEA methodology and derived using the CLEA model, with modified toxicological and exposure parameters. To date, C4SLs have been released for six substances (arsenic, cadmium, chromium (VI), lead, benzo(a)pyrene and benzene).

The C4SLs have been derived on the assumption that where they exist, they will be used as generic screening criteria within generic quantitative risk assessment.

Following publication of the C4SLs, Land Quality Management (LQM), in conjunction with the Chartered Institute for Environmental Health (CIEH) released Suitable 4 Use Levels (S4ULs) in January 2015.

The S4ULs have been derived in accordance with UK legislation, and using a modified version of the Environment Agency's CLEA software. As such, the S4ULs are based on the concept of minimal or tolerable risk as described in Human Health Toxicological Assessment of Contaminants in Soil (Science Report SR2, Environment Agency 2009a).

S4ULs have been derived for a wider number of substances.

In addition to the existing SGVs, C4SLs and S4ULs, Atkins ATRISK^{soil} also provide a set of Soil Screening Values. These are currently intended to be used in conjunction with SGVs, although they intend to update these values in line with the C4SLs in due course.

We have reviewed all sets of values and intend to use the most appropriate assessment criteria as Tier 1 screening values in the first instance. Where a published S4UL is available, and considered appropriate, this will be used in the first instance.

3.2 CONCEPTUAL MODEL FRAMEWORK

The preliminary stage of the risk assessment process is to develop and define a conceptual site model, based on the desk study and any existing site investigation data. This is used to establish any potential contaminant sources, identify existing and future receptors, and assess if there are any potentially active pathways by which a potential risk may be present.

3.2 CONCEPTUAL MODEL FRAMEWORK (CONTINUED)

The preliminary conceptual site model will be developed and refined as site specific data is gathered, such as actual ground conditions and chemical data, resulting in a more robust conceptual understanding of the site.

3.3 CRITICAL SENSITIVE RECEPTOR – HUMAN HEALTH

The proposed redevelopment of the site is for a residential end use. Therefore, the critical sensitive receptor from a human health perspective is an on-site residential receptor.

In accordance with S4UL/C4SL and CLEA guidance for a standard residential scenario, the critical sensitive receptor for a residential end use risk assessment is a female child, with exposure from 0 to 6 years.

The standard residential with homegrown produce end use conceptual model defined by S4UL/C4SL and CLEA is assumed to be suitable for the purposes of this assessment.

3.4 CRITICAL SENSITIVE RECEPTOR – CONTROLLED WATERS

Based on the proposed redevelopment of the site for a residential end use, and the findings of the desk study, the critical sensitive receptor from a controlled water perspective is groundwater within the Secondary 'A' Aquifer of the St Maughans Formation.

By considering groundwater as the critical sensitive receptor for controlled waters, the groundwater/hydrogeological risk assessment will also be protective of any nearby surface water features.

3.5 POTENTIAL CONTAMINANT SOURCES

As identified in the desk study, the site remained undeveloped until the 1960s, when buildings were constructed in the eastern area of the site. By the 1970s a library had been constructed in the southwest area and a youth centre in the northwest area. The buildings (with exception of the youth centre) were demolished during 2020.

The potential types of contaminants of concern are listed below:

- Metals, semi-metals, and inorganics within the shallow made ground,
- Polyaromatic hydrocarbons (PAH) within the shallow made ground,
- Asbestos within the shallow made ground.

3.6 POTENTIAL EXPOSURE PATHWAYS

Potential exposure pathways for the critical receptors (both human health and controlled waters) are listed below:

- Dermal contact with soil and/or soil derived dust,
- Ingestion of soil and/or soil attached to home-grown produce,
- Ingestion of home-grown produce,
- Inhalation of soil derived dust,
- Inhalation of vapours – indoor and outdoor air,
- Leaching of contaminants from made ground to groundwater,
- Transportation of contaminants within groundwater.

In addition, the following exposure pathways have also been considered:

- Ground gas generation and migration
- Building materials durability.

3.7 SUMMARY OF CONCEPTUAL EXPOSURE MODEL

A preliminary conceptual exposure model has been developed for the site. This is based on the findings of the desk study, historical review and site walk over and includes all potential sources, pathways and receptors that may be present on site. Those that have been identified as being potentially active require further investigation in the form of sampling and testing of soils and groundwater, followed by appropriate risk assessment.

The preliminary conceptual exposure model will be reviewed and refined following the completion of the site works and laboratory testing.

The preliminary conceptual exposure model is presented below in Table 1.

3.7 SUMMARY OF CONCEPTUAL EXPOSURE MODEL (CONTINUED)

TABLE 1: PRELIMINARY CONCEPTUAL EXPOSURE MODEL				
Source		Receptor	Pathway	Potentially Active Pathway?
Origin	Contaminant			
Made Ground of unknown origin and historical land uses	Metals, semi-metals, non-metals, PAH, asbestos	Resident – human health	Dermal Contact with made ground/dust	✓
			Ingestion of soil and/or soil attached to home-grown produce	✓
			Ingestion of home-grown produce	✓
			Inhalation of dust	✓
			Inhalation of vapours – indoor/outdoor	✓
	Metals, semi-metals, inorganics, PAH	Groundwater quality	Leaching from made ground	✓
	Metals, semi-metals, inorganics, PAH	Surface water quality	Transportation within groundwater	✓
Made Ground of unknown origin and natural ground	pH and water-soluble sulphate	Building Materials Durability	Direct contact	✓
Ground Gas – organic, gas producing materials present within site or adjacent to the site	Methane, carbon dioxide	Human health	Accumulation of gases in confined spaces, and/or migration off site, leading to asphyxiation, or risk of explosion	X Significant thickness of gas producing materials are not anticipated

4.0 THE SITE INVESTIGATION

4.1 FIELDWORKS

An intrusive site investigation was designed in accordance with BS 5930:2015+A1:2020, the Code of Practice for Site Investigations, BS10175:2011+A2:2017, the Code of Practice for Investigation of Potentially Contaminated Sites, and 'Development of Land Affected by Contamination: A Guide for Developers' prepared by Welsh Local Government Association (WLGA)/Natural Resources Wales (NRW) Land Contamination Working Group, 2017.

The site investigation was also designed to provide information to support and refine the preliminary conceptual site model/conceptual exposure model.

An investigation comprising the excavation of 6 No. trial pits (including 2 No. soil infiltration test pits) was carried out during August 2023.

The trial pits (referenced TP01 to TP06) were positioned across the site following the findings of the Desk Study Report and in areas where access for the excavator was readily available to obtain representative information. The trial pits were excavated to a maximum depth of 3.10m below existing ground level (bgl). The purpose of the trial pits was to prove the shallow ground conditions and allow an assessment of the most appropriate foundation type for the proposed development. Soil infiltration testing was undertaken at 2 No. trial pit localities (TP03 and TP04) to assess/monitor the likely permeability of the natural ground.

Representative soil samples were taken from the trial pits for laboratory chemical and geotechnical testing and placed in the appropriate sample containers deemed suitable for the analysis required. Strict protocols were adopted during this process to limit the cross contamination of samples.

The fieldworks were supervised by a qualified Geotechnical Engineer from Intégral Géotechnique (Wales) Limited who logged all trial pit excavations, before preparing detailed engineering logs in accordance with the requirements of BS5930:2015+A1:2020. The engineering logs provide descriptions of the materials encountered in accordance with BSEN ISO 14688-1 (2002) and 14689-1 (2003) for soils and rocks respectively.

The approximate locations of the trial pits and soil infiltration test pits are shown on Figure 2, while their associated logs are presented in Appendix A.

The results of the soil infiltration testing are presented in Appendix B.

4.2 FIELD OBSERVATIONS

No gross visual or olfactory evidence of any contamination was observed during the excavation of the trial pits. However, made ground likely associated with the demolition of the buildings that formerly occupied several areas of the site was encountered in western and eastern areas of the site.

A concrete obstruction, suspected to be the foundation to the former library building, was noted within an excavation within the western area of the site.

Reworked topsoil which included several fragments of anthropogenic materials was also encountered.

4.3 LABORATORY CHEMICAL TESTING

Representative soil samples were taken from the trial pit excavations across the site, stored at the appropriate temperature and dispatched to the laboratories of i2 Analytical for laboratory chemical testing within 24 hours.

The samples were tested for a range of contaminants that reflects the historical use of the site, the findings of the Desk Study Report and the preliminary conceptual site model/conceptual exposure model.

A list of the soil testing carried out is given below:

Beryllium	Cadmium
Total Chromium	Hexavalent Chromium (VI)
Copper	Lead
Mercury	Nickel
Vanadium	Zinc
Arsenic	Boron
Selenium	Elemental Sulphur
Total Cyanide	Total Sulphate
Sulphide	Water Soluble Sulphate
pH	Monohydric Phenol
Polyaromatic Hydrocarbons (PAH)	

Samples were also screened for fibres of Asbestos.

The results of the laboratory chemical testing are presented in Appendix C.

4.4 LABORATORY GEOTECHNICAL TESTING

Representative bulk soil samples taken from the trial pits were dispatched to the laboratories of Apex Testing Solutions for geotechnical testing. The samples were tested for Atterberg Limits, moisture content, pH, and water-soluble sulphate.

The geotechnical test results are presented in Appendix D.

5.0 GROUND CONDITIONS

The ground conditions encountered at the surface included granular made ground deposits within the footprints of the former buildings that occupied the site, along with reworked topsoil deposits within the centre of the site. Cohesive superficial clay deposits were encountered immediately below the made ground/reworked topsoil deposits, along with granular alluvial superficial deposits at depth.

The ground conditions to the northwest of the site were not investigated due to the currently active building within this area.

A summary of the ground conditions encountered within the trial pit excavations across the site is presented below in Table 2.

Table 2: Summary of Ground Conditions

Depth (m) From	To	Soil Horizons
G.L.	0.35 / 0.70	MADE GROUND: Grass over loose and medium dense light brown silty sandy GRAVEL with low to medium cobble and boulder (600x300mm) content of sub-angular sandstone, limestone, and concrete. Gravel is fine to coarse sub-angular of limestone, brick, and concrete. Includes rare fragments of metal and ceramic [encountered within footprint of the former buildings on site]. or Grass over dark brown slightly gravelly CLAY/SILT with frequent roots and rootlets. Includes low cobble content of sub-angular brick. Gravel is fine to coarse sub-angular of sandstone and rare brick. Includes rare fragments of glass and ceramic [encountered within areas of soft landscaping – reworked topsoil].
0.35 / 0.70	0.85 / 1.10	Firm reddish brown silty sandy gravelly CLAY. Gravel is fine to coarse sub-rounded and rounded of sandstone.
0.85 / 1.10	>2.10 / >3.10	Medium dense yellow brown silty SAND and GRAVEL with high cobble and boulder (350-400x250-300mm) content of sub-rounded and rounded sandstone. Gravel is fine to coarse sub-rounded and rounded of sandstone.

Instability was noted within all trial pit excavations. Spalling of the trial pit sides was noted below depths of 0.80m and 1.00m bgl and was typically associated with the granular sand and gravel deposits encountered below these depths.

5.0 GROUND CONDITIONS (CONTINUED)

The unstable walls of the trial pit excavations below these depths generally restricted the depths of excavation that could be achieved due to material spalling, collapsing, and replacing the removed material from the excavation.

5.1 MADE GROUND

5.1.1 Hardstanding

Tarmac hardstanding was noted at the surface within the site access point off Brookland Road, along with the parking area adjacent to the northern boundary of the site.

Tarmac hardstanding was also noted along the eastern boundary of the site, outside the footprints of the former buildings that occupied these areas.

No exploratory holes were located within these areas due to the continual use as vehicle parking areas for the active youth centre on site.

5.1.2 Granular Made Ground

Granular made ground deposits were encountered immediately at the surface within TP01, TP05, and TP06 to maximum depths of 0.40m and 0.70m bgl. These granular made ground deposits were restricted to the footprints of the buildings that formerly occupied the site and included loose and medium dense light brown silty sandy gravel. The primary gravel constituent included fine to coarse, sub-angular limestone, brick, and concrete.

Cobbles and boulders, typically <600x300mm, were noted within these granular made ground deposits and comprised of sub-angular sandstone, limestone, and concrete.

Anthropogenic materials were occasionally noted, which included fragments of metal and ceramic.

5.1.3 Reworked Topsoil

The areas of existing soft landscaping in the centre of the site, in the vicinity of TP02, TP03, and TP04, included reworked topsoil immediately at the surface.

The reworked topsoil deposits were measured to maximum depths of 0.35m and 0.40m bgl and were noted to be soft, dark brown, slightly gravelly clay/silt deposits with frequent roots and rootlets.

The gravel constituent included fine to coarse sub-angular sandstone.

5.1 MADE GROUND (CONTINUED)

These deposits included rare anthropogenic materials, including fine to coarse gravel sized sub-angular brick, and fragments of ceramic and shards of glass.

5.1.4 Buried Obstructions

A concrete obstruction, suspected to be the foundation to the former library building, was noted within TP01 at an approximate depth of 1.10m bgl.

5.2 SUPERFICIAL DEPOSITS

5.2.1 Cohesive Superficial Soils

Cohesive superficial deposits were noted immediately below the made ground/reworked topsoil deposits across the site between minimum depths of 0.35m and 0.70m bgl, and 0.85m and 1.10m bgl.

The cohesive superficial soils included firm reddish brown silty sandy gravelly clay, with the gravel constituent including fine to coarse, sub-rounded and rounded sandstone.

5.2.2 Granular Superficial Soils

Beyond depths of 0.85m and 1.10m bgl, medium dense yellow brown alluvial deposits were encountered, and comprised of silty sands and gravels. The gravel constituent included fine to coarse, sub-rounded and rounded sandstone.

Cobbles and boulders (typically less than 400x300mm) were frequently recovered and included sub-rounded and rounded sandstone.

The base of the granular alluvial superficial soils was not proven within the trial pit excavations.

No bedrock strata were encountered during the site investigation.

5.3 SUMMARY OF LABORATORY GEOTECHNICAL TEST RESULTS

Laboratory geotechnical testing was carried out on representative samples of superficial soil deposits.

The results of the laboratory geotechnical testing are included within Appendix D.

5.3 SUMMARY OF LABORATORY GEOTECHNICAL TEST RESULTS (CONTINUED)

A summary of the geotechnical tests results is presented below in Table 3 below.

TABLE 3: SUMMARY OF ATTERBERG LIMIT TESTING

Location	Depth (m)	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	% Passing 425um	Modified Plasticity Index (%)	Volume Change Potential
TP01	1.50	9.3	0	0	0	33	0	Negligible
TP06	1.50	7.0	37	20	17	13	2.21	Negligible

Therefore, in accordance with NHBC standards, the modified plasticity indices indicate that the superficial deposits are regarded to be of negligible volume change potential.

5.4 GROUNDWATER

No strong inflows or seepages were noted within the trial pit excavations; however, a minor perched water seepage was noted within TP01 at a depth of 0.70m bgl, at the base of the made ground deposits.

It should be noted that these groundwater observations were made at the time of the site investigation and that groundwater levels may vary due to seasonal and other effects.

5.5 SOIL INFILTRATION TESTING

Soil infiltration testing was carried out at 2 No. locations (referenced TP03 and TP04).

The soil infiltration test pits were intended to be excavated to the depths based on the anticipated incoming pipe invert levels at each location. However, as noted in Section 5.1, the unstable walls of the trial pit excavations limited the depth of excavation that could be achieved due to material spalling and collapsing into the excavation as material was being removed, widening the excavation with time.

The soil infiltration testing at TP03 and TP04 was carried out at the following termination depths:

- *TP03: 2.20m bgl,*
- *TP04: 2.10m bgl.*

5.5 SOIL INFILTRATION TESTING (CONTINUED)

Following termination at the above depths, the infiltration test pits were rapidly filled with clean water using a water bowser, with the subsequent test pit water level monitored over a period of time. Where infiltration and time allowed, repeat cycles were carried out in general accordance with BRE365.

The results of the soil infiltration testing are presented in Appendix B, while a summary is provided in Table 4 below.

TABLE 4: SUMMARY OF SOIL INFILTRATION TEST RESULTS

Test Location	Test Depth (m bgl)	Soil Infiltration Rate (m/s)			
		Test Cycle 1	Test Cycle 2	Test Cycle 3	Design Soil Infiltration Rate*
TP03	2.10	$2.5x10^{-4}$	$2.0x10^{-4}$	$1.7x10^{-4}$	$1.6x10^{-4}$
TP04	2.20	$3.5x10^{-4}$	$2.1x10^{-4}$	$2.4x10^{-4}$	$2.0x10^{-4}$

**Design soil infiltration rates are based on the most conservative values.*

Note that the soil infiltration rates are specific to the location and depth of the test undertaken.

The soil infiltration rates should be provided to a suitable qualified drainage engineer.

It should be noted that this initial testing should only be regarded as indicative. If it should be proposed to use soakaways for this site, then more extensive follow-up tests will be required and should fully comply with BRE 365, in order to confirm the suitability of the site and to satisfy the local authority.

6.0 CONTAMINATION

6.1 AVERAGING AREAS

In order to assess the laboratory test results reliably and in context, the data has been grouped into an averaging area. An averaging area (or area of interest) is that area of soil to which a receptor is exposed or which otherwise contributes to the creation of hazardous conditions. This may be an area of historical industrial usage, a soil type, or a specific proposed end use.

In the case of this analysis, the averaging area has been determined according to the proposed residential end use.

6.2 SOIL CONTAMINATION

The Suitable 4 Use Levels (S4ULs) published by LQM have been adopted as critical concentrations against which soil contaminant concentrations can be compared. In the absence of additional published S4ULs, the Category 4 Screening Levels (C4SLs) derived by DEFRA and Soil Screening Values (SSVs) derived by Atkins ATRISK^{soil} for a residential with home grown produce end use have been adopted, where considered appropriate.

Since the results of the testing indicate total organic carbon content (TOC) in the range of 1.0% to 3.7%, the results have been compared to the respective guidelines, where applicable, for 1% soil organic matter content.

The soil test results for made ground have been summarised and are shown in Appendix E.

6.2.1 Made Ground

The results of the laboratory testing indicate that most of the analysed chemical elements or compounds are present at concentrations below the appropriate thresholds. However, the initial screening indicates exceedances of several metals and speciated PAH compounds.

Cadmium was detected within the made ground at TP01 at a depth of 0.40m bgl at a concentration of 34.0 mg/kg which exceeds the S4UL screening criteria value of 11.0 mg/kg. Cadmium was not detected above the laboratory limit of detection in TP03, TP04, and TP05, while 0.50 mg/kg was detected in TP06 (well below the adopted S4UL screening criteria value).

6.2 SOIL CONTAMINATION (CONTINUED)

An exceedance above the adopted S4UL screening criteria value for lead was detected within the made ground sample at TP01. The concentration within this sample was measured at 520 mg/kg, which exceeds the screening criteria value of 200 mg/kg.

Concentrations of zinc were also measured above the S4UL screening criteria value for the contaminant within the made ground at TP01. A value of 3900 mg/kg was measured in the laboratory, slightly exceeding the S4UL screening criteria value of 3700 mg/kg.

Several speciated PAH compounds, including benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(ah)anthracene, were recorded above the adopted S4UL screening criteria values within a single sample of made ground derived from TP06 (0.40m bgl).

Concentrations of benzo(a)pyrene were measured at 4.30 mg/kg at this location, which exceeds the adopted S4UL screening criteria value of 2.20 mg/kg.

Benzo(b)fluoranthene was also measured within the sample derived from TP06 at a concentration of 5.8 mg/kg. The adopted screening criteria value for this contaminant is 2.60 mg/kg.

An exceedance of dibenzo(ah)anthracene was also measured within TP06 at a concentration of 0.90 mg/kg, exceeding the S4UL screening criteria value of 0.24 mg/kg.

No further exceedances were detected within the samples of made ground.

Asbestos was not detected within any soil samples submitted for analysis.

6.2.2 In-situ Natural Ground

No visual or olfactory evidence of contamination of the in-situ natural soil was identified during the excavation of the trial pits. At the time of writing this report no samples of natural soils have been submitted for laboratory chemical analysis.

It is considered likely that concentrations of determinants within the natural ground are likely to be naturally occurring and as such, the natural ground poses no significant threat to human health or the environment.

7.0 REVISED CONCEPTUAL EXPOSURE MODEL

The preliminary conceptual exposure model has been reviewed and revised to reflect the findings of the site investigation and the results of the laboratory testing of soils, soil leachate, groundwater and gas monitoring. Pathways identified as a relevant pollutant linkage require appropriate risk assessment or mitigation measures (see Section 8.0).

TABLE 5: REVISED CONCEPTUAL EXPOSURE MODEL

Source		Receptor	Pathway	Preliminary Active Pathway? (see Sect. 3.7)	Relevant Pollutant Linkage	Justification/ Mitigation
Origin	Contaminant					
Made Ground of unknown origin and historical land uses	Metals, semi-metals, non-metals, PAH, asbestos	Resident – human health	Dermal Contact with made ground/dust	✓	✓	Elevated concentrations of metals and PAH compounds identified within the made ground – *risk assess.*
			Ingestion of soil and/or soil attached to home-grown produce	✓	✓	
			Ingestion of home-grown produce	✓	✓	
			Inhalation of dust	✓	✓	
			Inhalation of vapours – indoor/outdoor	✓	X	No sufficiently volatile contaminants identified.
	Metals, semi-metals, inorganics, PAH	Groundwater quality	Leaching from made ground	✓	✓	Elevated concentrations of metals and PAH compounds identified within the made ground – *risk assess.*
	Metals, semi-metals, inorganics, PAH	Surface water quality	Transportation within groundwater	✓	✓	
Made Ground of unknown origin and natural ground	pH and water-soluble sulphate	Building Materials Durability	Direct contact	✓	✓	Building materials will be in contact with made ground – *risk assess.*
Ground Gas – organic, gas producing materials	Methane, carbon dioxide	Human health	Accumulation of gases in confined spaces, and/or migration off site, leading to asphyxiation, or risk of explosion	✓	✓	Potential gas producing material present – *risk assess.*

8.0 RISK ASSESSMENT

8.1 METHODOLOGY

The risk of pollution, health effects or environmental harm occurring as a result of ground contamination is dependent upon three principal factors:

- The scale of the contamination sources;
- The presence of sensitive “receptors”, e.g., Humans: health of the general public, site occupiers, redevelopment workers. Environment: flora, fauna, etc;
- The existence of migration pathways by which contaminants can reach the sensitive receptors.

This section assesses each of these factors in order to evaluate the overall level of risk and potential harm to receptors. The receptor may be human, a water resource, an eco-system or construction materials. Pathways connecting a perceived hazard to a receptor are referred to as exposure pathways.

The sources of contamination and the links connecting the hazards to the sensitive receptors will represent the basis for the risk assessment.

8.2 SOURCE-PATHWAY-RECEPTOR MODEL

The preliminary conceptual site model was based on the findings of the desk study. This was later reviewed and refined according to the findings of the site investigation, allowing for the ground conditions encountered and the results of laboratory testing of soil. Any pathways considered to be inactive were removed from the model and all remaining potentially active pathways require risk assessment.

The pathways shown as potentially active in the Revised Conceptual Site Model in Section 7.0 above have been assessed below.

8.3 HUMAN HEALTH RISK ASSESSMENT

8.3.1 Site in its Present Condition

The areas of the site that include made ground materials, within the footprint of the former buildings, are hoarded off and are currently inaccessible. Therefore, the site in its present condition does not pose a risk to casual visitors or trespassers.

8.3 HUMAN HEALTH RISK ASSESSMENT (CONTINUED)

8.3.2 Future Site Users

The laboratory chemical test results and observations made during the site investigation show elevated concentrations of contaminants above adopted screening criteria values within the made ground (at shallow depth) of several metals and polyaromatic hydrocarbon compounds. No loose fibres of asbestos were detected within the samples submitted for analysis, while no Asbestos Containing Materials (ACM) was observed within the exploratory locations on site.

Given the elevated concentrations of several contaminants including cadmium, lead, zinc, and several PAH compounds, above adopted screening criteria values for a proposed residential end-use, it is considered that a potential risk to human health may exist via the following relevant pollutant linkages:

- Dermal contact,
- Ingestion of soil or soil derived dust,
- Ingestion of soil attached to homegrown produce,
- Ingestion of homegrown produce,
- Inhalation of soil bourn dust.

The inhalation of vapours pathways (indoor and outdoor air) are not considered to be active since the contaminants of concern identified are not sufficiently volatile.

It is therefore considered necessary to protect end users from the elevated concentrations of metals and PAH compounds in the shallow made ground. It is considered necessary to break the above listed relevant pollutant linkages in order to remove the potential risk.

It is recommended that a capping layer, of a minimum thickness of 600mm, of clean imported subsoil and topsoil is placed in all proposed private gardens and areas of soft landscaping. The capping soils should be placed on top of a hi-vis geotextile separation/alert membrane in order to maintain the integrity of the capping layer. This would break all the above listed relevant pollutant linkages and removing the potential risk to future end users.

It should be noted that inaccessible areas of the site, such as the area of the site occupied by the existing building, should be subject to supplementary investigation and inspection following demolition. This should include additional sampling and testing, to include screening for asbestos, from below the former building floor slab in order to check for any residual contamination.

8.3 HUMAN HEALTH RISK ASSESSMENT (CONTINUED)

Following completion of the post demolition supplementary investigation works, the above risk assessment should be reviewed and revised accordingly.

8.3.3 Construction Workers

With future site development works likely involving the excavation and the removal of existing made ground, along with the processing of demolition materials following the demolition of the existing building within the northwestern area of the site, there would be a potential risk to workers from contaminants in the soils. Appropriate measures are therefore recommended for works involving the excavation and removal of the existing made ground materials which are known to be present beneath the site, and any other materials produced during demolition.

All excavations should be regularly checked for safe atmospheres.

Normal good hygiene practices should be adequate to protect the health and safety of redevelopment workers, and should include:

- Minimum handling of materials;
- Washing of hands prior to all meal breaks, which should be taken in a designated clean area;
- The use of standard protective clothing such as boots and overalls and gloves, where considered relevant.

In dry weather, inhalation of dust and gases should be avoided preferably by the use of dust suppression techniques to minimise fugitive emissions and minimisation of exposed materials at any particular time.

Additionally, a system should be established by which any ‘unusual’ materials that may be encountered are reported immediately to the site management, so that the appropriate action may be taken, following specialist advice if necessary. An unusual material may be identified on site by colour, odour or physical nature.

Reference should be made to the Health and Safety Executive document “Protection of Workers and the General Public during the development of contaminated land” for detailed guidance on these matters.

8.3 HUMAN HEALTH RISK ASSESSMENT (CONTINUED)

It should be noted that the northwestern area of the site was occupied by an actively used building and no intrusive works were carried out within this area. It is expected that this building is to be demolished within the near future, therefore post demolition supplementary works should be carried out within this area (see Section 9.7 for recommended further works).

The post demolition supplementary works should involve the excavation of supplementary trial pits and sampling of made ground/demolition derived materials, subsequently followed by laboratory chemical analysis to inform the conceptual exposure models and update relevant human health and environmental risk assessments.

8.4 RISKS TO VEGETATION

Exceedances of contaminants above the adopted screening criteria values indicate a potential for adverse effects to vegetation. Similarly, the physical nature of the existing made ground identified within localised areas of the site does not provide a suitable growing medium for vegetation.

To ensure viable landscape areas by preventing upward migration of contaminants into the overlying soils, and in order to promote plant growth, any landscaped areas will require the provision of a minimum 600mm thick capping layer of clean, inert subsoil and topsoil materials. The capping soils should be placed on top of a hi-vis geotextile separation/alert membrane.

8.5 CONTROLLED WATERS RISK ASSESSMENT

As discussed in Section 4.5 of the Desk Study Report, the nearest surface water feature to the site is located 59.00m to the east of the site (unnamed water course). The River Ebbw is also shown to be located 179.00m to the south west of the site. The groundwater vulnerability map and aquifer data also classifies the bedrock and superficial deposits beneath the site as a Secondary ‘A’ Aquifer (permeable layers capable of supporting water supplies at a local rather than strategic scale). These are generally aquifers formerly classified as minor aquifers.

Locally elevated concentrations of cadmium, lead, zinc, and several PAH compounds were measured above adopted screening criteria values within the made ground.

Groundwater was not typically encountered within the trial pit excavations, with only a minor perched water seepage noted within TP01 at a depth of 0.70m bgl.

8.5 CONTROLLED WATERS RISK ASSESSMENT (CONTINUED)

Once developed, the site will likely be covered by either the footprints of newly constructed buildings or areas of hardstanding, while garden areas or areas of soft landscaping will be covered by a minimum of 600mm thick capping layer of clean inert imported soils placed above a high visibility anti-dig membrane.

It is therefore considered that the potential for rainfall infiltration into the made ground, subsequent leachate generation from the made ground and the potential for vertical migration of unacceptable leachate concentrations to impact the underlying groundwater is considered to be low.

Based on the encountered ground conditions, the results of the laboratory chemical analysis, and the likely developed state of the site, which is to include areas of hardstanding, a minimum 600mm capping layer, anti-dig membranes, along with the footprints of the buildings themselves; the risk to controlled waters is considered to be low.

8.6 GROUND GAS RISK ASSESSMENT

No significant thicknesses of potential ground gas producing made ground or any significant organic material that could give rise to potential ground gas was encountered. It is therefore unlikely that any methane/carbon dioxide ground gas protective measures for onsite sources are required at this site.

As discussed within the desk study, although there is one historical landfill and one registered landfill located within 250m of the site, they are located are located on the opposite side of the River Ebbw and at approximately the same topographical elevation as the site. Based on the location of this potential source of ground gas, the risk of ground gas migration to site users is considered to be low.

The overall potential risk from ground gas at the site is considered to be low.

No radon protective measures are required for the site.

8.7 RISKS TO BUILDINGS AND MATERIALS DURABILITY

8.7.1 Concrete Classification

A summary of the laboratory chemical test results for the chemicals monohydric phenol, sulphur, total sulphate, water soluble sulphate, sulphide and pH, which may adversely affect the durability of building materials is presented in Appendices C and D.

8.7 RISKS TO BUILDINGS AND MATERIALS DURABILITY (CONTINUED)

Evidence to date does not indicate any specifically aggressive conditions, but it would be reasonable to expect a degree of sulphate and acidic aggressiveness from the made ground.

Made Ground

In accordance with BRE Digest SD1:2005 and adopting the assessment procedure specified therein for brownfield sites, the laboratory chemical test results indicate a characteristic value for water soluble sulphate within the made ground of 44mg/l.

Using Table C2 of BRE Digest SD1:2005, this characteristic value corresponds to Design Sulphate Class DS-1.

The groundwater regime of the site has been assessed as 'mobile' and a characteristic pH value within the made ground of 6.7 has been determined. The Design Sulphate Class has been modified to give a site ACEC class of AC-1 for concrete structures constructed within the made ground.

Natural Soil

In accordance with BRE Digest SD1:2005 and adopting the assessment procedure specified therein for brownfield sites, the laboratory chemical test results indicate a characteristic value for water soluble sulphate within the natural soils 333mg/l.

Using Table C2 of BRE Digest SD1:2005, this characteristic value corresponds to Design Sulphate Class DS-1.

The groundwater regime of the site has been assessed as 'mobile' and a characteristic pH value within the made ground of 8.2 has been determined. The Design Sulphate Class has been modified to give a site ACEC class of AC-1 for concrete structures constructed within the natural soils.

8.7.2 Water Services

Water supply pipes will need to be protected from any contamination present within the ground. In particular, the presence of organic contaminants (such as PAH) should be addressed when selecting pipe materials. Measures to protect the pipes will include clean backfill to trenches and possibly alternative material selection. Reference should be made to UKWIR Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites, document No. 10/WM/03/21. The final design and selection of the pipe and associated backfill should be agreed with the appropriate Regulator prior to installation.

8.7 RISKS TO BUILDINGS AND MATERIALS DURABILITY (CONTINUED)

In order to comply with the UKWIR guidance, specific sampling and testing along the actual line of the proposed water supply route may need to be carried out once this has been established.

8.8 WASTE DISPOSAL

Excavated materials generated by the development may be considered as waste and subject to waste controls. Any re-use of excavated materials on-site should be undertaken in accordance with current waste and environmental legislation and which may require the production of an approved Materials Management Plan (MMP) prepared in accordance with the CL:AIRE Code of Practice.

It is recommended that a sustainable development strategy is adopted which reduces to a practicable minimum the generation of waste materials and the need for disposal to a licensed tip. Emphasis should be on recovery and re-use rather than disposal.

However, any waste or surplus materials that are generated will need to be classified in accordance with current EC regulations and Environment Agency guidance prior to disposal. It is the responsibility of the waste producer to classify the waste.

Based on the data obtained from the site investigation works, any waste materials comprising the existing made ground are likely to be classified as a combination of non-hazardous and hazardous waste.

The existing natural ground are likely to be classified as non-hazardous.

Any asbestos containing materials (ACMs) will be classified as hazardous waste.

This classification is provisional and indicative of the likely waste classification based on the data obtained to date (including chemical composition, moisture content, etc.). It also assumes that the materials tested will be representative of future generated waste.

In order to minimise disposal, the materials generated should be segregated and examined, with appropriate testing as necessary, to enable the materials to be sorted or treated into lower classifications, with the resultant benefit of potentially generating re-use rather than disposal.

8.8 WASTE DISPOSAL (CONTINUED)

Once final waste sources and volumes are known, the waste stockpile to be disposed off-site will need to be classified in accordance with Environment Agency/Natural Resources Wales Waste Classification – Guidance on the Classification and Assessment of Waste Technical Guidance WM3 (2015). This is likely to require additional sampling and testing of the generated waste materials to provide an up-to-date current basis for classification.

Depending on the waste classification, waste acceptance criteria (WAC) testing may be required, in order to determine which class of landfill site the waste can be sent to.

It is recommended that the results of the waste classification and any WAC test results are sent to the intended licensed waste operator prior to disposal in order to confirm their classification and acceptance.

8.9 UNCERTAINTIES

It is important to recognise that there may be areas of contamination within the site that have not been found or that contaminants may be present at concentrations above those that have been found. It is also important to recognise that contamination may be localised and that no investigation, however comprehensive, is capable of finding such occurrences, other than by chance.

It should be noted that the northwestern area of the site was occupied by an actively used building and no intrusive works were carried out within this area. It is expected that this building is to be demolished within the near future, and post demolition supplementary works should be carried out within this area to check for any residual contamination from beneath the former building floor slab (see Section 9.7 for recommended further works).

The post demolition supplementary works should involve the excavation of supplementary trial pits and sampling of made ground/demolition derived materials, subsequently followed by laboratory chemical analysis to inform the conceptual exposure models and update relevant human health and environmental risk assessments.

9.0 ENGINEERING CONSIDERATIONS AND RECOMMENDATIONS

9.1 DETAILS OF PROPOSED DEVELOPMENT

Development plans are not available at this stage; however, it is considered that the proposed development will likely comprise of low-rise residential units with associated access roads and areas of hardstanding. The development will also likely include private gardens and areas of soft landscaping.

9.2 SITE PREPARATION

Prior to works commencing on site, any services within the site area should be identified. Early discussions should be held with the service operators regarding any required diversionary works or any required protection measures/easements. Any diversionary works should be carried out under the supervision of, and to the specification of the appropriate Statutory Authorities. The resulting excavations should be backfilled with suitable acceptable granular fill material.

It is recommended that a survey of invasive species/pest plants is undertaken across the site. Any identified invasive species should be subject to an eradication programme.

Any protection orders relating to the existing vegetation/ecology should be adhered to during the development of the site.

Few mature trees/hedges are located along the southern and eastern boundary of the site. Allowances should therefore be made for the protection of any hedges and trees which are to be retained. Where trees or hedges are to be removed this should include the removal of any associated roots that may become exposed in any nearby earthworks and foundation excavations. Any such works should be conducted in accordance with the code of practice recommended by the NHBC.

No compressible materials should be left in-situ below the proposed foundation structures as there may be future residual settlement issues associated with these materials.

Given the nature of the near surface soils, the exposed surface of the site will deteriorate in poor weather and due to trafficking of plant. We therefore recommend that to minimise surface water management risk and minimise the generations of silt, softened materials and unsuitable arisings, a strategic earthworks materials management is required.

9.2 SITE PREPARATION (CONTINUED)

Areas of stripping should be minimised at all times. The exposed formations should be protected from damage in wet weather and designated access routes should be well maintained and suitably designed and maintained working platforms should be provided for construction plant.

Prior to demolition of the above ground structures, a Refurbishment/Demolition Survey should be carried out and any asbestos containing materials removed by an approved contractor. Building inventory and demolition strategies should be undertaken to ensure safe working methods and appropriate re-use and/or disposal of materials.

Prior to commencement of the reclamation works, boundary dust and asbestos air quality monitoring should be established. The data obtained should be reviewed regularly in order to inform the future/ongoing works and any additional precautionary measures required.

The findings of the Desk Study Report revealed that the site was previously occupied by a library building within the western area of the site, while other buildings formally occupied the far eastern area of the site. Remnants of the former strip foundations associated with the library building were also discovered during the excavation of TP01. It is therefore recommended that any buried foundations (including infrastructure) and any other walls, buried slabs etc associated with the former buildings are fully removed.

Any remnant structures/foundations, manholes, drainage runs, and other buried structures and areas of hardstanding should be demolished and removed, if no longer required.

Following demolition of the existing building and excavation and removal of any residual foundations, structures, walls, drainage runs, other buried structures and areas of hardstanding, all demolition materials arising from the redevelopment should be sorted, processed and the acceptable materials crushed to an appropriate size for re-use as granular fill (<125mm maximum particle size). Any unacceptable materials, such as reinforcing bar, timber, etc. will need to be removed. In addition, any occurrences of asbestos containing materials will also need to be assessed and removed from site. All unacceptable materials should be removed from site and disposed of at a suitable landfill facility.

As detailed above, the resulting excavations should be backfilled with suitable granular fill material laid and compacted to Department of Transport (DTp) Specification for Earthworks.

9.2 SITE PREPARATION (CONTINUED)

Any loose/soft spots or potential basements or chambers should also be excavated and replaced with granular fill materials to an agreed specification.

A system should be established for identification and dealing with any unforeseen contamination encountered during the site works (including identification of any potential asbestos containing materials).

Any contamination, or suspected contamination, should be reported to the site manager, so that appropriate action may be taken, following specialist advice if necessary.

Any reduced levels should be brought up to the required levels with well compacted site won or imported granular materials.

Department of Transport (DTp) Type 1 subbase or similar approved, could be used, and should be compacted in layers, in accordance with the current DTp Specification for Highway Works.

Exposed formations should be protected from site traffic and inclement weather in order to preserve their integrity. Any soft spots/areas should be removed and replaced with well compacted site won or imported granular fill material.

9.3 FOUNDATIONS AND FLOOR SLABS

The ground conditions at the site are characterised by localised areas of a thin layer of made ground and reworked topsoil at the surface, over a thin layer of, cohesive superficial deposits. These cohesive soils were noted to be generally firm reddish brown silty sandy gravelly clay deposits, with the gravel constituent including fine to coarse, sub-rounded and rounded sandstone. Beyond depths of between 0.85m and 1.10m bgl, medium dense to dense yellow brown alluvial deposits were encountered which comprised of silty sands and gravels. The gravel constituent included fine to coarse, sub-rounded and rounded sandstone. Cobbles and boulders (typically less than 400x300mm) were frequently recovered and included sub-rounded and rounded sandstone. The base of the granular alluvial superficial soils was not proven within the trial pit excavations. No bedrock strata were encountered during the site investigation.

Although the final development proposals have not been confirmed at this stage, it is likely that the proposed development is to comprise low-rise residential buildings (two storey) with associated access roads, areas of hardstanding, private gardens, and soft landscaping.

9.3 FOUNDATIONS AND FLOOR SLABS (CONTINUED)

It is therefore considered that the use of traditional mass concrete strip/trench fill foundations can be adopted for the proposed development, constructed within the medium dense to dense, yellow brown silty sands and gravels encountered below depths of approximately 0.85m and 1.10m bgl.

An allowable bearing pressure of 100kN/m^2 can be used for design purposes. At this intensity of loading, the total settlements should not exceed 25mm, and any angular distortions caused by differential movements should be less than 1:750.

Foundations should penetrate the founding stratum by a minimum of 200mm and be at a minimum depth of 450mm below finished development levels to protect against the effects of frost heave and/or thermal shrinkage.

The firm cohesive soils, noted to be of silty sandy gravelly clay deposits at shallow depths, should be fully penetrated, with the foundations constructed within the underlying sand and gravel deposits.

Foundations should be constructed within unform strata throughout in order to minimise the potential for differential settlement.

When within influencing distances of trees, footings would not need to be deepened further since the recommended bearing stratum has a negligible volume change potential.

As noted in Section 5.1, the trial pit excavations were noted to be largely unstable due to the granular nature of the strata. Allowances should therefore be made for overbreak in the sides of excavations within the sand and gravel deposits and over pour of concrete.

Due to the presence of cohesive soils near the surface, together with localised areas of made ground, allowances should be made for floor slabs to be designed and constructed as suspended.

No radon protective measures will be required in the construction of any building on site.

9.4 EXCAVATIONS AND FORMATIONS

Excavations within the superficial soils should be possible with normal excavating machinery. However, allowances should be made for the use of hydraulic breakers should any residual obstructions be encountered within the previously developed areas of the site.

9.4 EXCAVATIONS AND FORMATIONS (CONTINUED)

Any residual structures within the ground will likely be encountered within the western and eastern area of the site, within the footprints of the former buildings.

Based on the findings of the intrusive site investigation, excavations are unlikely to encounter significant groundwater inflows. Any groundwater inflows together with any rainfall infiltrations should be dealt with by using conventional pumping techniques.

Potential over pouring of concrete should be allowed for in excavations within the sands, gravel, cobbles, and boulder deposits due to overbreak and spalling of the excavation sides. It will be imperative to control the sides of excavations in order to minimise over pouring of concrete.

The sides of excavations deeper than 1.0m should be supported by trench boxes.

Foundations should be constructed as soon as possible after the excavation works and the surrounding ground should be brought up to the adjacent ground levels as soon as possible. This is in order to avoid ponding and the discharge of concentrated rainfall accumulations into the ground.

The exposed formations within the near surface cohesive in-situ materials will be extremely susceptible to damage, softening and deterioration by wet weather and site traffic. They should therefore be protected by blinding concrete or a 100mm thick layer of hard-core immediately after exposure.

9.5 ACCESS ROADS AND CAR PARKING AREAS

For preliminary design purposes a California Bearing ratio (CBR) value of between 2% and 3% could be assumed for the made ground/in situ cohesive natural soils underlying the site.

After proof rolling the formations, any ‘soft spots/areas’ should be removed and replaced with well compacted imported granular materials. Such materials should be to the approval of the local highway authority and should be compacted in layers, in accordance with the DTp Specification for Highways Works.

Formations should be regarded as frost susceptible.

It should be noted that CBR tests should be carried out in order to confirm the above assumptions.

9.5 ACCESS ROADS AND CAR PARKING AREAS (CONTINUED)

Depending on the outcome of such field tests, the above assumptions may need to be revised.

9.6 DRAINAGE

BRE365 compliant soil infiltration testing was carried out at 2 No. locations (referenced TP03 and TP04).

The soil infiltration test pits were intended to be excavated to the depths based on the anticipated incoming pipe invert levels at each location. However, as noted in Section 5.1, the unstable walls of the trial pit excavations limited the depth of excavation due to material spalling, and collapsing into the excavation as material was being removed, eventually widening the excavation with time.

The soil infiltration testing at TP03 and TP04 was carried out at the following termination depths:

- *TP03: 2.20m bgl,*
- *TP04: 2.10m bgl.*

Three soil infiltration test cycles were carried out in both test pits over a maximum period of 31 minutes (TP03) and 30 minutes (TP04). The Design Soil Infiltration Rates were calculated to be 1.6×10^{-4} m/sec (TP03), and 2.0×10^{-4} m/sec (TP04). These values are based on the most conservative soil infiltration rate over the three cycles completed.
Note that the soil infiltration rates are specific to the location and depth of the test undertaken.

The soil infiltration rates should be provided to a suitable qualified drainage engineer.

It should be noted that this initial testing should only be regarded as indicative. If it should be proposed to use soakaways for this site, then more extensive follow-up tests will be required and should fully comply with BRE 365, in order to confirm the suitability of the site and to satisfy the local authority.

9.7 RECOMMENDED FURTHER WORKS

It is recommended that following demolition of the existing Youth Centre building within the northwestern area of the site, it would be prudent to excavate supplementary trial pits within the footprints of the former building to investigate/confirm the underlying ground conditions and check for residual obstructions. Additional soil samples should also be collected from around the footprint of the Youth Centre following breaking out and removal of the floor slab and scheduled for laboratory analysis to assess the potential for any residual soil contamination within this area.

Upon completion of the supplementary works, the relevant human health and environmental risk assessments should be updated, along with the recommendations and considerations discussed within Section 9.0 of this report.

APPENDIX A

TRIAL PIT LOGS

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Tel. 029 20807991
Fax. 029 20862176
mail@integralgeotec.com

Project Name:	Project No.:	Trial Pit No.:
Brookland Road	**14147**	**TP01** Sheet 1 of 1

Location:	Client:	Logged By:	Scale
Risca	Caerphilly County Borough Council	OTJ	1:25

Equipment: JCB 3CX

Coordinates:

Date Excavated: 02/08/2023

Level:

Dimensions

Depth : 2.70m

2.90m

1.20m

Samples & In-situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
0.40	ES					MADE GROUND: Grass over medium dense light brown silty sandy GRAVEL with medium cobble content of sub-angular sandstone and limestone. Gravel is fine to coarse sub-angular of limestone and brick.
			0.70			Firm reddish brown very silty sandy CLAY.
			1.00			Medium dense yellow brown silty SAND and GRAVEL with high cobble and boulder (400x300mm) content of sub-rounded and rounded sandstone. Gravel is fine to coarse sub-rounded and rounded of sandstone.
1.50	B					
			2.70			End of Trialpit at 2.70 m

Remarks:

1. Trial pit terminated at 2.70m bgl due to pit wall instability. 2. Concrete obstruction encountered within northern end of excavation at approximately 1.10m bgl - suspected former library building footings.

Groundwater: Groundwater (perched) seepage encountered at 0.70m bgl.

Stability: Spalling of trial pit sides below 1.00m.

Key:

D - Small disturbed sample
B - Bulk disturbed sample
ES - Environmental soil sample
W - Water sample

AGS

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Project Name:	Project No.:	Trial Pit No.:
Brookland Road	**14147**	**TP02** Sheet 1 of 1

Location:	Client:	Logged By:	Scale
Risca	Caerphilly County Borough Council	OTJ	1:25

Equipment:	Coordinates:	**Dimensions**
JCB 3CX		2.90m
Date Excavated: 02/08/2023	Level:	Depth : 2.70m, 1.10m

Samples & In-situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
						MADE GROUND: Grass over dark brown slightly gravelly CLAY/SILT with frequent roots and rootlets. Includes low cobble content of sub-angular brick. Gravel is fine to coarse sub-angular of sandstone and rare brick. Includes rare fragments of ceramic [reworked topsoil].
			0.40			Firm reddish brown silty slightly sandy slightly gravelly CLAY. Gravel is fine to coarse sub-rounded and rounded of sandstone.
			0.85			Medium dense yellow brown silty SAND and GRAVEL with high cobble and boulder (400x300mm) content of sub-rounded and rounded sandstone. Gravel is fine to coarse sub-rounded and rounded of sandstone.
			2.70			End of Trialpit at 2.70 m

1
2
3
4
5

Remarks:
1. Trial pit terminated at 2.20m bgl due to pit wall instability.

Groundwater: No groundwater encountered within excavation.

Stability: Spalling of trial pit sides below 0.80m.

Key:
D - Small disturbed sample
B - Bulk disturbed sample
ES - Environmental soil sample
W - Water sample

AGS

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Project Name:	Project No.:	Trial Pit No.:
Brookland Road	**14147**	**TP03** Sheet 1 of 1

Location:	Client:	Logged By:	Scale
Risca	Caerphilly County Borough Council	OTJ	1:25

Equipment:	Coordinates:	**Dimensions**
JCB 3CX		2.70m
Date Excavated: 02/08/2023	Level:	Depth : 2.10m / 1.20m

Samples & In-situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
0.20	ES					MADE GROUND: Grass over dark brown slightly gravelly CLAY/SILT with frequent roots and rootlets. Includes low cobble content of sub-angular brick. Gravel is fine to coarse sub-angular of sandstone and rare brick. Includes rare fragments of glass and ceramic [reworked topsoil].
			0.35			Firm reddish brown silty slightly sandy slightly gravelly CLAY. Gravel is fine to coarse sub-rounded and rounded of sandstone.
			0.90			Dense reddish brown silty SAND and GRAVEL with high cobble and boulder content of sub-rounded and rounded sandstone.
			2.10			End of Trialpit at 2.10 m

Remarks:
1. Trial pit terminated at 2.10m bgl due to pit wall instability. 2. Soil infiltration test carried out in excavation.

Groundwater: No groundwater encountered within excavation.

Stability: Spalling of trial pit sides below 0.90m

Key:
D - Small disturbed sample
B - Bulk disturbed sample
ES - Environmental soil sample
W - Water sample

AGS

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mail@integralgeotec.com

Project Name:	Project No.:	Trial Pit No.:
Brookland Road	**14147**	**TP04** Sheet 1 of 1

Location:	Client:	Logged By:	Scale
Risca	Caerphilly County Borough Council	OTJ	1:25

Equipment: JCB 3CX

Coordinates:

Dimensions

2.80m

Depth : 2.20m

1.10m

Date Excavated: 02/08/2023

Level:

Samples & In-situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
0.30	ES		0.35			MADE GROUND: Grass over dark brown slightly gravelly CLAY/SILT with frequent roots and rootlets. Includes low cobble content of sub-angular brick. Gravel is fine to coarse sub-angular of sandstone and rare brick [reworked topsoil].
			0.90			Firm reddish brown silty slightly sandy slightly gravelly CLAY. Gravel is fine to coarse sub-rounded and rounded of sandstone.
			2.20			Medium dense yellow brown silty SAND and GRAVEL with high cobble and medium boulder (350x250mm) content of sub-rounded and rounded sandstone. Gravel is fine to coarse sub-rounded and rounded of sandstone.
						End of Trialpit at 2.20 m

Remarks:

1. Trial pit terminated at 2.20m bgl due to pit wall instability. 2. Soil infiltration test carried out in excavation.

Groundwater: No groundwater encountered within excavation.

Stability: Spalling of trial pit sides below 0.90m

Key:

D - Small disturbed sample
B - Bulk disturbed sample
ES - Environmental soil sample
W - Water sample

AGS

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Project Name:	Project No.:	Trial Pit No.:
Brookland Road	**14147**	**TP05** Sheet 1 of 1

Location:	Client:	Logged By:	Scale
Risca	Caerphilly County Borough Council	OTJ	1:25

Equipment:	Coordinates:	**Dimensions**
JCB 3CX		3.10m
Date Excavated: 02/08/2023	Level:	Depth : 3.10m / 1.30m

Samples & In-situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
0.30	ES					MADE GROUND: Vegetation onto loose light brown silty sandy GRAVEL with low cobble and boulder (600x300mm) content of sub-angular concrete. Gravel is fine to coarse sub-angular of limestone brick, and concrete. Includes rare fragments of metal and ceramic.
			0.40			Firm reddish brown silty slightly sandy slightly gravelly CLAY. Gravel is fine to coarse sub-rounded and rounded of sandstone.
			0.90			Medium dense yellow brown silty SAND and GRAVEL with high cobble and boulder (400x300mm) content of sub-rounded and rounded sandstone. Gravel is fine to coarse sub-rounded and rounded of sandstone.
			3.10			End of Trialpit at 3.10 m

1
2
3
4
5

Remarks:
1. Trial pit terminated at 2.20m bgl due to pit wall instability.

Groundwater: No groundwater encountered within excavation.

Stability: Spalling of trial pit sides below 0.90m.

Key:
D - Small disturbed sample
B - Bulk disturbed sample
ES - Environmental soil sample
W - Water sample

AGS

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Project Name:	Project No.:	Trial Pit No.:
Brookland Road	**14147**	**TP06** Sheet 1 of 1

Location:	Client:	Logged By:	Scale
Risca	Caerphilly County Borough Council	OTJ	1:25

Equipment:	Coordinates:	**Dimensions**
JCB 3CX		2.60m
Date Excavated: 02/08/2023	Level:	Depth : 2.90m, 1.00m

Samples & In-situ Testing			Depth (m)	Level (m AOD)	Legend	Stratum Description
Depth (m)	Type	Results				
0.40	ES					MADE GROUND: Vegetation onto loose light brown silty sandy GRAVEL with low cobble and boulder (600x300mm) content of sub-angular concrete. Gravel is fine to coarse sub-angular of limestone brick, and concrete. Includes rare fragments of metal and ceramic.
			0.50			
0.70	ES					Firm reddish brown silty slightly sandy slightly gravelly CLAY. Gravel is fine to coarse sub-rounded and rounded of sandstone.
			1.10			
1.50	B					Medium dense yellow brown silty SAND and GRAVEL with high cobble and boulder (400x300mm) content of sub-rounded and rounded sandstone. Gravel is fine to coarse sub-rounded and rounded of sandstone.
			2.90			End of Trialpit at 2.90 m

Remarks:
1. Trial pit terminated at 2.20m bgl due to pit wall instability.

Groundwater: No groundwater encountered within excavation.

Stability: Spalling of trial pit sides below 1.00m.

Key:
D - Small disturbed sample
B - Bulk disturbed sample
ES - Environmental soil sample
W - Water sample

AGS

APPENDIX B

SOIL INFILTRATION TEST RESULTS

BRE365 SOIL INFILTRATION RATE TEST - TP03

Brooklands Road, Risca 14147

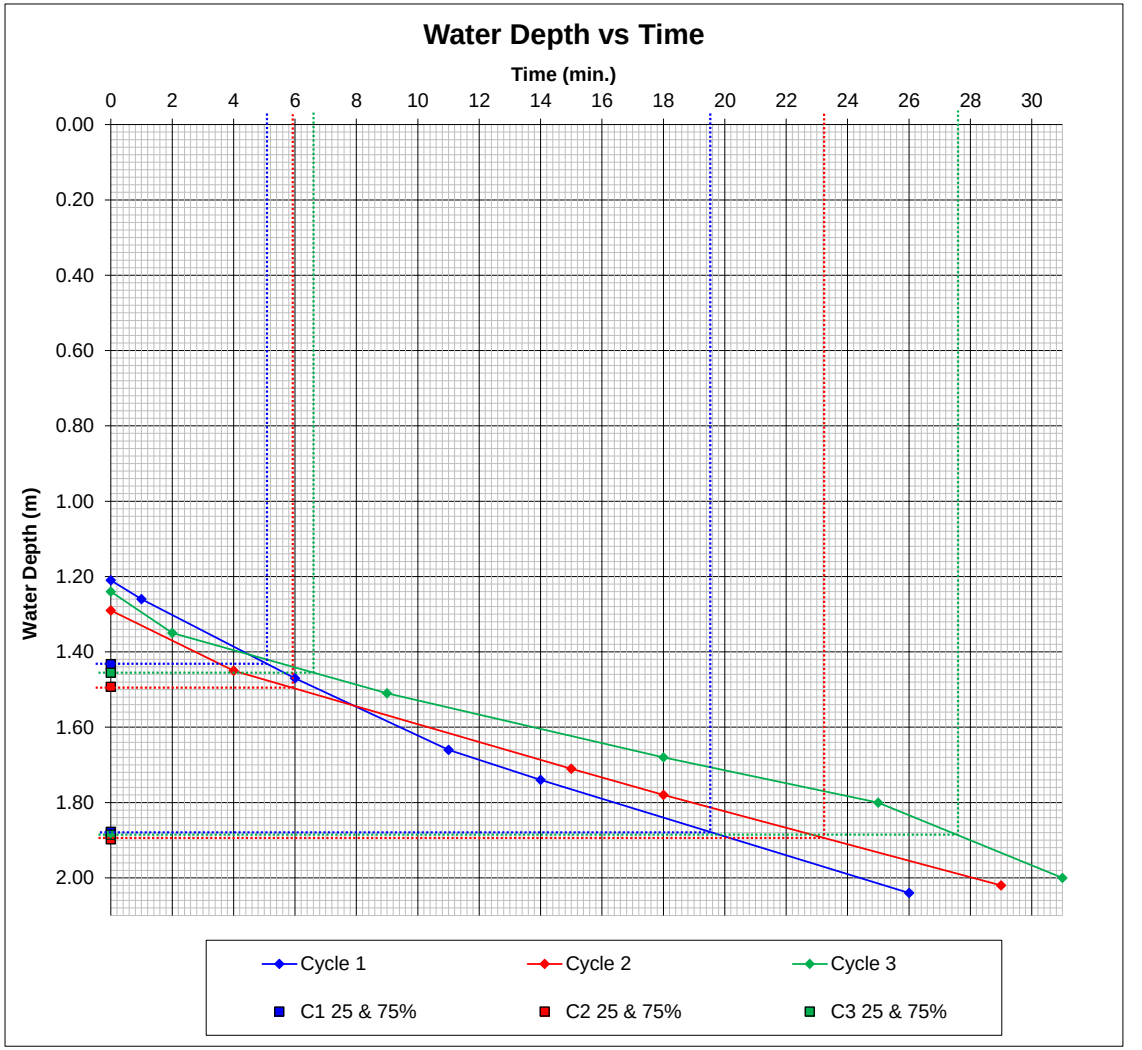
Trial Pit Information	
Length (m)	2.70
Width (m)	1.20
Depth (m)	2.10
Groundwater	Dry
Weather Conditions	Drizzle
Date	02-Aug-23

Remarks

1. Trial pit terminated at 2.20m bgl due to pit wall instability.

2. No groundwater encountered within excavation.

Cycle 1		Cycle 2		Cycle 3	
Time (min)	Depth (m)	Time (min)	Depth (m)	Time (min)	Depth (m)
0	1.21	0	1.29	0	1.24
1	1.26	4	1.45	2	1.35
6	1.47	15	1.71	9	1.51
11	1.66	18	1.78	18	1.68
14	1.74	29	2.02	25	1.80
26	2.04			31	2.00



Final Excavation Depth (m)	Cycle 1	Cycle 2	Cycle 3
At end of testing cycle	2.10	2.10	2.10
Water Depths (m)			
Water depth at start of test	1.21	1.29	1.24
Water depth at end of test	2.04	2.02	2.00
Effective depth (measured)	0.83	0.73	0.76
% Effective storage depth	0.93	0.90	0.88
Effective Storage Depths (m)			
Effective storage depth (100%)	0.89	0.81	0.86
Effective storage depth (75%)	0.67	0.61	0.65
Effective storage depth (50%)	0.45	0.41	0.43
Effective storage depth (25%)	0.22	0.20	0.22
Outflow Time (min)			
Time for measured outflow	26	29	31
Time for 100% outflow	26	29	31
Time for 75-25% outflow	14	17	21
Volume of Outflow (m^3)			
Over measured effective depth	2.69	2.37	2.46
Over 100% effective depth	2.88	2.62	2.79
From 75% - 25% effective depth	1.44	1.31	1.39
Surface Area (m^2)			
For 100% effective storage	10.18	9.56	9.95
For 50% effective storage	6.71	6.40	6.59
Over measured depth	9.71	8.93	9.17
Soil Infiltration Rate (m/s)	**Cycle 1**	**Cycle 2**	**Cycle 3**
Over 100% effective depth	1.8E-04	1.6E-04	1.5E-04
Over measured depth	1.8E-04	1.5E-04	1.4E-04
Over 75% - 25% effective depth	**2.5E-04**	**2.0E-04**	**1.7E-04**

Design Soil Infiltration Rate: 1.6E-04 m/s

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BRE365 SOIL INFILTRATION RATE TEST - TP04

Brooklands Road, Risca 14147

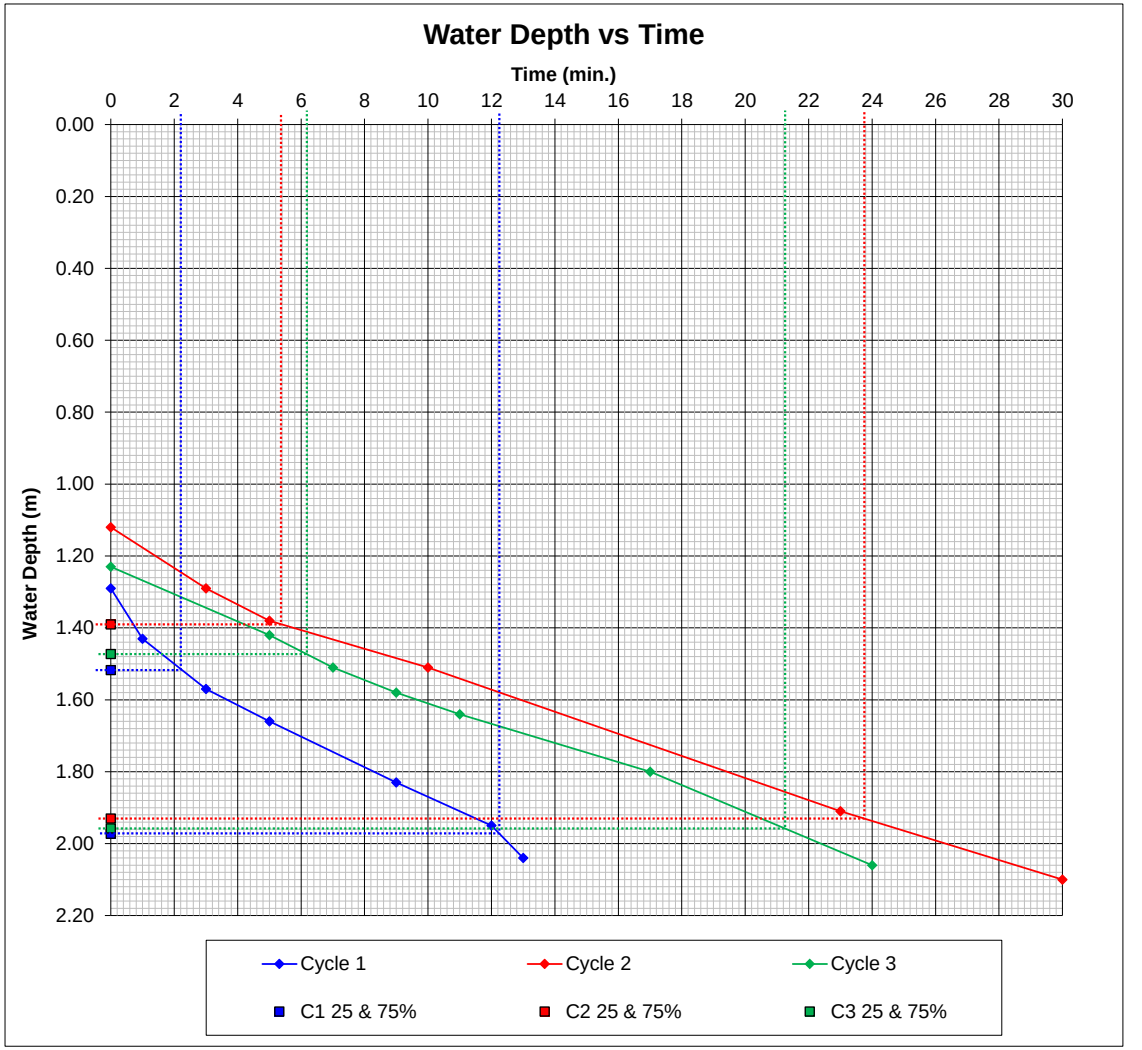
Trial Pit Information	
Length (m)	2.80
Width (m)	1.10
Depth (m)	2.20
Groundwater	Dry
Weather Conditions	Drizzle
Date	02-Aug-23

Remarks

1. Trial pit terminated at 2.20m bgl due to pit wall instability.

2. No groundwater encountered within excavation.

Cycle 1		Cycle 2		Cycle 3	
Time (min)	Depth (m)	Time (min)	Depth (m)	Time (min)	Depth (m)
0	1.29	0	1.12	0	1.23
1	1.43	3	1.29	5	1.42
3	1.57	5	1.38	7	1.51
5	1.66	10	1.51	9	1.58
9	1.83	23	1.91	11	1.64
12	1.95	30	2.10	17	1.80
13	2.04			24	2.06



Final Excavation Depth (m)	Cycle 1	Cycle 2	Cycle 3
At end of testing cycle	2.20	2.20	2.20
Water Depths (m)			
Water depth at start of test	1.29	1.12	1.23
Water depth at end of test	2.04	2.10	2.06
Effective depth (measured)	0.75	0.98	0.83
% Effective storage depth	0.82	0.91	0.86
Effective Storage Depths (m)			
Effective storage depth (100%)	0.91	1.08	0.97
Effective storage depth (75%)	0.68	0.81	0.73
Effective storage depth (50%)	0.46	0.54	0.49
Effective storage depth (25%)	0.23	0.27	0.24
Outflow Time (min)			
Time for measured outflow	13	30	24
Time for 100% outflow	13	30	24
Time for 75-25% outflow	10	18	15
Volume of Outflow (m^3)			
Over measured effective depth	2.31	3.02	2.56
Over 100% effective depth	2.80	3.33	2.99
From 75% - 25% effective depth	1.40	1.66	1.49
Surface Area (m^2)			
For 100% effective storage	10.18	11.50	10.65
For 50% effective storage	6.63	7.29	6.86
Over measured depth	8.93	10.72	9.55
Soil Infiltration Rate (m/s)	**Cycle 1**	**Cycle 2**	**Cycle 3**
Over 100% effective depth	3.5E-04	1.6E-04	1.9E-04
Over measured depth	3.3E-04	1.6E-04	1.9E-04
Over 75% - 25% effective depth	**3.5E-04**	**2.1E-04**	**2.4E-04**

Design Soil Infiltration Rate: 2.0E-04 m/s

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APPENDIX C

LABORATORY CHEMICAL TEST RESULTS (SOILS)

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Analytical Report Number : 23-49161

Project / Site name:	Brooklands	**Samples received on:**	04/08/2023
Your job number:	14147	**Samples instructed on/ Analysis started on:**	04/08/2023
Your order number:	14147 OTJ	**Analysis completed by:**	14/08/2023
Report Issue Number:	1	**Report issued on:**	14/08/2023
Samples Analysed:	6 soil samples		

Izabela Wójcik
Signed:

Izabela Wójcik
Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils	- 4 weeks from reporting
leachates	- 2 weeks from reporting
waters	- 2 weeks from reporting
asbestos	- 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 23-49161
Project / Site name: Brooklands
Your Order No: 14147 OTJ

Lab Sample Number				2771340	2771341	2771342	2771343
Sample Reference				TP01	TP03	TP04	TP05
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.40	0.20	0.30	0.30
Date Sampled				02/08/2023	02/08/2023	02/08/2023	02/08/2023
Time Taken				0910	1050	1130	1255
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**				
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	9.1	20	19	16
Total mass of sample received	kg	0.001	NONE	0.5	0.5	0.4	0.6
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Not-detected	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	EWS	EWS	EWS	EWS

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.6	6.7	7.6	7.9
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO4	mg/kg	50	MCERTS	1700	700	710	910
Water Soluble Sulphate as SO4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	-	-	-	-
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.0435	0.0093	0.0105	0.0384
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	-	-	-	-
Sulphide	mg/kg	1	MCERTS	42	1	< 1.0	3.3
Total Sulphur	mg/kg	50	MCERTS	1900	380	430	490
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	1	3	3.7	2.3
Loss on Ignition @ 450oC	%	0.2	MCERTS	2.2	7.3	9.2	8.1

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.06	0.13
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.06
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.07
Phenanthrene	mg/kg	0.05	MCERTS	0.16	0.18	0.18	0.8
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.18
Fluoranthene	mg/kg	0.05	MCERTS	0.37	0.22	0.26	1.3
Pyrene	mg/kg	0.05	MCERTS	0.34	0.21	0.24	1
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.28	0.16	0.19	0.84
Chrysene	mg/kg	0.05	MCERTS	0.3	0.18	0.26	0.94
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	0.42	0.21	0.29	1.1
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	0.14	0.08	0.1	0.46
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.31	0.16	0.22	0.81
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.17	0.09	0.14	0.45
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.08	< 0.05	0.06	0.18
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.18	0.1	0.18	0.47

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	2.75	1.59	2.18	8.8

Analytical Report Number: 23-49161
Project / Site name: Brooklands
Your Order No: 14147 OTJ

Lab Sample Number				2771340	2771341	2771342	2771343
Sample Reference				TP01	TP03	TP04	TP05
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.40	0.20	0.30	0.30
Date Sampled				02/08/2023	02/08/2023	02/08/2023	02/08/2023
Time Taken				0910	1050	1130	1255
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**				
Heavy Metals / Metalloids							
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	16	27	25	20
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.63	0.89	0.87	0.89
Boron (water soluble)	mg/kg	0.2	MCERTS	0.9	0.5	0.7	0.4
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	34	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	12	20	19	18
Copper (aqua regia extractable)	mg/kg	1	MCERTS	32	73	45	36
Lead (aqua regia extractable)	mg/kg	1	MCERTS	520	87	130	110
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	0.4	0.5	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	15	21	21	19
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	14	40	35	32
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	3900	110	110	90

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number: 23-49161
Project / Site name: Brooklands
Your Order No: 14147 OTJ

Lab Sample Number				2771344	2771345
Sample Reference				TP06	TP06
Sample Number				None Supplied	None Supplied
Depth (m)				0.70	0.40
Date Sampled				02/08/2023	02/08/2023
Time Taken				1345	1340
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
Stone Content	%	0.1	NONE	< 0.1	45
Moisture Content	%	0.01	NONE	14	8.8
Total mass of sample received	kg	0.001	NONE	0.5	0.6

Asbestos in Soil	Type	N/A	ISO 17025	-	Not-detected
Asbestos Analyst ID	N/A	N/A	N/A	N/A	EWS

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.2	8.5
Total Cyanide	mg/kg	1	MCERTS	-	< 1.0
Total Sulphate as SO4	mg/kg	50	MCERTS	-	670
Water Soluble Sulphate as SO4 16hr extraction (2:1)	mg/kg	2.5	MCERTS	23	-
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.0114	0.0231
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	11.4	-
Sulphide	mg/kg	1	MCERTS	-	21
Total Sulphur	mg/kg	50	MCERTS	-	500
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	-	1.5
Loss on Ignition @ 450oC	%	0.2	MCERTS	-	3.2

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	< 1.0

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	-	0.14
Acenaphthylene	mg/kg	0.05	MCERTS	-	0.1
Acenaphthene	mg/kg	0.05	MCERTS	-	0.31
Fluorene	mg/kg	0.05	MCERTS	-	0.4
Phenanthrene	mg/kg	0.05	MCERTS	-	5.3
Anthracene	mg/kg	0.05	MCERTS	-	1.4
Fluoranthene	mg/kg	0.05	MCERTS	-	9.2
Pyrene	mg/kg	0.05	MCERTS	-	6.7
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	5.3
Chrysene	mg/kg	0.05	MCERTS	-	5.1
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	-	5.8
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	-	2.2
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	4.3
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	2.2
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	0.9
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	2.2

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	-	51.4

Analytical Report Number: 23-49161
Project / Site name: Brooklands
Your Order No: 14147 OTJ

Lab Sample Number				2771344	2771345
Sample Reference				TP06	TP06
Sample Number				None Supplied	None Supplied
Depth (m)				0.70	0.40
Date Sampled				02/08/2023	02/08/2023
Time Taken				1345	1340
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**		
Heavy Metals / Metalloids					
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	-	11
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	0.75
Boron (water soluble)	mg/kg	0.2	MCERTS	-	0.9
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	-	0.5
Chromium (hexavalent)	mg/kg	1.8	MCERTS	-	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	23
Copper (aqua regia extractable)	mg/kg	1	MCERTS	-	51
Lead (aqua regia extractable)	mg/kg	1	MCERTS	-	33
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	-	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	-	17
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	-	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	25
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	-	81

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number : 23-49161
Project / Site name: Brooklands

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
2771340	TP01	None Supplied	0.4	Brown clay and sand with gravel and vegetation.
2771341	TP03	None Supplied	0.2	Brown loam and clay with vegetation and gravel
2771342	TP04	None Supplied	0.3	Brown loam and clay with vegetation and gravel
2771343	TP05	None Supplied	0.3	Brown clay and loam with vegetation and gravel
2771344	TP06	None Supplied	0.7	Brown clay and sand.
2771345	TP06	None Supplied	0.4	Brown clay and loam with vegetation and stones.

Analytical Report Number : 23-49161
Project / Site name: Brooklands

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Loss on ignition of soil @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace.	In house method.	L047-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Sulphate, water soluble, in soil	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS

Analytical Report Number : 23-49161
Project / Site name: Brooklands

Water matrix abbreviations:
Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).
For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).
For method numbers ending in 'PL or B' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

APPENDIX D

GEOTECHNICAL TEST RESULTS

Results Summary

Apex Testing Solutions Limited
Sturmi Way
Village Farm Industrial Estate
Pyle
Bridgend
CF33 6BZ

Telephone: 01656 746762
E-mail: andrew.grogan@apex-drilling.com
laura.davis@apex-drilling.com

Reporting Details		**Key Information**	
Company Name:	Integral Geotechnique	**Site Name:**	Brooklands, Risca
Address:	7 Beddau Way		
	Castlegate Business Park	**Job Number:**	D23345
	Caerphilly	**Date Received:**	03/08/2023
	CF83 2AX	**Job Coordinator:**	L. Davies
Contact Name:	**Owain**		
Contact Number:			

Item No.	Tests Undertaken	Number of Tests
1	Atterburg Limits (4 point) - BS1377-2: 1990	2
2	Water Content - ISO 17892 2014+A1:2022	2
3	# pH & sulphate (pH/SO4)	2

Results Issued: 10/08/2023

Comments

Results herein relate only to samples received in the laboratory and where not sampled by Apex Testing Solutions personnel relate to the samples as received.
Where tests are UKAS accredited any Opinion and/or Interpretation expressed herein are outside the scope of the UKAS Accreditation. The reports shall not be reproduced in full without the written approval of the laboratory.

Please contact the job coordinator should any further information be required.

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528777
email: hawardencustomerservices@alsglobal.com
Website: www.alsenvironmental.co.uk

Apex Testing Solutions Limited
Sturmi Way
Village Farm Industrial Estate
Pyle
Bridgend
CF33 6BZ

Attention: Laura Davies

CERTIFICATE OF ANALYSIS

Date of report Generation:	10 August 2023
Customer:	Apex Testing Solutions Limited
Sample Delivery Group (SDG):	230805-49
Your Reference:	D23345
Location:	Brooklands
Report No:	699658
Order Number:	ATS 1842

We received 2 samples on Saturday August 05, 2023 and 2 of these samples were scheduled for analysis which was completed on Thursday August 10, 2023. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

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

Chemical testing (unless subcontracted) performed at ALS Laboratories (UK) Limited Hawarden.

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.
Incorrect sampling dates and/or sample information will affect the validity of results.

Approved By:

Sonia McWhan
Operations Manager

1291

CERTIFICATE OF ANALYSIS

SDG: 230805-49 **Report Number:** 699658 **Superseded Report:**
Client Ref.: D23345 **Location:** Brooklands

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
28436319	TP01		1.50	03/08/2023
28436323	TP06		1.50	03/08/2023

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

Validated

CERTIFICATE OF ANALYSIS

SDG: 230805-49 **Report Number:** 699658 **Superseded Report:**
Client Ref.: D23345 **Location:** Brooklands

Results Legend

X Test

N No Determination Possible

Sample Types -
S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water
Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)			28436319	28436323
Customer Sample Reference			TP01	TP06
AGS Reference				
Depth (m)			1.50	1.50
Container			250g Amber Jar (ALE210)	250g Amber Jar (ALE210)
Sample Type			S	S
Anions by Kone (soil)	All	NDPs: 0 Tests: 2	X	X
pH	All	NDPs: 0 Tests: 2	X	X
Sample description	All	NDPs: 0 Tests: 2	X	X

CERTIFICATE OF ANALYSIS

SDG: 230805-49 **Report Number:** 699658 **Superseded Report:**
Client Ref.: D23345 **Location:** Brooklands

Sample Descriptions

Grain Sizes

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

Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Inclusions	Inclusions 2
28436319	TP01	1.50	Light Brown	Sandy Loam	Stones	Vegetation
28436323	TP06	1.50	Light Brown	Loamy Sand	Stones	Vegetation

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

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

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

Validated

CERTIFICATE OF ANALYSIS

SDG: 230805-49 **Report Number:** 699658 **Superseded Report:**
Client Ref.: D23345 **Location:** Brooklands

Results Legend		Customer Sample Ref.	TP01	TP06				
#	ISO17025 accredited.							
M	mCERTS accredited.							
aq	Aqueous / settled sample.							
diss.filt	Dissolved / filtered sample.							
tot.unfilt	Total / unfiltered sample.							
*	Subcontracted - refer to subcontractor report for accreditation status.							
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery							
(F)	Trigger breach confirmed							
1-4+§@	Sample deviation (see appendix)							
		Depth (m)	1.50	1.50				
		Sample Type	Soil/Solid (S)	Soil/Solid (S)				
		Date Sampled	03/08/2023	03/08/2023				
		Sample Time	.	.				
		Date Received	05/08/2023	05/08/2023				
		SDG Ref	230805-49	230805-49				
		Lab Sample No.(s)	28436319	28436323				
		AGS Reference						

Component	LOD/Units	Method						
Moisture Content Ratio (% of as received sample)	%	PM024	10	5.8				
pH	1 pH Units	TM133	8.26 M	8.36 M				
Water Soluble Sulphate as SO4 2:1 Extract	<0.004 g/l	TM243	0.0333 M	0.0209 M				

Table of Results - Appendix

Method No	Description
PM024	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material
TM133	Determination of pH in Soil and Water using the GLpH pH Meter
TM243	Mixed Anions In Soils By Kone

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Laboratories (UK) Limited Hawarden (Method codes TM).

CERTIFICATE OF ANALYSIS

SDG: 230805-49 **Report Number:** 699658 **Superseded Report:**
Client Ref.: D23345 **Location:** Brooklands

Test Completion Dates

Lab Sample No(s)	28436319	28436323
Customer Sample Ref.	TP01	TP06
AGS Ref.		
Depth	1.50	1.50
Type	Soil/Solid (S)	Soil/Solid (S)
Anions by Kone (soil)	10-Aug-2023	10-Aug-2023
pH	09-Aug-2023	09-Aug-2023
Sample description	05-Aug-2023	05-Aug-2023

Appendix General

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

2. If sufficient sample is received a sub sample will be retained free of charge for 15 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

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

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

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

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

7. Results relate only to the items tested.

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

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

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

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

12. For dried and crushed preparations of soils volatile loss may occur e.g volatile mercury

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

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

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

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

17 Data retention. All records, communications and reports pertaining to the analysis are archived for seven years from the date of issue of the final report.

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

19. **Sample Deviations**

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Matrix interference**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to late arrival of instructions or samples**
§	**Sampled on date not provided**

20. **Asbestos**

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2021), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as “Not detected”. If no asbestos fibre types are found all will be reported as “Not detected” and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials and soils are obtained from supplied bulk materials andd soils which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2021).

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

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

Visual Estimation Of Fibre Content

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

Respirable Fibres

Respirable fibres are defined as fibres of <3 µm diameter, longer than 5 µm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.

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

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

TEST REPORT

Determination Of Water Content

ISO 17892-1: 2014+A1:2022

Project No:	D23345	**Client:**	Integral Geotechnique
Project Name:	Brooklands, Risca	**Address:**	7 Beddau Way Castlegate Business Park Caerphilly CF83 2AX
ATS Sample No:	33937		

Site Ref / Hole ID:	TP01	**Depth (m):**	1.50
Sample No:		**Sample Type:**	Bulk
Sampling Certificate Received:	No	**Material Description:**	Brown slightly clayey sandy GRAVEL
Location in Works:	N/a	**Material Source:**	Ex-Site
Date Sampled:	Unknown	**Material Supplier:**	Ex-Site
Sampled By:	Client	**Specification:**	ISO 17892-1
Date Received:	03 August 2023	**Date Tested:**	04 August 2023

Test Results

Moisture Content (%)	9.3

Remarks:

QA Ref.	**Apex Testing Solutions**		Approver	Date	Fig
EN ISO 17892-1:2014 A1:2022	Sturmi Way, Village Farm Industrial Est, Pyle, Bridgend, CF33 6BZ Tel: 01656 746762 Fax: 01656 749096	7771	*G Llewellyn*	04/08/2023	**MC**
			G Llewellyn, Senior Technician		

TEST REPORT

LIQUID LIMIT, PLASTIC LIMIT & PLASTICITY INDEX

BS 1377:Part 2:1990. Clause 4.3/5.3/5.4

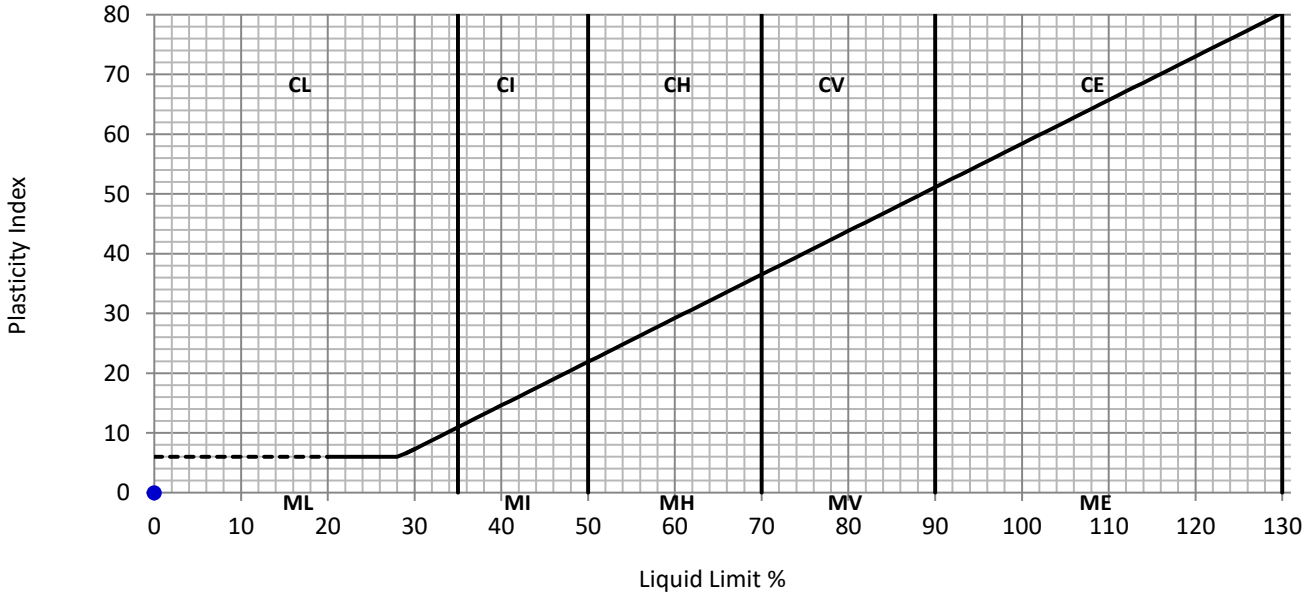
Project No:	D23345	**Client:**	Integral Geotechnique
Project Name:	Brooklands, Risca	**Address:**	7 Beddau Way Castlegate Business Park Caerphilly CF83 2AX
ATS Sample No:	33937		

Site Ref / Hole ID:	TP01	**Depth (m):**	1.50
Sample No:		**Sample Type:**	Bulk
Sampling Certificate Received:	No	**Material Description:**	Brown slightly clayey sandy GRAVEL
Location in Works:	N/a	**Material Source:**	Ex-Site
Date Sampled:	Unknown	**Material Supplier:**	Ex-Site
Sampled By:	Client	**Specification:**	BS1377
Date Received:	03 August 2023	**Date Tested:**	04 August 2023

Test Results

Liquid Limit	0	%
Plastic Limit	0	%
Plasticity Index	0	%

Preparation:	4.2.4 Sieved Specimen	
Proportion retained on 425µm sieve:	67	%



Remarks: **Sample is non-plastic**

TEST REPORT

Determination Of Water Content

ISO 17892-1: 2014+A1:2022

Project No:	D23345	**Client:**	Integral Geotechnique
Project Name:	Brooklands, Risca	**Address:**	7 Beddau Way Castlegate Business Park Caerphilly CF83 2AX
ATS Sample No:	33938		

Site Ref / Hole ID:	TP06	**Depth (m):**	1.50
Sample No:		**Sample Type:**	Bulk
Sampling Certificate Received:	No	**Material Description:**	Brown sandy gravelly CLAY
Location in Works:	N/a	**Material Source:**	Ex-Site
Date Sampled:	Unknown	**Material Supplier:**	Ex-Site
Sampled By:	Client	**Specification:**	ISO 17892-1
Date Received:	03 August 2023	**Date Tested:**	04 August 2023

Test Results

Moisture Content (%)	7.0

Remarks:

QA Ref.	**Apex Testing Solutions**		Approver	Date	Fig
EN ISO 17892-1:2014 A1:2022	Sturmi Way, Village Farm Industrial Est, Pyle, Bridgend, CF33 6BZ Tel: 01656 746762 Fax: 01656 749096	7771	*G Llewellyn*	04/08/2023	**MC**
			G Llewellyn, Senior Technician		

TEST REPORT

LIQUID LIMIT, PLASTIC LIMIT & PLASTICITY INDEX

BS 1377:Part 2:1990. Clause 4.3/5.3/5.4

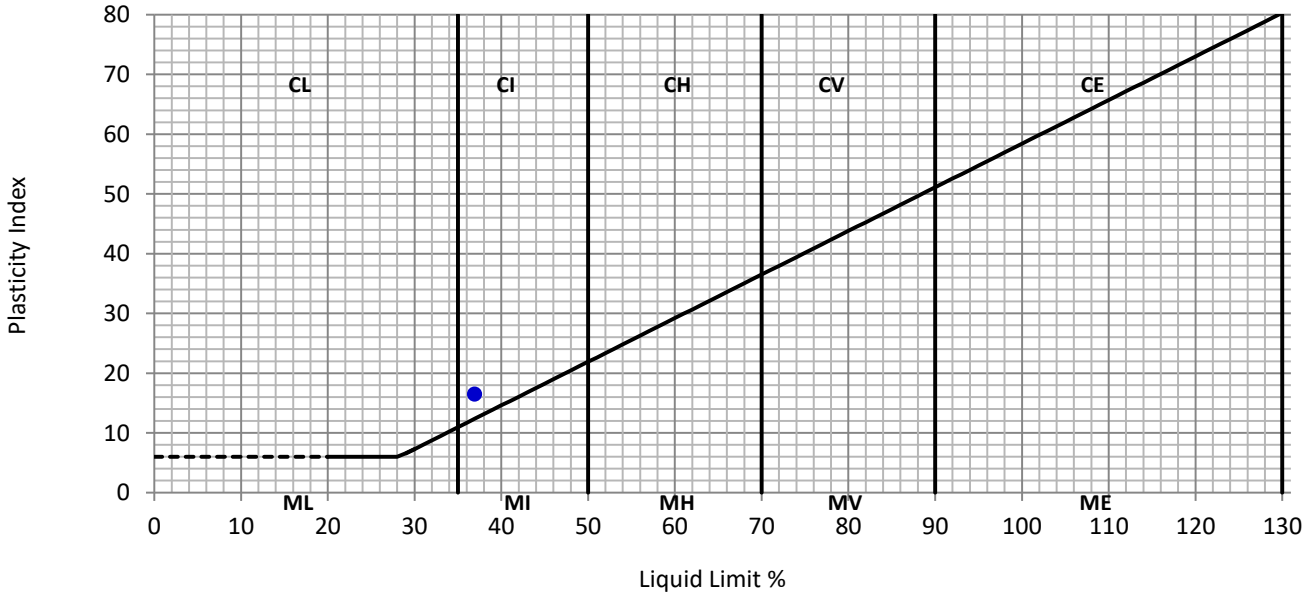
Project No:	D23345	**Client:**	Integral Geotechnique
Project Name:	Brooklands, Risca	**Address:**	7 Beddau Way Castlegate Business Park Caerphilly CF83 2AX
ATS Sample No:	33938		

Site Ref / Hole ID:	TP06	**Depth (m):**	1.50
Sample No:		**Sample Type:**	Bulk
Sampling Certificate Received:	No	**Material Description:**	Brown sandy gravelly CLAY
Location in Works:	N/a	**Material Source:**	Ex-Site
Date Sampled:	Unknown	**Material Supplier:**	Ex-Site
Sampled By:	Client	**Specification:**	BS1377
Date Received:	03 August 2023	**Date Tested:**	04 August 2023

Test Results

Liquid Limit	37	%
Plastic Limit	20	%
Plasticity Index	17	%

Preparation:	4.2.4 Sieved Specimen	
Proportion retained on 425µm sieve:	87	%



Remarks:

QA Ref.	**Apex Testing Solutions**	Approver	Date	Fig.
BS1377 - 2 Rev. 3.0	Sturmi Way, Village Farm Industrial Est, Pyle, Bridgend, CF33 6BZ Tel: 01656 746762 Fax: 01656 749096 7771	*G Llewellyn*	04/08/2023	**ATT**
		G Llewellyn, Senior Technician		

APPENDIX E

SUMMARY OF LABORATORY CHEMICAL TEST RESULTS – MADE GROUND

SUMMARY OF LABORATORY SOIL TEST RESULTS

Job No.: 14147
Site: Brookland Road, Risca
Soil Type: Made Ground
Soil Organic Matter: 1%

METALS AND SEMI-METALS

No.	Location	Depth (m)	Arsenic (mg/kg)	Boron (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Chromium (VI) (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (Elemental) (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)
1	TP01	0.40	16	0.9	0.63	34	12	< 1.8	32	520	< 0.3	15	< 1.0	14	3900
2	TP03	0.20	27	0.5	0.89	< 0.2	20	< 1.8	73	87	0.4	21	< 1.0	40	110
3	TP04	0.30	25	0.7	0.87	< 0.2	19	< 1.8	45	130	0.5	21	< 1.0	35	110
4	TP05	0.30	20	0.4	0.89	< 0.2	18	< 1.8	36	110	< 0.3	19	< 1.0	32	90
5	TP06	0.40	11	0.9	0.75	0.5	23	< 1.8	51	33	< 0.3	17	< 1.0	25	81
	Screening Criteria Value		37.0	290.0	1.7	11.0	-	6.0	2400.0	200.0	1.2	130.0	250.0	410.0	3700.0
	Source of Screening Criteria Value		S4UL	S4UL	S4UL	S4UL	-	S4UL	S4UL	C4SL	S4UL	S4UL	S4UL	S4UL	S4UL

Intégral Géotechnique

SUMMARY OF LABORATORY SOIL TEST RESULTS

Job No.: 14147
Site: Brookland Road, Risca
Soil Type: Made Ground
Soil Organic Matter: 1%

INORGANIC CHEMICALS & OTHERS

No.	Location	Depth (m)	Cyanide (mg/kg)	Loss on ignition, dried solids (%)	Moisture content at 30 C (%)	Phenol (mg/kg)	pH (pH units)	Water Soluble Sulphate (g/l)	Sulphate Total as SO4 (mg/kg)	Sulphide (mg/kg)	Total Sulphur (mg/kg)	TOC by Ignition in O2 (%)	Equivalent SOM (%)	Asbestos in Soil	Asbestos Quantification (%)
1	TP01	0.40	< 1.0	2.20	9.10	< 1.0	8.60	0.044	1700.00	42.00	1900.00	1.00	1.72	Not-detected	#N/A
2	TP03	0.20	< 1.0	7.30	20.00	< 1.0	6.70	0.009	700.00	1.00	380.00	3.00	5.16	Not-detected	#N/A
3	TP04	0.30	< 1.0	9.20	19.00	< 1.0	7.60	0.011	710.00	< 1.0	430.00	3.70	6.36	Not-detected	#N/A
4	TP05	0.30	< 1.0	8.10	16.00	< 1.0	7.90	0.038	910.00	3.30	490.00	2.30	3.96	Not-detected	#N/A
5	TP06	0.40	< 1.0	3.20	8.80	< 1.0	8.50	0.023	670.00	21.00	500.00	1.50	2.58	Not-detected	#N/A
	Screening Criteria Value		34.0	-	-	120.0	-	-	-	-	-	-	-	-	0.001
	Source of Screening Criteria Value		ATRISK	-	-	S4UL	-	-	-	-	-	-	-	-	IOM

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POLYAROMATIC HYDROCARBONS (PAH)

No.	Location	Depth (m)	Acenaphthene (mg/kg)	Acenaphthylene (mg/kg)	Anthracene (mg/kg)	Benzo(a)anthracene (mg/kg)	Benzo(a)pyrene (mg/kg)	Benzo(b)fluoranthene (mg/kg)	Benzo(ghi)perylene (mg/kg)	Benzo(k)fluoranthene (mg/kg)	Chrysene (mg/kg)	Dibenzo(ah)anthracene (mg/kg)	Fluoranthene (mg/kg)	Fluorene (mg/kg)	Indeno(123cd)pyrene (mg/kg)	Naphthalene (mg/kg)	Phenanthrene (mg/kg)	Pyrene (mg/kg)
1	TP01	0.40	< 0.05	< 0.05	< 0.05	0.28	0.31	0.42	0.18	0.14	0.3	0.08	0.37	< 0.05	0.17	< 0.05	0.16	0.34
2	TP03	0.20	< 0.05	< 0.05	< 0.05	0.16	0.16	0.21	0.1	0.08	0.18	< 0.05	0.22	< 0.05	0.09	< 0.05	0.18	0.21
3	TP04	0.30	< 0.05	< 0.05	< 0.05	0.19	0.22	0.29	0.18	0.1	0.26	0.06	0.26	< 0.05	0.14	0.06	0.18	0.24
4	TP05	0.30	0.06	< 0.05	0.18	0.84	0.81	1.1	0.47	0.46	0.94	0.18	1.3	0.07	0.45	0.13	0.8	1
5	TP06	0.40	0.31	0.1	1.4	5.3	**4.3**	**5.8**	2.2	2.2	5.1	**0.9**	9.2	0.4	2.2	0.14	5.3	6.7
	Screening Criteria Value		**210.0**	**170.0**	**2400.0**	**7.2**	**2.2**	**2.6**	**320.0**	**77.0**	**15.0**	**0.24**	**280.0**	**170.0**	**27.0**	**2.3**	**95.0**	**620.0**
	Source of Screening Criteria Value		S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL	S4UL

Intégral Géotechnique

FIGURES

Figure 1: Site Location

Project: Brookland Road, Risca	Job no.: 14147	Intégral Géotechnique	Integral House, 7 Beddau Way, Castlegate Business Park, Caerphilly, CF83 2AX. Tel: 029 2080 7991
Client: Currie & Brown Limited	Scale: 1:10,000 at A4		

Figure 2: Site Plan

Project: Brookland Road, Risca	Job No.: 14147	Intégral Géotechnique	Integral House, 7 Beddau Way, Castlegate Business Park, Caerphilly, CF83 2AX. Tel: 029 2080 7991
Client: Currie & Brown Limited	Scale: 1:500 at A3		