



Geo-Environmental and Geotechnical Ground Investigation Report – Tees Valley ERF Site

Grangetown Prairie, Redcar, TS10 5QW

Date:

27/11/2020

Prepared for:

Hartlepool Borough Council, Darlington Borough Council,
Stockton on Tees Borough Council, Middlesbrough
Borough Council, Redcar & Cleveland Borough Council,
Newcastle City Council, and Durham County Council

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Project Name:

Tees Valley EfW

Project No:

41527104

Report Ref:

RPT_41527104_RT-NN-2789-01

Sign-off Sheet

Project Name	Tees Valley EfW
Project No	41527104
Report Reference	RPT_41527104_RT-NN-2789-01

Revision	Date	Description	Author	Check	Review
0	06 th November 2020	First draft	Ben Douglas (Geo- Environmental) Adrian Jones (Geotechnical)	Jason Hoyte	Stephen Howard / Malcolm Eddleston
01	27 th November 2020	Final version		Stephen Howard	Stephen Howard

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Executive Summary

Stantec has been commissioned on behalf of Hartlepool Borough Council, Darlington Borough Council, Stockton on Tees Borough Council, Middlesbrough Borough Council, Redcar & Cleveland Borough Council, Newcastle City Council, and Durham County Council, together “The Councils”, to undertake a combined Geo-Environmental and Geotechnical Phase II Report to support the design of a proposed Energy Recovery Facility (ERF) plant. The site comprises an approximate 25-hectare plot of land located within the former Cleveland Steel Works, now part of the South Tees Development Corporation (STDC) area, 4.5km east of Middlesbrough town centre.

At the time of the Ground Investigation, the site was undergoing demolition works in order to remove all existing structures related to the previous land uses, most notably the former Steel Works. This included the removal of all notable spoil heaps from the site since the site walkover assessment on 14th February 2020, as well as presenting significant excavations on site, exposing large previous structures including those of particular archaeological significance.

Site History

A review of the site history reveals a varied industrial background. Earliest available mapping from 1957 shows the former Eston Iron Works in the northwest of the site, with associated infrastructure including tanks and a railway, with the remainder of the site shown as undeveloped. By 1895, the site formed part of the wider Cleveland Steel Works, predominantly within the north. Further development of the Steel Works by 1915 shows additional tanks, railway sidings, and a travelling crane, with further expansion southwards evident by 1929. Further industrial development was evident by 1953 and 1971-76, including additional blast furnaces and pipelines. Removal of industrial infrastructure was evident by 1983-89, with large tanks and electricity substations shown adjacent to buildings in the northeast. A pipeline leading to a flare stack is shown by 1983-89, with an additional access road by 1993. The access track and associated infrastructure are shown to be in place until c.2005, with the site shown as disused by 2017, similarly to as was seen prior to current demolition and excavation works.

Ground Investigation

Allied Exploration and Geotechnics (AEG) was commissioned by TVCA to undertake a ground investigation throughout the site in order to provide information on ground and groundwater conditions, as well as to obtain samples for geo-environmental and geotechnical testing. The ground investigation was undertaken under the supervision of Stantec, and in accordance with Stantec’s specification. The investigation comprised the following:

- 15 cable percussion boreholes with rotary follow-on were drilled to final depths of between 17.5m bgl and 43.0m bgl.
- 14 dynamic windowless sampling boreholes were drilled to final depths of between 3.65m bgl and 7.65m bgl.
- 45 trial pits were mechanically excavated to depths of between 0.3m bgl and 4.5m bgl.

On completion, select cable percussive, rotary, and dynamic sampler boreholes were chosen for standpipe installation based upon groundwater observations during drilling, as well as estimated likelihood of water accumulation over time after drilling.

Geology

During the ground investigation, the following geological deposits were encountered at the site within the depth ranges provided below:

- Made Ground (0.0 - 5.2m BGL);
- Tidal Flat Deposits (Alluvium) (0.8 - 7.3m BGL);
- Glaciolacustrine Deposits (1.8 - 12.0m BGL);
- Glacial Till (3.7 - 21.7m BGL);
- Mercia Mudstone (7.8 - 43.0m BGL).

Groundwater

During the investigation:

- 23 monitoring wells were installed within boreholes advanced using cable percussive and direct push drilling methods to depths of between 2.5 and 41.0m BGL (installation response zones varied from 1.0 to 41.0m BGL). The monitoring standpipes were 50mm in diameter.
- Following installation, groundwater monitoring took place on 8th September 2020: measured water levels ranged from 0.5 to 4.8m BGL with one well (DS08) found to be dry.
- 52 groundwater levels were also measured from 48 of the exploratory holes, with reported depths of 0.4m BGL to 26.5m BGL.

Observed Evidence of Contamination

During the investigation, 8 observations of visual and olfactory evidence of potential on-site contamination were noted from 7 locations.

In-Situ Testing

- **Organic Vapour Screening** - 358 Photo-Ionisation Detector (PID) readings were taken to screen for semi-volatile organic compounds (SVOCs) and volatile organic compounds (VOCs) from soil samples collected from across the site at different depths, in conjunction with soil sampling. Generally, PID readings remained <0.1 parts per million (ppm) at all locations and depths across the site, with 27 exceptions from 16 locations, ranging from 0.1 to 4.8 ppm.
- **Water Quality Parameters** – 15 installed locations underwent testing for pH (7.34 to 11.72), temperature (12.75 to 21.28°C), electrical conductivity (9.49 to 5930.00 µS), redox potential (-400.60 to 285.00 mV), and dissolved oxygen (0.00 to 98.75%).
- **Gas Monitoring** – 16 installed locations underwent testing for flow rate (0.0 to 2.1 l/hr), methane (<0.1 to 0.1% v/v), carbon dioxide (<0.1 to 0.5% v/v), oxygen (19.3 to 20.4% v/v), hydrogen sulphide (<1.0 ppm in all locations), and carbon monoxide (<1.0 to 1.0 ppm).

Laboratory Chemical Testing

- **Soil** –109 soil samples were analysed to assess for potential contamination and submitted to DETS (AEG's UKAS accredited laboratory). The samples underwent the following analyses:
 - Suite 1 - First Stage Assessment of Waste Classification (WAC) and Land Quality Assessment;
 - Suite 2 - TPH CWG Banded;

- Suite 3 - Second Stage Assessment of WAC;
- Asbestos identification, and quantification if detected; sulphate – total acid soluble; sulphur – free; thiocyanate; pesticides; manganese; molybdenum; VOCs; total, free and easily liberated cyanide; MTBE; SVOCs; dry solids; and volatile solids.

To evaluate potential risks to human health receptors (i.e. future site users at the site), the soil analytical results have been assessed against a commercial generic assessment criteria(GAC). No exceedances of the corresponding GACs were detected.

53 asbestos samples were tested from within the Made Ground of each exploratory hole location. Asbestos was detected in 22 samples, of which 7 were quantified below the limit of detection (<0.001%). The remaining 15 samples recorded asbestos quantities ranged from 0.002% to 0.13%.

A hazardous properties assessment of the 109 soil samples using the HazWasteOnline tool showed a total of 33 soil samples classified as Hazardous, with the remaining 76 soil samples classified as Non-Hazardous.

Following WAC testing, of the non-hazardous waste samples compared to the landfill waste acceptance criteria, 15 samples exceeded the TOC threshold for inert waste landfill of 3% only. As this is the only threshold exceedance, these samples may be permissible at an Inert landfill facility due to all DOC levels being below 500 mg/kg. following approval by the landfill operator. The vast majority of exceedances of inert waste landfill were from made ground samples.

Thirty-three samples were classified as hazardous waste; therefore, they can only be accepted at a stable non-reactive hazardous waste cell of a landfill site or at a hazardous waste landfill site. Five samples exceeded the thresholds for hazardous waste landfill with all other samples suitable for stable non-reactive hazardous waste (SNRHW) in a non-hazardous landfill or hazardous waste landfill.

- **Soil Leachates, Grab Samples, and Groundwater Monitoring Samples** - A total of 24 of the 109 soil samples underwent soil leachate testing, with 7 grab samples during works and 14 post-investigation monitoring samples retrieved. Leachates and waters underwent the following analyses:
 - Metals; cyanide (free and total); thiocyanate; sulphide; sulphate; pH; total and speciated petroleum hydrocarbons; PAHs; BTEX; VOCs; phenol, cresols, xylenols, ethyl phenols, naphthols, trimethylphenols, and total phenols; TOC; pesticides; manganese; molybdenum; ammonia; chloride; MTBE; hardness; and BOD.

The results were screened against 6 applicable GACs, with multiple exceedances shown in one or more of the GACs for metals, inorganics, petroleum hydrocarbons, PAHs, and VOCs (grab and groundwater monitoring samples only).

Laboratory Geotechnical Testing

Geotechnical laboratory testing comprised on soils: Atterberg limits and natural moisture content, compaction, CBR, undrained strength in triaxial compression, oedometer tests; sulphate and pH testing. On rock cores testing comprised unconfined uniaxial compression strength and point load strength tests. Results are reported in Section 7.

Recommendations

It is proposed to re-use excavated materials from the top 2.5m of soils across the development areas with the intention to re-use under a Materials Management Plan (MMP) following the CL:AIRE Definition of Waste Code of Practice (DoW CoP) under a direct transfer scenario.

- **Human Health** – No exceedances in commercial GAC were detected across the site, including both Made Ground and naturally occurring soils. However, following a hazardous properties assessment, 33 of the 109 soil samples showed hazardous properties. In addition, asbestos was detected in 22 Made Ground samples.

Some material has already been excavated and stockpiled at the site. If this is to be reused, sampling and testing of these stockpile materials is recommended for further risk assessment.

- **Environment (controlled waters)** – Despite exceedances of groundwater GAC across the site in both soil leachates and groundwater samples, groundwater at the site is not considered to be a particularly sensitive receptor for contamination. It is therefore recommended that no further groundwater sampling is required at the site. However, given uncertainty over the accuracy of the leachate data collected to date when compared to corresponding soil concentrations, it is recommended that the previously mentioned additional soil samples collected from the already stockpiled material are subject to leachate testing.
- **Geotechnical Suitability** – Types of foundations will depend on the type, weight and performance criteria of proposed structures at the site. No information on this is currently available so no detailed recommendations on foundations can be given at present.

Abbreviations

°C	Degrees Celsius
µS	Microsiemens
ACM	Asbestos Containing Material
AEG	Allied Exploration and Geotechnics
AGL	Above Ground Level
ANC	Acid Neutralisation Capacity
BGL	Below Ground Level
BOD	Biological Oxygen Demand
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene(s)
C4SL	Category 4 Screening Level
CIEH	Chartered Institute of Environmental Health
CLEA	Contaminated Land Exposure Assessment
CWG	Criteria Working Group
DEFRA	Department for Environment, Food, and Rural Affairs
DOC	Dissolved Organic Carbon
DoW CoP	Definition of Waste Code of Practice
ERF	Energy Recovery Facility
GAC	Generic Assessment Criteria
GC-FID	Gas Chromatography-Flame Ionisation Detection
GC-MS	Gas Chromatography-Mass Spectrometry
HPLC	High Performance Liquid Chromatography
l/hr	Litres per Hour
LoD	Limit of Detection
Lol	Loss on Ignition
LQM	Land Quality Management
m	Metre
mbar	Millibar
mV	Millivolts

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MMP	Materials Management Plan
MTBE	Methyl Tert-Butyl Ether
NGR	National Grid Reference
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PID	Photo-Ionisation Detector
ppm	Parts Per Million
S4UL	Suitable for Use Level
SOM	Soil Organic Matter
SPZ	Source Protection Zone
STDC	South Tees Development Corporation
SVOC	Semi-Volatile Organic Compound
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
UKAS	United Kingdom Accreditation Service
VOC	Volatile Organic Compound
WAC	Waste Acceptance Criteria

1.0 INTRODUCTION

Stantec has been commissioned on behalf of Hartlepool Borough Council, Darlington Borough Council, Stockton on Tees Borough Council, Middlesbrough Borough Council, Redcar & Cleveland Borough Council, Newcastle City Council, and Durham County Council, together “The Councils”, to undertake a combined Geo-Environmental and Geotechnical Phase II Factual Report to support the design of a proposed Energy Recovery Facility (ERF). The Phase II investigation took place within an approximate 25-acre plot of disused land at a former steel works in the southwest of the South Tees Development Corporation (STDC) area, Grangetown, Redcar, North Yorkshire, TS10 5QW, referred to herein as ‘the site’.

The ground investigation works comprised cable percussion and rotary drilling, dynamic sampling, and trial pitting methods, with the aim of gathering a comprehensive and varied set of geo-environmental and geotechnical data.

This purpose of this report is to present a summary of the ground and groundwater conditions, in-situ and laboratory testing, and pertinent engineering considerations that need to be addressed as part of the design and construction of the proposed scheme.

It should be noted that this report has been produced based on currently available design information. Should the propose design alter then this report may require updating in order to reflect the design changes.

2.0 SITE LOCATION AND DESCRIPTION

The site comprises an approximate 25-acre (~10-hectare) near-rectangular shaped plot of land located within the western footprint of the former Cleveland Steel Works, now part of the South Tees Development Corporation (STDC) area. The site is located approximately 900m east of South Bank station with Middlesbrough town centre approximately 4.5km east of the site and the River Tees located approximately 1.3km northwest. The site is centred at approximate National Grid Reference (NGR) 454449, 521337 (NZ 544213). A site location plan is included as Figure 2-1.

Figure 2-1 - Site Location Plan (Source: Google Maps, 2020)



The site is bound to the west by a spoil bund and steep-sided earth bank (approximately 3-4m below ground level (m BGL)) with large pipe rack beyond. The same pipe rack crosses the site in the southwest and runs to the northeast (parallel to the southern access road). The north of the site is bound by the northern access track, with the Tees Valley rail line approximately 20m north of this. To the east, the site is bound by further demolition works as part of the wider STDC development of the area.

At the time of the ground investigation, the site was undergoing demolition works in order to remove all existing structures related to the previous land uses, most notably the former Steel Works. Due to the extensive demolition works, all notable spoil heaps had been removed from the site since the site walkover assessment on 14th February 2020, along with any above-ground remains of concrete structures as previously noted in the Phase I Geo-Environmental and Geotechnical Desk Study (Stantec, 2020). In addition, significant excavations were present on site, exposing large previous structures, as well as those of particular archaeological significance.

Some areas of vegetation, with small trees including buddleia, were still present in small patches throughout the site, notably around the site's centre. Areas were cordoned off where there was evidence of nesting birds. In addition, some pools/ponds were still evident, with tall reeds surrounding larger water bodies.

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Site Location and Description

An area of suspected asbestos containing material (ACM) noted during the February 2020 site visit in the south of the site had also been cordoned off by the demolition contractor.



Slide 1: View looking north, taken from around the centre-southwest of the site. The photograph shows a particularly significant area of excavated material, exposing previous structures lying below the previous ground level. An old tram line, as well as large blast furnace foundations can be noted in this location.

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Site Location and Description



Slide 2: View looking northeast, taken from the original location of BH9. The photograph shows the demolition of large underground concrete structures in the upper right hand corner, with aforementioned areas of vegetation beyond.



Slide 3: View looking northwest from the southeast of the site. The photograph shows a large excavation in the centre-south of the site, as well as drilling of BH12 (left of the photograph) and BH9 (right of the photograph).

3.0 SITE CHARACTERISATION

As previously mentioned in Section 2.0, a Ground Engineering Desk Study (Stantec, 2020) has been carried out for the site, which includes descriptions of the site history, geology, geological hazards, environmental data and where available historical ground investigation data. The following section provides a summary of the historical and geological setting for the site. For further information, please refer to the full Envirocheck Report, Order No. 234035108_1_1, dated 11th February 2020 (Landmark, 2020).

3.1 SITE HISTORY

The earliest available historical mapping from 1857 shows the northwestern section of the site occupied by Eston Iron Works, with associated structures including several small buildings and a row of circular tanks extending eastwards. A railway is shown to encroach onto the site, running up the western site boundary, and a siding branching off and ultimately terminating to the south of the tanks mentioned above. The remainder of the site appears undeveloped, and labelled as “The Pastures”, which forms part of the wider area surrounding the site.

The site forms a significant portion of the wider Cleveland Steel Works by 1895. Buildings associated with the steel works are predominantly located in the north of the site, with railway sidings and smaller process/storage buildings and tanks forming the remainder. An Environmental Statement by JBA (2019) reports 3 No. 20m high blast furnaces serving 4 No. Bessemer furnaces, coke ovens, steel mills, and associated plant. A “Hi Line” elevated rail line is reported to have served the furnaces.

By 1915, the Steel Works had undergone further development, with extended railway sidings in the east and southeast, and further storage tanks in the centre-west. A travelling crane was also noted towards the west.

The main steel works buildings are shown to expand southwards in the east on the site by 1929, with further travelling cranes shown in the centre, northeast, and north of the site. An engine house, water cooling tower and chimneys are also noted on site, with rolling mills reported east of the site.

Further development is evident in maps from 1953, with the addition of multiple pipelines running from the western boundary to tanks within the centre and centre-south of the site. The travelling crane within the centre-west is now shown as blast furnaces, with north-south running pipelines either side. Multiple chimneys are shown in the northwest of the site.

The site appears to be in a similar industrial setting by 1971-76, except some western railway sidings have since been removed. Former blast furnaces are no longer labelled, and associated infrastructure appears to be reduced in size. There are also reduced railway sidings leading off the main rail line in the southwest. A large electricity substation is recorded in the east of the site, with a tank farm slightly north.

By 1983-89, no buildings or sidings are shown in the north or northeast of the site, with two large tanks and electricity substations shown adjacent to the buildings in the northeast. The tanks in the centre of the site are no longer present, along with the railway lines in the southwest. A pipeline leading to a flare stack is shown in maps from 1983-89, with an access road to the flare stack present by 1993.

The large tanks are not present in the northeast of the site by 1994, and the flare stack access track is shown to link up with a road off-site to the north. Aerial photographs from 1999 to 2008 (Google Earth) show the access track and associated structures in place until c.2005, with the remainder of the site used as storage for possible steel lengths. By 2017, the site appears disused, similar to as it is seen presently.

3.2 PUBLISHED GEOLOGY

3.2.1 Artificial Ground / Made Ground

The BGS Onshore Geoindex (BGS, 2020) shows artificial ground described as “Made Ground (undivided) – Artificial Deposit” in the south of the site, approximately 350m east and a vast area approximately 100m north and east of the site (beyond the railway line) which extends all the way to the River Tees. This Made Ground is from historic land reclamation during development of the iron and steel making industry along the Tees corridor (JBA, 2019).

Previous ground investigation (GI) (by unknown, 2005) reported by JBA (2019) noted Made Ground to be present across the site from approximately 0m to 1.9m bgl. Information provided by the STDC site representative during the walkover (Stantec, 2020) detailed the Made Ground to comprise concrete overlying approximately 2m of blast furnace slag. The Environmental Statement (JBA, 2019) also reported that blast furnace slag was likely used for reclamation of land on the banks of the River Tees.

3.2.2 Superficial Geology

The BGS Onshore Geoindex (BGS, 2020) shows **Glaciolacustrine Deposits** (clay and silt) underlying the site. According to previous GI (unknown, 2005), these deposits are reported to extend further north than is defined by BGS data.

Tidal Flat Deposits are recorded by BGS approximately 120m north and could therefore encroach onto the site and are described as mud flat and sand flat deposits comprising clay and occasional peat, silt and sand.

The JBA Environmental Statement (2019) reported that there is uncertainty as to whether the Glaciolacustrine Deposits encountered on site during previous ground investigations are dominated more by Tidal Flat deposits.

Glacial Till, typically comprising stiff clay with varying proportions of silty sand, gravel, cobbles and boulders, is expected to underlie the Glaciolacustrine and Tidal Flat deposits.

3.2.3 Bedrock Geology

The BGS Onshore Geoindex (BGS, 2020) shows the site is underlain by **Mercia Mudstone** Group, described by the BGS as red and sometimes green mudstones and subordinate siltstones with thick halite-bearing units in some basinal areas, with sandstones also present.

Penarth Group – Mudstone, described by the BGS as grey to black mudstones with subordinate limestones and sandstones, predominantly marine in origin, subcrops immediately to the south of the site and may therefore subcrop in limited areas in the south of the site overlying the Mercia Mudstone.

The **Redcar Mudstone Group** is also shown to subcrop approximately 140m south, so may also encroach onto the site.

3.2.4 BGS Borehole Logs

The nearest borehole record from the BGS online mapping (NZ52SW131/D at NGR 454866 521300, approximately 220m to the east of the site, dated 1953) recorded approximately 0.15m thickness of topsoil containing slag, over laminated brown silty clays (Glaciolacustrine Deposits) which extended to approximately 5.6m bgl, over Glacial Till extending to 8.8m bgl. Mudstone was proved from 8.8m bgl to 9.3m bgl. Other nearby BGS records proved a similar geological sequence.

4.0 GROUND INVESTIGATION - SCOPE

Allied Exploration and Geotechnics (AEG) was commissioned by The Councils to undertake a ground investigation throughout the site in order to provide information on ground and groundwater conditions, as well as to obtain samples for geo-environmental and geotechnical testing. The ground investigation was undertaken under the supervision of Stantec, and in accordance with Stantec's specification.

The site works were carried out between 7th July and 7th August 2020 and comprised the following:

- Fifteen cable percussion boreholes¹ with rotary follow-on were drilled to final depths of between 17.5m bgl and 43.0m bgl.
- Fourteen dynamic windowless sampling boreholes were drilled to final depths of between 3.65m bgl and 7.65m bgl.
- Forty-five trial pits were mechanically excavated to depths of between 0.3m bgl and 4.5m bgl.

Table 4.1 (below) details exploratory hole location IDs, and summarises where they required relocating and renaming due to sub-surface obstructions. NB – Dynamic sampling location DS01B and DS14 were turned to additional trial pit locations due to substantial Made Ground present in the general area which prevented drilling.

¹ A total of twenty cable percussion boreholes were attempted, however five were not completed to final depths due to concrete obstructions

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Ground Investigation - Scope

Table 4.1 – Exploratory Hole Summary Table

Exploratory Hole Number	Excavation Method	Completion Depth (m BGL)	Remarks
BH01	CP+RC	29.50	Advanced to required depth.
BH02	TP	2.10	Terminated due to concrete obstruction. Relocated to BH02A.
BH02A	TP	1.60	Relocated from BH02. Terminated due to concrete obstruction. Relocated to BH02B.
BH02B	TP	2.00	Relocated from BH02A. Terminated due to concrete obstruction. Relocated to BH02C.
BH02C	CP+RC	31.00	Relocated from BH02B. Continued by rotary coring from 23.00m BGL. Advanced to required depth.
BH03	CP+RC	43.00	Continued by rotary coring from 23.00m BGL. Advanced to required depth.
BH04	TP	3.10	Terminated due to concrete obstruction. Relocated to BH04A.
BH04A	TP	2.50	Relocated from BH04. Terminated due to concrete obstruction. Relocated to BH04B.
BH04B	CP	16.00	Relocated from BH04A. Terminated due to lost tool down borehole. Relocated to BH04C.
BH04C	CP+RC	28.00	Relocated from BH04B. Continued by rotary coring from 20.00m BGL. Advanced to required depth.
BH05	CP+RC	26.50	Continued by rotary coring from 16.40m BGL. Terminated due to possible artesian water and collapsing.
BH06	CP+RO+RC	26.50	Continued by rotary openhole between 9.95m and 17.50m BGL, and rotary coring from 17.50m BGL. The borehole was re-drilled between 8.50m and 9.95m BGL on 23/07/2020. Advanced to required depth.
BH07	CP+RC	24.10	Continued by rotary coring from 16.10m BGL. Advanced to required depth.
BH08	CP+RC	34.00	Continued by rotary coring from 14.30m BGL. Advanced to required depth.
BH09	CP	1.74	Terminated – unable to progress. Relocated to BH09A.

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Ground Investigation - Scope

Table 4.1 – Exploratory Hole Summary Table

Exploratory Hole Number	Excavation Method	Completion Depth (m BGL)	Remarks
BH09A	CP	3.40	Relocated from BH09. Terminated due to concrete obstruction. Relocated to BH09B.
BH09B	CP+RC	20.00	Relocated from BH09A. Continued by rotary openhole between 10.30m and 12.00m BGL, and rotary coring from 12.00m BGL. Re-drilled between 6.50m and 10.30m BGL on 27/07/2020. Advanced to required depth.
BH10	CP+RC	29.90	Continued by rotary coring from 9.00m BGL. Advanced to required depth.
BH11	CP	0.60	Terminated due to reinforced concrete obstruction. Relocated to BH11A.
BH11A	CP	0.90	Relocated from BH11. Terminated due to reinforced concrete and steel girder. Relocated to BH11B/TP10.
BH11B/TP10	TP	4.50	Relocated from BH11A. Terminated due to concrete obstruction. Relocated to BH11C.
BH11C	TP	1.30	Relocated from BH11B. Terminated due to concrete obstruction (possible floor). Relocated to BH11D.
BH11D	CP+RC	29.75	Relocated from BH11C. Continued by rotary coring from 9.00m BGL. Advanced to required depth.
BH12	CP+RC	17.50	Continued by rotary coring from 9.50m BGL. Advanced to required depth.
BH13	CP+RC	30.00	Continued by rotary coring from 10.00m BGL. Advanced to required depth.
BH14	CP+RO+RC	41.00	14.00 obstruction Continued by rotary openhole between 14.00m and 21.00m BGL, and rotary coring from 21.00m BGL. Advanced to required depth.
BH15/TP03	TP	2.30	Terminated due to concrete obstruction. Relocated to BH15A.
BH15A	TP	2.30	Relocated from BH15/TP03. Terminated due to concrete obstruction. Relocated to BH15B.

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Ground Investigation - Scope

Table 4.1 – Exploratory Hole Summary Table

Exploratory Hole Number	Excavation Method	Completion Depth (m BGL)	Remarks
BH15B	TP	1.00	Relocated from BH15A. Terminated due to concrete obstruction. Relocated to BH15C.
BH15C	TP	2.60	Relocated from BH15B. Terminated due to concrete obstruction. Relocated to BH15D.
BH15D	CP+RC	30.00	Relocated from BH15C. Continued by rotary coring from 22.00m BGL. Advanced to required depth.
DS01	TP	2.00	Terminated due to concrete obstruction. Relocated to DS01A.
DS01A	TP	1.90	Relocated from DS01. Terminated due to concrete obstruction. Relocated to DS01B/TP17.
DS01B/TP17	TP	2.90	Relocated from DS01A. Terminated due to concrete obstruction.
DS02	TP	1.10	Terminated due to concrete obstruction. Relocated to DS02A.
DS02A	WLS	6.45	Relocated from DS02. Advanced to required depth.
DS03	WLS	6.75	Advanced to required depth.
DS04	WLS	6.45	Advanced to required depth.
DS05	TP	1.20	Terminated due to concrete obstruction. Relocated to DS05A.
DS05A	TP	0.60	Relocated from DS05. Terminated due to concrete obstruction. Relocated to DS05B.
DS05B	TP	1.00	Relocated from DS05A. Terminated due to concrete obstruction. Relocated to DS05C/TP04.
DS05C/TP04	TP	1.00	Relocated from DS05B. Terminated due to concrete obstruction. Relocated to DS05D.
DS05D	TP	1.00	Relocated from DS05C/TP04. Terminated due to concrete obstruction. Relocated to DS05E.
DS05E	WLS	6.65	Relocated from DS05D. Advanced to required depth.
DS06	WLS	7.65	Advanced to required depth.

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Ground Investigation - Scope

Table 4.1 – Exploratory Hole Summary Table

Exploratory Hole Number	Excavation Method	Completion Depth (m BGL)	Remarks
DS07	WLS	7.45	Advanced to required depth.
DS08	WLS	7.45	Advanced to required depth.
DS09	WLS	5.60	Terminated due to cobble obstruction.
DS10	TP	1.20	Terminated due to concrete obstruction. Relocated to DS10A.
DS10A	WLS	4.45	Relocated from DS10. Terminated due to hole collapse.
DS11	WLS	6.45	Terminated due to hole collapse.
DS12	TP	1.00	Terminated due to concrete obstruction. Relocated to DS12A.
DS12A	TP	2.70	Relocated from DS12. Terminated due to repeated collapse, undermining and possible concrete base. Relocated to DS12B.
DS12B	WLS	5.65	Relocated from DS12A. Advanced to required depth.
DS13	WLS	3.65	Terminated – unable to proceed/hole collapse.
DS14/TP18	TP	1.90	Terminated due to concrete obstruction. Relocated to DS14A.
DS14A	TP	1.90	Relocated from DS14/TP18. Terminated due to concrete chamber.
DS15	TP	3.50	Terminated due to concrete obstruction. Relocated to DS15A.
DS15A	WLS	6.45	Relocated from DS15. Terminated due to hole collapse.
DS16	WLS	4.45	Terminated due to hole collapse.
TP01	TP	3.00	Advanced to required depth.
TP02	TP	3.00	Advanced to required depth.
TP05	TP	3.00	Advanced to required depth.
TP06	TP	0.40	Terminated due to concrete obstruction. Relocated to TP06A.
TP06A	TP	0.40	Relocated from TP06. Terminated due to concrete obstruction. Relocated to TP06B.
TP06B	TP	3.00	Relocated from TP06A. Advanced to required depth.

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Ground Investigation - Scope

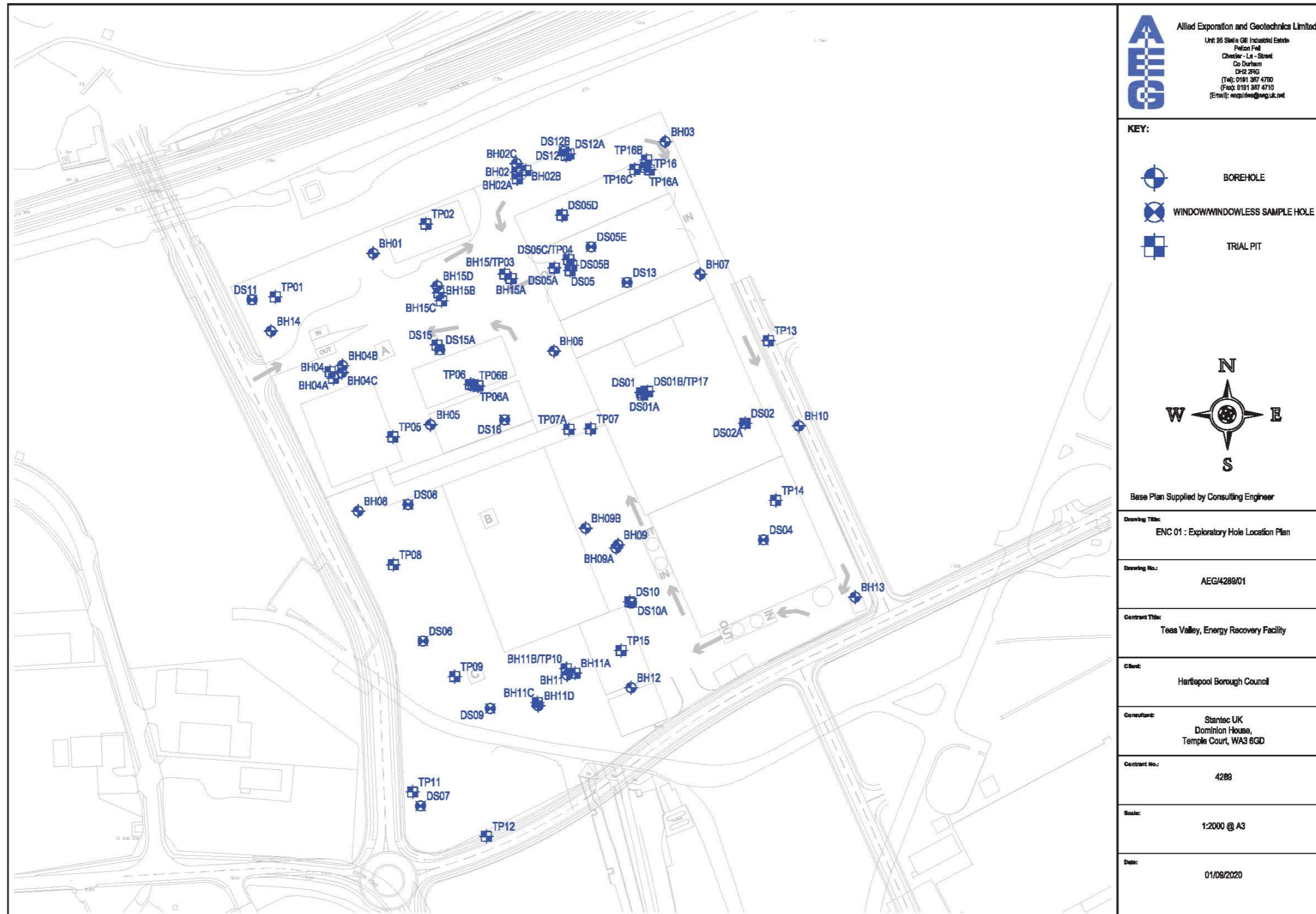
Table 4.1 – Exploratory Hole Summary Table

Exploratory Hole Number	Excavation Method	Completion Depth (m BGL)	Remarks
TP07	TP	0.80	Terminated due to concrete obstruction. Relocated to TP07A.
TP07A	TP	3.00	Relocated from TP07. Advanced to required depth.
TP08	TP	3.00	Advanced to required depth.
TP09	TP	3.10	Advanced to required depth.
TP11	TP	3.00	Advanced to required depth.
TP12	TP	3.00	Advanced to required depth.
TP13	TP	3.00	Advanced to required depth.
TP14	TP	3.00	Advanced to required depth.
TP15	TP	3.00	Advanced to required depth.
TP16	TP	0.30	Terminated due to concrete obstruction. Relocated to TP16A.
TP16A	TP	1.60	Relocated from TP16. Terminated due to concrete obstruction. Relocated to TP16B.
TP16B	TP	1.20	Relocated from TP16A. Terminated due to concrete obstruction. Relocated to TP16C.
TP16C	TP	1.10	Relocated from TP16B. Terminated due to concrete obstruction.
CP = Cable Percussion; RO = Rotary Openhole; RC = Rotary Coring; TP = Trial Pit; WLS = Windowless Sampling			

A full exploratory hole location plan can be found in Figure 4-1 (below). A summary of observed geology can be found in Table 5.1.

On completion, select cable percussive, rotary, and dynamic sampler boreholes were chosen for standpipe installation based upon groundwater observations during drilling, as well as estimated likelihood of water accumulation over time after drilling. A detailed list of these locations, along with groundwater observations, can be found in Table 5.2.

Figure 4-1 – Exploratory Hole Location Plan



5.0 GROUND CONDITIONS

5.1 SITE GEOLOGY

A summary of encountered geology from all excavation locations, noted above, is provided in Table 5.1. Site geology found during the investigation was broadly consistent with the published geology and previous ground investigation data (see Section 3.2). The information summarised below is also presented in the exploratory hole logs within the GI Factual Report in **Appendix A**.

Table 5.1 – Summary of Encountered Geology

Stratum	Description	Depths of Stratum (m BGL)
Made Ground	(Grass over) Topsoil	0.0 – 0.4
	Concrete (potentially reinforced with or without rebar or found as a slab) or brick ² . Void noted at 0.8-2.0m (DS01) following concrete breaking at 0.8m.	0.1 – 1.8
	Reworked sandy/gravelly clay, or clayey/silty sand, gravel or rare cobbles/boulders of brick, macadam, tile, coal, slag, ash, concrete, wood, rebar, mortar, cloth/fabric, plastic, sandstone/mudstone and/or metal fragments. Slag and ash found in varying quantities from 0-100%. Slag is often vesicular.	0.0 – 5.2
Tidal Flat Deposits (Alluvium)	Soft to firm brown/grey/orange or brown mottled grey clay or sandy clay. Occasional fine to coarse gravel, and pockets of yellow/brown sand noted.	0.8 – 7.3
Glaciolacustrine Deposits	Soft to firm frequently thinly or occasionally indistinctly laminated brown/grey/orange or brown mottled grey clay. Occasional fine sand noted on laminae.	1.8 – 12.0
Glacial Till	Firm to very stiff occasionally friable dark brown/brown/red brown clay or sandy/gravelly silt or clay with rare sub-angular cobbles or yellow brown clayey sand or fine to coarse frequently loose sand or	3.7 – 21.7

² Concrete was found to be widespread across the site. Generally, where found at the surface, concrete was removed through use of a concrete corer or hydraulic breaker. Concrete found at deeper levels often resulted in relocation due to refusal while drilling, as detailed in Table 4.1. Although widespread, concrete was not encountered within all locations which indicates that it is not present in a continuous layer across the site. Concrete is instead likely to be present as localised footings, previous foundations, and as large broken slabs possibly used for previous infill material.

Ground Conditions

Stratum	Description	Depths of Stratum (m BGL)
	<p>sand and gravel or dense grey brown very sandy gravel.</p> <p>Gravel is fine to coarse and sub-angular to sub-rounded. Gravel and cobbles include sandstone, limestone, gypsum and flint, with gravel of coal noted as possible Made Ground at 0.2-0.6m (DS02A). Wood fragments noted at 10.3-10.8m (BH09B). Black cobble noted at 14.0-14.1m (BH14).</p> <p>Clay occasionally described as laminated, with fine sand on laminae.</p>	
Mercia Mudstone Group	<p>Extremely weak to medium strong red brown frequently laminated and glauconitic and occasionally clayey mudstone with frequent distinct weathering and local destructuring.</p> <p>Frequent numerous white gypsum bands and veins noted, with occasional thin interbeds of gypsum and inclusions of gypsum, glauconite and/or calcite noted.</p> <p>Drillers' notes describe frequent marl.</p>	7.8 – 43.0

5.2 GROUNDWATER

5.2.1 Groundwater Observations During Site Works

A total of 52 groundwater observations were noted within 48 of the exploratory holes during the investigation (18 no. observations from 14 no. cable percussion borehole locations, 17 no. observations from 17 no. windowless sampling locations, and 17 no. observations from 17 no. trial pit locations).

Groundwater observations were noted from depths of between 0.4m BGL (DS05B; DS05C/TP04; DS05D; DS12; and DS13), described as “Saturated strata. Moderate inflow.” to 26.5m BGL (BH05). The groundwater in BH05 is noted to rise above ground level in the borehole casing, measuring 0.00m at 12:30pm, 0.15m Above Ground Level (AGL) at 13:00, 0.30m AGL at 13:30, 0.36m AGL at 14:00, 0.26m BGL at 16:00 and 0.98m BGL at 17:00³.

Full details of groundwater observations are presented in Field Data Enclosure 3 – Groundwater Observations Made at the Time of Site Works within the GI Factual Report in **Appendix A**.

³ Rising groundwater within BH05 is not suggested to reflect artesian conditions due to lack of evidence from surrounding topography and observations within the remaining locations. It is suggested that perched water present within Made Ground, as well as groundwater movement from surrounding demolition works is the cause of this irregularity.

Ground Conditions

5.2.2 Groundwater Monitoring

During site works, 14 no. borehole locations and 9 no. windowless sampling locations were installed with monitoring standpipes of 50mm diameter to depths of between 2.5m BGL (DS10A) and 31.0m BGL (BH02C). Installation response zones varied from 1.0m BGL (BH13) to 31.0m BGL (BH02C) to capture groundwater within specific layers of strata.

Following installation of standpipes during site works and development of the monitoring wells in the boreholes, groundwater monitoring took place on 8th September 2020. Water levels within the monitoring wells ranged from 0.5m BGL (DS05E) to 4.8m BGL (BH10). DS08 was found to be dry. The range of groundwater elevations indicate that there is no significant hydraulic continuity across the site, which is likely due to perched groundwater within the made ground and shallow superficial deposits.

Installation details and groundwater monitoring results can be found in Table 5-2 and in the exploration hole summary table and exploration hole logs (Field Data Enclosure 2) and groundwater monitoring results (Field Data Enclosure 4) within the GI Factual Report in **Appendix A**.

Table 5.2 - Installation Details and Groundwater Monitoring Results from 8th September 2020

Exploratory Hole I.D.	Depth of Well (m bgl)	Ground Elevation (m AOD)	Water Depth (m BGL)	Groundwater Elevation (m AOD)	Response Zone (m BGL)	Remarks
BH01	12.0	8.42	2.60	5.82	2.0-12.0	-
BH02C	31.0	7.93	4.50	3.43	22.0-31.0	-
BH04C	16.0	8.4	2.80	5.60	11.0-16.0	-
BH05	22.0	8.18	2.80	5.38	17.0-22.0	-
BH06	8.0	7.79	1.90	5.89	3.5-8.0	-
BH07	12.5	7.79	2.30	5.49	3.0-12.5	-
BH08	10.5	7.75	4.00	3.75	9.0-10.5	-
BH09B	20.0	-	-	-	10.0-20.0	Could not locate / destroyed
BH10	20.0	8.24	4.80	3.44	10.0-20.0	-
BH11D	7.0	8.93	1.90	7.03	2.0-7.0	-

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Exploratory Hole I.D.	Depth of Well (m bgl)	Ground Elevation (m AOD)	Water Depth (m BGL)	Groundwater Elevation (m AOD)	Response Zone (m BGL)	Remarks
BH12	17.5	8.90	-	-	8.5-17.5	Could not locate / destroyed
BH13	4.0	8.75	1.30	7.45	1.0-4.0	-
BH14	41.0	-	-	-	8.0-41.0	Could not locate / destroyed
BH15D	13.2	7.98	-	-	12.2-13.2	Could not locate / destroyed
DS02A	6.0	8.06	-	-	4.5-6.0	Could not locate / destroyed
DS03	6.0	-	2.30	-	2.0-6.0	Not accessible during surveying
DS04	4.5	8.51	-	-	1.5-4.5	Could not locate / destroyed
DS05E	3.4	7.83	0.50	7.33	1.6-3.4	Unable to obtain water sample due to insufficient recharge after purging
DS07	6.0	9.93	1.4	8.53	2.5-6.0	-
DS08	5.0	8.2	Dry	-	2.0-5.0	-
DS10A	2.5	8.39	-	-	2.0-2.5	Could not locate / destroyed
DS12B	5.0	7.70	1.20	6.50	3.0-5.0	-
DS15A	6.0	7.98	2.3	5.68	4.0-6.0	-

5.3 OBSERVED EVIDENCE OF ON-SITE CONTAMINATION

Some visual and olfactory evidence of potential on-site contamination was noted during the investigation by the site engineer during sampling. This is summarised in Table 5-3 – Observed Potential On-site Contamination:

Table 5.3 – Observed Potential On-site Contamination

Exploratory Hole I.D.	Observation	Depth (m BGL)	Description
BH13	Olfactory and visual	0.3 – 0.7	Oily sheen and hydrocarbon odour noted
BH15C		1.1 – 2.6	Silt noted as “tar like” with moderate hydrocarbon odour
DS01B/TP17	Olfactory and visual	1.6	Slight hydrocarbon odour. Standing water has an oily sheen
		1.6 – 2.9	Silt noted as “tar like” with moderate hydrocarbon odour
DS05C/TP04	Olfactory and visual	0.4	Slight hydrocarbon odour. All submerged strata have an oily sheen
DS09		1.0 – 2.2	Silt noted as “tar like” with moderate hydrocarbon odour
DS16	Olfactory	3.6 – 4.45	Bituminous odour noted
TP05	Olfactory and visual	1.8	Hydrocarbon smear noted on surface. Oily sheen on standing water

6.0 GEOENVIRONMENTAL ASSESSMENT

6.1 IN-SITU TESTING

A number of geo-environmental in-situ tests were carried out both during and following the ground investigation; these are detailed in Sections 6.1.1 to 6.1.3.

6.1.1 Photo-Ionisation Detector Screening

6.1.1.1 Scope

Photo-Ionisation Detector (PID) screening for semi-volatile organic compounds (SVOCs) and volatile organic compounds (VOCs) was conducted on selected environmental samples taken during the investigation, using a MiniRAE 2000.

A total of 358 no. PID tests were taken from across the site at different depths, in conjunction with soil sampling.

6.1.1.2 Results

Generally, PID readings remained <0.1 parts per million (ppm) at all locations and depths across the site, with exceptions detailed in Table 6-1

Table 6.1 - PID Screening Results at 0.1 ppm and Above

Exploratory Hole I.D.	Depth (m BGL)	PID Reading (ppm)	Date Tested
BH03	0.5	0.1	04/08/2020
	1.5		
BH04B	0.25	0.5	17/07/2020
	1.0		
	1.7		
BH08	0.25	0.6	15/07/2020
BH09B	1.0	1.4	15/07/2020
	2.0	0.5	
BH12	1.0	0.1	10/07/2020
BH13	0.5	0.4	09/07/2020
	1.0	2.8	
	2.7	0.5	
BH15C	1.5	3.5	16/07/2020
DS01B/TP17	0.5	0.1	15/07/2020
	1.0	0.3	
	2.0	4.8	
DS05	0.5	0.1	15/07/2020
DS05C/TP04	0.25	0.6	16/07/2020
	0.5	1.9	
DS05E	0.25	0.4	16/07/2020
DS08	1.0	1.0	14/07/2020

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Exploratory Hole I.D.	Depth (m BGL)	PID Reading (ppm)	Date Tested
DS16	3.6	1.6	17/07/2020
TP05	0.25	0.1	27/07/2020
	0.5	0.1	27/07/2020
TP07A	2.3	0.2	15/07/2020
TP16A	0.2	0.2	23/07/2020
	0.5	0.1	23/07/2020

Full details of PID results are presented within the GI Factual Report (**Appendix A**) in tabular format (*In-Situ* Testing Enclosure 3), and, where applicable, on the exploratory hole logs.

6.1.2 Water Quality Parameters

6.1.2.1 Scope

In-situ groundwater quality parameters testing took place on 10th and 11th September 2020, and included monitoring from 10 no. BH locations and 5 no. WS locations (N.B. - DS05E was found to have insufficient water for testing/sampling following purging). Each location was tested for pH, groundwater temperature (°C), electrical conductivity (µS), redox potential (mV), and dissolved oxygen (%).

6.1.2.2 Results

The following results were recorded from the tests:

- **pH** was recorded between 7.34 (DS03) and 11.72 (BH05);
- **Temperature** was recorded between 12.75°C (BH01) and 21.28°C (BH08);
- **Electrical conductivity** was recorded between 9.49 µS (DS03) and 5930.00 µS (DS15A);
- **Redox potential** was recorded between -400.60 mV (BH13) and 285.00 mV (DS03);
- **Dissolved oxygen** was recorded between 0.00% (DS07) and 98.75% (DS03).

Full details of water quality parameters testing are presented in *In-Situ* Testing Enclosure 4 within the GI Factual Report in **Appendix A**.

6.1.3 Gas Monitoring

6.1.3.1 Scope

Gas monitoring took place on 8th September 2020 and included monitoring from 10 no. BH locations and 6 no. WS locations using a calibrated GA5000 gas monitor (calibration certificates can be found in Field Data Enclosure 4 within the GI Factual Report In **Appendix A**). The weather for the day of sampling was documented as sunny, with an ambient temperature of 18 degrees Celsius (°C) and atmospheric pressure between 1020 and 1021 millibars (mbar).

6.1.3.2 Results

The following ground gas results were recorded from the monitoring round:

- **Flow rate** was recorded at 0.0 to 0.1 litres per hour (l/hr) in the majority of locations, with a maximum of 2.1 l/hr recorded at DS07;
- **Methane** was recorded at <0.1% v/v in the majority of locations, with 0.1% v/v recorded at BH01, BH06, DS07, and DS15A;
- **Carbon dioxide** was generally recorded at <0.1 to 0.1% v/v in the majority of locations, with the maximum concentration recorded at 0.5% v/v at DS03.
- **Oxygen** was generally recorded above 20% v/v throughout the site, with concentrations ranging from 19.3% v/v at DS08 to 20.4% v/v at BH07, BH10, BH13, DS05E, and DS07.
- **Hydrogen sulphide** was recorded at <1.0 ppm at all locations;
- **Carbon monoxide** was recorded at between <1.0 and 1.0 ppm across the site.

Full details of gas monitoring results are presented in Field Data Enclosure 5 within the GI Factual Report in **Appendix A**.

6.2 GEOENVIRONMENTAL TESTING

This section assesses geo-environmental soil, soil leachate, grab groundwater samples retrieved during the GI, and groundwater monitoring samples retrieved post-GI at the site.

6.2.1 Soil Sampling

6.2.1.1 Scope

109 soil samples were analysed to assess for potential contamination. Typically, 1 to 2 no. Made Ground samples and 1 to 4 no. natural soil samples were retrieved from each location depending on on-site observations. The samples were submitted to DETS (AEG's UKAS accredited laboratory) and underwent the following analyses:

- **Suite 1 – Land Quality Assessment and First Stage Assessment for Waste Classification:**
 - Total metals: arsenic (As), cadmium (Cd), total chromium (Cr), lead (Pb), mercury (Hg), selenium (Se), copper (Cu), nickel (Ni), and zinc (Zn);
 - phenol, cresols, xylenols, ethyl phenols, naphthols, trimethylphenol and total phenols by HPLC;
 - Benzene, Toluene, Ethylbenzene, Xylenes (BTEX);
 - Polycyclic Aromatic Hydrocarbons (PAHs): Naphthalene, Acenaphthylene, Acenaphthene, Anthracene, Chrysene, Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)perylene, Benzo(a)pyrene, Dibenzo(a,h)anthracene, Fluorene, Fluoranthene, Indeno(1,2,3-c,d) pyrene, Phenanthrene and Pyrene;
 - Polychlorinated biphenyls (PCBs 7 congeners);

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- sulphide;
 - cyanide (free and total);
 - total sulphate;
 - total chloride;
 - nitrate;
 - phosphate;
 - pH;
 - Total Organic Carbon (TOC);
 - Loss on Ignition (LoI);
 - Acid Neutralisation Capacity (ANC); and
 - total moisture content (%).
- **Suite 2 - (TPH CWG Banded):**
 - Aliphatic C5 to C6, C6 to C8, C8 to C10, C10 to C12, C12 to C16, C16 to C21, C21 to C35, C35 to C44.
 - Aromatic C6 to C7, C7 to C8, C8 to C10, C10 to C12, C12 to C16, C16 to C21, C21 to C35, C35 to C44;
 - **Suite 3 - (Second Stage Assessment for Landfill Waste Acceptance Criteria):**
Eluate preparation in accordance with BSEN 12457-2 and determinations in mg/l and mg/kg at L/S10 for testing on:
 - As, Ba, Cd, Cr (III, VI, total), Cu, Hg, Mo, Ni, Pb, Sb, Se, Zn, Cl, F;
 - SO₄;
 - total dissolved solids (TDS);
 - phenol index;
 - pH; and
 - dissolved organic carbon (DOC) (at own pH or pH7).
 - **Additional Soil Determinands:**
 - Asbestos identification, and quantification if detected;
 - sulphate – total acid soluble;
 - sulphur – free;
 - thiocyanate;
 - pesticides;
 - manganese;
 - molybdenum;

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- VOCs;
- total, free and easily liberated cyanide;
- methyl tert-butyl ether (MTBE);
- SVOCs;
- dry solids; and,
- volatile solids.

6.2.1.2 Results

The laboratory results are provided in the Summary of Chemical Analysis in **Appendix B** and within the Laboratory Certificates of Analyses in the GI Factual Report in **Appendix A**. Figure 1 shows a plan of sampling locations, depths, and materials.

The following sections detail screening processes of the samples relating to human health and hazardous properties.

6.2.1.3 Assessment of Potential Risks from Contamination to Human Health

To evaluate potential risks to human health receptors (i.e. future site users at the site), the soil analytical results have been assessed against the following generic assessment criteria (a commercial generic assessment criteria (GAC), namely the following:

- S4ULs: LQM's and CIEH's Suitable for Use Values (S4ULs) (Nathanail et al, 2015).
- C4SLs: As a S4UL for lead is unavailable, lead has been compared against the respective Defra Category 4 Screening Level (C4SL) for a commercial scenario, adopting a 1% soil organic matter (SOM) value (mean 1.9%) (Defra, 2014)).
- Stantec-derived assessment criteria: There are no current soil guideline values, S4ULs, or C4SLs for cyanide (free and total) therefore the Stantec-derived residential and commercial GAC of 36 mg/kg based on the former UK guidance on Updated Technical Background to the contaminated land exposure assessment (CLEA) Model (EA, 2009) and Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans (Defra, 2002) is adopted as the screening value.

No exceedances of the respective GAC were detected.

Vapour saturation limits were exceeded in the following samples:

- Aliphatic C12-C16 in DS02A at 0.25m, with a concentration of 25 mg/kg, exceeded the vapour saturation limit of 24 mg/kg;
- Aliphatic C12-C16 in DS06 at 0.25m, with a concentration of 31 mg/kg, exceeded the vapour saturation limit of 24 mg/kg;
- Aliphatic C10-C12 in TP02 at 1.8m, with a concentration of 58 mg/kg, exceeded the vapour saturation limit of 48 mg/kg;
- Aliphatic C12-C16 and aromatic C12-C16 in DS01B/TP17 at 2.0m, with concentrations of 330 and 280 mg/kg, exceeding the vapour saturation limits of 24 and 169 mg/kg, respectively.

An exceedance of the vapour saturation limit indicates that the method used to model soil vapours may no longer be applicable above the saturation limit concentration. The concentration is still below the GAC for risks to human health in the given land use scenario.

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Figure 2 highlights Made Ground locations where metals concentrations are between 0.1 and 1.0 times the GAC for each analyte. Metals concentrations that fall within this range have been flagged and displayed in the figure to provide a general indication of elevated metal concentrations across the site and to identify any trends. It should be reiterated that no samples contained contaminant concentrations above their respective GAC, and no metals concentrations from within natural ground had concentrations within this range, with the exception of DS06 at 1.1m which had an arsenic concentration of 64 mg/kg.

Figure 2 shows elevated concentrations of arsenic, lead, and zinc only within Made Ground samples. Arsenic appears to be elevated only within the centre and northeast of the site, with lead showing a prevalent and well-spread presence of concentrations within 10% of the GAC, particularly within the north of the site. Nickel only shows a single elevated concentration, within DS1B/TP17, located within the centre-east of the site. Elevated arsenic and lead concentrations are also shown at this location⁴.

53 samples were tested for asbestos from within the Made Ground of each exploratory hole location. Asbestos was detected in 22 samples, of which 7 were quantified below the limit of detection (<0.001%). The remaining 15 samples recorded asbestos quantities ranging from 0.002% (BH12 at 0.4m and TP16A at 1.0m) to 0.13% (TP01 at 2.0m). Figure 3 shows the locations of asbestos testing, as well as locations where asbestos was detected and quantified within the made ground.

6.2.1.4 Excavated Materials (Waste) Management

In order to determine the presence of hazardous properties within the soil, all samples underwent screening for hazardous properties and landfill waste acceptance using the methods described below:

Hazardous Properties Assessment

Soil analytical results for the 109 soil samples described above have been screened for hazardous properties as identified in Technical Guidance WM3 – Waste Classification – Guidance on the classification and assessment of waste (1st Edition v1.1) (Environment Agency, 2018). This screening was carried out using the HazWasteOnline tool (One Touch Data, 2020).

A total of 33 soil samples recorded determinands at concentrations in excess of hazardous property thresholds and are therefore classified as Hazardous. The remaining 76 soil samples show no concentrations in excess of hazardous property thresholds and are classified as Non-Hazardous. In general, materials with hazardous properties are mostly noted within made ground samples with a random geographic distribution across the site. Natural soils show less occurrences of hazardous classifications than made ground, as expected, however there are some exceptions where natural soils (e.g. BH6 and BH7 at 7.0m) are shown to contain hazardous properties.

The majority of the samples (20) exceeding the waste classification criteria were for HP8 (corrosive) only. Occasional exceedances of HP3 (flammability), HP7 (Carcinogenic), HP10 (toxic for reproduction), HP11 (Mutagenic) and HP14 (ecotoxic) were also found. A copy of the HazWasteOnline assessment (Report No. S6WG8-SYL2L-ZRB4J) dated 4th November 2020) is provided in **Appendix C**.

Landfill Waste Acceptance Criteria (WAC) Testing

104 soil samples underwent analysis for Waste Acceptance Criteria (WAC) testing to inform on landfill disposal options.

⁴ NB – Manganese and molybdenum were not evaluated in this manner due to not having respective GAC values available.

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WAC Assessment – Non-Hazardous Waste Samples

Of the non-hazardous waste samples compared to the landfill waste acceptance criteria, 15 samples exceeded the TOC threshold for inert waste landfill of 3%. As this was the only threshold exceedance, these samples may be permissible at an Inert landfill facility due to all DOC levels being below 500 mg/kg. following approval by the landfill operator.

The vast majority of exceedances of inert waste landfill were from made ground samples, with a few exceptions from where natural soil was found at particularly shallow depths (e.g. DS13 at 0.8m). Geographically, the locations where exceedances were noted show no particular trends. The inert waste exceedances are as follows:

- TPH C10-C40 exceeding the inert waste landfill threshold of 500 mg/kg by 5 samples, ranging from 520 mg/kg at DS04 at 0.2m to 940 mg/kg at BH06 at 0.6m;
- PAHs exceeding the inert threshold of 100 mg/kg within DS02A at 0.3m (110 mg/kg), DS08 at 1.0m (240 mg/kg), and TP02 at 1.0m (170 mg/kg);
- Mercury exceeding the inert threshold of 0.01 mg/kg within TP01 at 0.2m (0.014 mg/kg);
- Chloride exceeding the inert threshold of 800 mg/kg within DS16 at 2.5m (1800 mg/kg);
- Sulphate exceeding the inert threshold of 1000 mg/kg within DS15A at 3.0m (2400 mg/kg);
- TDS exceeding the inert threshold of 4000 mg/kg within DS15A at 3.0m (5100 mg/kg) and DS16 at 2.5m (6300 mg/kg).

The highlighted samples would be suitable for disposal at a non-hazardous waste landfill site unless additional evaluation of the spatial distribution and disposal volumes is carried out.

WAC Assessment – Hazardous Waste Samples

Thirty-three samples were classified as hazardous waste; largely from within the made ground (as discussed in the Hazardous Properties Assessment), therefore, they can only be accepted at a stable non-reactive hazardous waste cell of a landfill site or at a hazardous waste landfill site. Five samples exceeded the thresholds for hazardous waste landfill. These were from made ground samples only, with two from the northwest corner of the site (BH1 at 0.5m and DS11 at 0.25m). All others were well-spread across the site. All other samples are suitable for stable non-reactive hazardous waste (SNRHW) in a non-hazardous landfill or hazardous waste landfill. A summary of the landfill classification for samples classified as hazardous waste is as follows:

- TOC between 9.3% w/w in DS11 at 0.25 to a maximum of 14% w/w in DS02A at 0.25m bgl exceeded the hazardous waste threshold;
- LOI exceeding the hazardous waste threshold of 10% within TP11 at 1.0m (26%) and DS01B/TP17 at 2.0m (15%), although this is expected as they also fail for TOC;

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- pH exceeded the stable non-reactive hazardous waste (SNRHW) threshold (>6) in BH01 at 4.3m with a pH of 1.
- All other samples classified as hazardous waste are suitable for SNRHW.

The laboratory WAC analysis results are provided in the Summary of Chemical Analysis with a summary of exceedances in **Appendix B** and within the Laboratory Certificates of Analyses in the GI Factual Report in **Appendix A**. A summary of exceedances can be found in **Appendix B**.

6.2.2 Soil Leachate and Groundwater Testing

6.2.2.1 Scope

An assessment of risks to controlled waters has been undertaken using soil leachates from soil samples gathered during GI, groundwater grab samples gathered during GI, and groundwater samples collected during the groundwater monitoring round following site works, as listed below:

- 24 of the 109 soil samples underwent soil leachate testing (BS EN 12457-1 liquid / solid ratio 2:1).
- Seven (7) groundwater grab samples were collected during GI, based on on-site observations.
- Fourteen (14) groundwater samples were retrieved during the post-works groundwater monitoring round on 8th September (see Section 5.2.2 for further details), using a low-flow peristaltic pump. The sampling was undertaken at depths close to the natural groundwater inlet within the well in order to provide an accurate representation of the groundwater. Groundwater monitoring locations can be found in Figure 4.
- The soil leachate and groundwater grab and monitoring samples comprised the same suite of analysis, which comprised the following:
 - Metals (arsenic, cadmium, chromium, lead, manganese, mercury, molybdenum selenium, boron, copper, nickel, and zinc);
 - cyanide (free and total);
 - thiocyanate;
 - sulphide;
 - sulphate;
 - pH;
 - PAHs;
 - BTEX;
 - VOCs;
 - phenols, cresols, xylenols, ethyl phenols, naphthols, trimethylphenols, and total phenols by HPLC;
 - TOC;

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- pesticides;
- ammonia;
- chloride;
- MTBE;
- hardness (mg/l CaCO₃); and
- biological oxygen demand (BOD).

6.2.2.2 Results

Full details of the samples discussed below are provided in the Summary of Chemical Analysis in **Appendix B** and within the Laboratory Certificates of Analyses in the GI Factual Report in **Appendix A**.

The analytical results have been compared against the following GACs to assess the potential risk to controlled waters:

- **1** - Water Supply (WQ) Regulations 2016 Drinking Water (Drinking Water Inspectorate);
- **2** - Default EQS Standards for Groundwater (Water Supply (Water Quality) Regulations 1989, UKTAG (2013) and Drinking Water Standard (DWS) (2000) Regulations);
- **3** - Alternative Standards for Groundwater (WHO Guidelines and UKTAG 2013);
- **4** - Groundwater – Inland Surface Water Receptor (short-term) (EU WFD 2015 and UK TAG 2013);
- **5** - Groundwater – Inland surface Receptor (long-term) (EU WFD 2015 and UK TAG 2013);
- **6** - Groundwater dependent terrestrial ecosystems (wetlands) (UKTAG 2013).

A summary of the results in comparison to the GACs is provided below.

Soil Leachates

A review of the soil leachate data against the relevant screening criteria shows numerous exceedances of the above selected GACs. Generally, there is a trend of exceedances favouring made ground samples, particularly for PAHs, however some deeper samples within the natural soil (e.g. BH4B at 10.5m) show exceedances of both metal and PAH values. Geographically, the distribution of exceedances appears random. Details of specific exceedances are as follows:

- **Metals** - exceedances of one or more of the above GACs were found for arsenic, cadmium, chromium, copper, lead, manganese, and mercury, with GAC **5** showing the majority of exceedances, notably for copper where all but 3 samples tested exceeded the GAC of 1 µg/l;
- **Inorganics** – exceedances were recorded for all of the cyanide (total) GACs in BH12 at 0.4m (58 µg/l), DS11 at 0.25m (46 µg/l), DS16 at 1.2m (120 µg/l), TP01 at 2.0m (830 µg/l), BH15/TP03 at 2.0m (56 µg/l), and DS14/TP18 at 0.5m (58 µg/l). The only other exceedances recorded were for cyanide (free) in TP01 at 2.0m (22 µg/l), exceeding GACs **4** and **5** (2.8 and 0.26 µg/l, respectively).

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- **Petroleum Hydrocarbons** – 11 exceedances of GACs **2**, **3**, and **4** were found from 8 separate locations for aliphatic C8-C10, aliphatic C16-C21, aliphatic C21-C35, aromatic C12-C16, aromatic C16-C21, and aromatic C21-C35.
- **PAHs** – a total of 7 samples exceeded GAC **2** only for naphthalene, with the majority of samples showing a variety of exceedances for anthracene, fluoranthene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, indeno[1,2,3-cd]pyrene, and benzo[ghi]perylene, showing a very loose correlation with shallow or made ground samples.

No further exceedances were recorded, with remaining minor detections only present for chloromethane (BH06 at 9.0m), methylene chloride (BH10 at 0.5m and DS05D at 2.0m), trans-1,2-dichloroethylene (DS10A at 1.0m), 1,2-dichloropropane (DS11 at 3.6m), and toluene (BH06 at 9.0m, BH08 at 5.5m, DS16 at 1.2m, and BH15/TP3 at 2.0m).

Groundwater Grab Samples

While groundwater grab samples were gathered during GI based on on-site observations, these data only provide an indication of groundwater quality in this area, with specific groundwater samples from monitoring wells likely to be more representative.

GAC exceedances have been recorded in the following:

- **Metals** – exceedances of GAC **5** were recorded in all samples for arsenic, with samples from DS05C/TP10 at 2.1m and DS01B/TP17 at 1.9m exceeding GACs **1**, **2**, **4**, and **5** with concentrations of 13 and 20 µg/l, respectively, and all except DS01B/TP17 at 1.9m for copper. Cadmium showed two exceedances in GAC **2**, with chromium showing a single exceedance of GAC **5**. All other metals showed exceedances of GACs **1-5** in multiple locations, with the exception of boron, molybdenum, selenium, and zinc where no exceedances were recorded.
- **Inorganics** – exceedances in all GACs were recorded for cyanide (total) in all samples, with the exception of BH01 at 4.12m and TP11 at 2.5m where concentrations were detected below the limit of detection (LoD) (<20 µg/l). Exceedances of GACs **4** and **5** were recorded for cyanide (free) in BH11B/TP10 at 2.1m and TP15 at 1.5m, with all other samples below the LoD (<20 µg/l). No further exceedances were recorded.
- **Petroleum Hydrocarbons** – exceedances in GACs **2**, **3** and **4** were recorded in BH05 at 4.5m for aliphatics C12-C16, C16-C21, and C21-C35. This was also shown in DS01B/TP17 at 1.9m, with the addition of an exceedance of aliphatic C10-C12. The same pattern was found for aromatics at these two locations, with the addition of exceedances of GAC **2** at DS05C/TP04 for aromatic C12-C16, C16-C21, and C21-C35. No other exceedances were recorded.
- **PAHs** – exceedances were shown for all samples with the exception of BH01 at 4.12m for naphthalene (GAC **2**), fluoranthene (GACs **2** and **4**), benzo[b]fluoranthene (GACs **4** and **5**), benzo[k]fluoranthene (GACs **4** and **5**), benzo[a]pyrene (GACs **1**, **4**, and **5**), and indeno[1,2,3-cd]pyrene (GAC **4**). Exceedances in GACs **4** and **5** were recorded all in samples for anthracene with the exception of BH01 at 4.12m, BH11B/TP10 at 2.1m, and TP11 at 2.5m. All samples exceeded GACs **4** and **5** for benzo[g,h,i]perylene. No further exceedances were recorded.
- **VOCs** – three detections were recorded for DS01B/TP17: toluene at 240 µg/l, exceeding GACs **2** and **5**; 1,3,5-trimethylbenzene at 1 µg/l; and p-isopropyltoluene at 6 µg/l. No further detections were recorded.

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No further exceedances were recorded, with minor detections found for xylenols and ethylphenols in BH11B/TP10 at 2.1m (0.23 µg/l) and phenols (total) in DS05C/TP04 at 1.0m (6 µg/l), TP15 at 1.5m (6 µg/l), and DS01B/TP17 at 1.0m (20 µg/l).

Groundwater Monitoring Samples

Following laboratory analysis, GAC exceedances can be found in the following:

- **Metals** – the following GAC exceedances were recorded:
 - Arsenic exceeded GAC **5** at all sampling locations, with BH02C also exceeding GAC **2** at 7.7 µg/l, and DS15A also exceeding GACs **1**, **2**, and **4** at 17 µg/l;
 - Chromium exceeded GAC **5** at all locations with the exception of BH02C, BH07, BH13, DS03, DS12B, and DS15A, with DS07 showing exceedances in GACs **1**, **4**, and **5**;
 - Copper results exhibited a similar pattern to chromium, with GAC **5** exceedances in all locations except BH02C, BH04C, and DS15A;
 - Lead was detected at all locations, with GAC **5** exceedances only in DS07, DS12B, and DS15A;
 - Manganese exceeded GAC **1** in all locations except BH10, BH11D, and DS15A;
 - Mercury exceeded GACs **2**, **3**, and **4** in 8 locations;
 - Nickel exceeded GACs **1**, **2**, **4**, and **5** in 9 locations.

No GAC were exceeded for boron, cadmium, molybdenum, selenium, or zinc. Figure 5 shows locations where metals exceeded one or more GAC values.

- **Inorganics** – exceedances were recorded for all GACs for cyanide (total) in all locations except BH10 and DS07, where concentrations were found below the LoD (<40 µg/l). Exceedances in GACs **4** and **5** were also recorded for cyanide (free) in BH05 and BH11D, with all other locations showing concentrations below the LoD (<20 µg/l). No further exceedances were recorded. Figure 6 shows locations where inorganics exceeded one or more GAC values, indicating elevated cyanide concentrations in all locations sampled across the site, with the exception of DS7 and BH10.
- **Petroleum Hydrocarbons** – exceedances in GAC **2** were recorded in all locations except BH07, BH10, BH11D, BH13, DS03, and DS12B where concentrations were below the LoD (<0.1 µg/l). Further exceedances in GAC **2** were recorded for aliphatic C16-C21 in BH04C (16 µg/l) and DS15A (12 µg/l). Exceedances in GACs **2** and **4** for aliphatic C21-C35 were also found in these locations with concentrations of 160 and 210 µg/l, respectively. An additional exceedance in GAC **2** for aromatic C21-C35 was recorded in DS15A (88 µg/l). No further exceedances were recorded. Figure 7 shows locations where petroleum hydrocarbons exceeded one or more GAC values, which indicates elevated TPH concentrations within the north and west of the site.
- **PAHs** – the following PAH exceedances were recorded:
 - Naphthalene exceeded GAC **2** in 6 locations, ranging from 0.08 µg/l (BH08) to 0.49 µg/l (BH13);

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- Anthracene exceeded GACs **4** and **5** in BH02C (0.2 µg/l) and BH13 (1.5 µg/l);
- Fluoranthene showed exceedances in GAC **5** in all locations. Additional exceedances were recorded for GACs **2** and **4** in BH02C (0.26 µg/l) and BH13 (3.3 µg/l);
- Benzo[b]fluoranthene showed exceedances for GACs **4** and **5** in 5 locations, ranging from 0.02 µg/l (BH07, BH11D, and DS12B) to 2.1 µg/l (BH13);
- Benzo[k]fluoranthene showed exceedances for GAC **5** in BH02C and BH10 (0.01 µg/l), and for GACs **4** and **5** in BH13 (1 µg/l) and DS03 (0.02 µg/l);
- Benzo[a]pyrene showed exceedances for GACs **1** and **5** in BH07 (0.02 µg/l) and DS03 (0.03 µg/l), with an additional exceedance for GAC **4** in BH13 (1.6 µg/l);
- Indeno[1,2,3-cd]pyrene showed exceedances for GAC µg/l **5** in BH10, BH11D, BH13, DS03, and DS12B, with concentrations ranging from 0.01 to 1.5 µg/l;
- Benzo[g,h,i]perylene showed exceedances for GACs **4** and **5** in BH07, BH11D, BH13, DS03, and DS12B, with concentrations ranging from 0.01 to 1.2 µg/l.

No further exceedances were recorded. Figure 8 shows locations where PAHs exceeded one or more GAC values. The figure shows a prevalence of multiple PAHs within the southeast of the site, with the northwest and southwest showing elevated concentrations of naphthalene and fluoranthene only.

- **VOCs** – an exceedance in GAC **1** was recorded for vinyl chloride in BH05 with a concentration of 3 µg/l. Two further exceedances were found for 1,1,1-trichloroethane in BH05 and BH10, with concentrations of 22 and 9 µg/l, respectively. No further exceedances were recorded, with detections only for chloroethane and 1,1-dichloroethane at BH05 (1 and 50 µg/l, respectively).

No further exceedances were recorded, with detections found only for cresols in BH05 and DS07 (1.3 and 0.92 µg/l, respectively), phenols in BH05 and DS07 (0.83 and 2.5 µg/l, respectively), and phenols (total) in BH05, BH07, and DS07 (2.1, 60, and 3.4 µg/l, respectively). Figure 9 shows locations where VOCs exceeded one or more GAC values.

7.0 GEOTECHNICAL ASSESSMENT

7.1 SCOPE OF TESTING

Geotechnical testing on soils and rock core samples comprised the following:

Soils

- Moisture content and Atterberg Limits – BS 1377 part 2
- Particle size distribution (and sedimentation on selected samples) - BS 1377 part 2
- 2.5 kg hammer Compaction tests (optimum moisture content and maximum dry density) – BS 1377 part 4
- California Bearing Ratio tests – BSc 1377 part 4
- One dimensional consolidation tests – BS 1377 part 7
- Acid and water soluble sulphate content, total Sulphur and pH – BRE Special Digest No 1 'Concrete in Aggressive Ground'.

Rock Cores

- Unconfined uniaxial compressive strength on 38 mm diameter rock cores – ISRM 1985
- Point load index on rock cores (axial and diametral)

Groundwater

- Sulphate and pH - BRE Special Digest No 1 'Concrete in Aggressive Ground'.

7.2 GEOTECHNICAL TESTING RESULTS

7.2.1 Made Ground

Made ground comprised both granular and cohesive material

Classification

3 no. cohesive samples underwent Atterberg limits analysis; these gave:

- moisture content of 27.2 – 28.6 (average 27.8%)
- liquid limit of 37-45% (average 42%)
- plastic limit of 21-23% (average 22%)
- plasticity index of 14-24% (average 20%)

These classify the samples as clay, of intermediate plasticity (BSI, 2015). For two of these samples tested, 49% to 52% of the material passed through the 425µm sieve, reflecting the variable nature of the deposit.

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The consistency indices derived from the above Atterberg Limit analysis are between 0.60 and 0.74 (these do not account for <100% passing the 425µm sieve since this information is not available in all cases.) This classifies the material as firm in accordance with BS EN ISO 14688 part 2 Table 8.

19 No samples underwent a particle size distribution test. The range of gradings was very wide, with silt/clay from between 0 and 93% (all 19 samples); sand from between 2 and 39% (all 19 samples); gravel from between 23 and 73% (18 samples); cobbles 3 to 75% (15 samples)

Bulk Density

There were no undisturbed samples of made ground recovered so no undisturbed samples to measure bulk density.

Shear Strength (Total Stress)

There were no undisturbed samples so no undrained strength triaxial testing was possible. In addition, the material was generally with too high a gravel content to allow shear strength testing by hand vane methods.

CBR testing

Two laboratory CBR tests were undertaken on recompacted samples from shallow depth at natural moisture content, without soaking. Results were as follows:

Table 7.1 - Made Ground CBR Testing Results

Trial Pit	Depth m bgl	CBR top/base	Natural moisture content top/base%	Description
TP07A	1.8	1.0/0.9	30.4/29.9	Soft to firm gravelly Clay
TP09	0.8	14.1/56.2	17/17	Fine to coarse sand and gravel

Compaction testing

Two laboratory 2.5 kg hammer compaction tests were undertaken. Results were as follows:

Table 7.2 - Made Ground Compaction Test Results

Trial Pit	Depth m bgl	Maximum dry density Mg/m3	Optimum moisture content %	Natural moisture content %	Description
TP07A	1.8	1.69	20	30.4	Soft to firm gravelly Clay
TP09	0.8	1.84	15.6	17.0	Fine to coarse sand and gravel

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SPT testing

There were no SPT tests in the made ground.

Chemical Properties

16 no. samples underwent water and acid soluble sulphate, total sulphur and pH testing. The results gave:

- water-soluble sulphate content - 22 to 810 mg/l,
- acid-soluble sulphate content – 0.15 to 1.34 mg/kg,
- total sulphur content - 0.10 to 0.46%, and
- pH – 9.7 to 12.0.

7.2.2 Alluvium

Classification

16 no. samples underwent Atterberg limits analysis, these gave:

- moisture content of 17-36% (average 28%)
- liquid limit of 30-56% (average 42%)
- plastic limit of 10-27% (average 21%)
- plasticity index of 10-32% (average 21%)

These classify the majority of samples as clay, of intermediate plasticity (BSI, 2015).

The consistency indices derived from the above Atterberg Limit analysis are between 0.22 and 1.2. The smallest value of 0.22 indicates a very soft consistency, while 1.2 is very stiff although this highest value is considered an outlier and is not consistent with the field descriptions. The average consistency index is 0.65, which is firm.

Five samples underwent a particle size distribution:

- All samples, silt/clay content in the range 71-93%
- All samples, sand in range 7 to 27%
- One sample only, 4 % gravel.

These data generally confirm the soil descriptions, being principally a silty Clay.

Bulk Density

5 no. bulk density measurements were carried out, on undisturbed samples, density was in the range 1.92 – 2.12 Mg/m³, average 1.98 Mg/m³.

Shear Strength (Total Stress)

5 no. triaxial tests (unconsolidated undrained compression tests without measurement of pore water pressure) gave an undrained shear strength range of 25-141 kPa; the 141 kPa is considered an outlier, if removed the results were in the range 25 – 72 kPa, average 46 Pa (medium strength).

Coefficient of Volume Compressibility

Four oedometer consolidation tests have been carried out:

Table 7.3 - Alluvium Oedometer Consolidation Tests

Borehole	Depth (m)		Coefficient of volume compressibility, m_v (m^2/MN)					
			Pressure increment (kPa)					
			50	100	200	400	200	100
BH01	2.7	Firm Clay	0.501	0.191	0.16	0.185	0.013	0.045
BH01	4.5	Soft/firm sandy clay	0.925	0.31	0.202	0.122	0.009	0.032
BH10	3.0	Soft/firm Clay	0.18	0.217	0.167	0.111	0.028	0.083
BH14	2.5	Firm Clay	0.184	0.158	0.169	0.127	0.016	0.065

These results are typical of what might be expected of a moderately compressible material

Compaction testing

One light compaction test on an alluvium sample (DS02A, 2.5m) described as a firm slightly gravelly Clay gave a maximum dry density (MDD) of 1.65 Mg/m³, at an optimum moisture content (OMC) of 20%. Natural moisture content of the sample was not reported.

SPT testing

21 no. SPT tests were carried out; 7No in material described as sand or sandy Silt i.e. essentially granular, and the remainder in cohesive alluvium.

SPT N values in the more granular Alluvium ranged from 5 to 8, average 7. Those in the cohesive alluvium ranged from 4 to 25, although the higher values may be as a result of occasional gravel in the alluvium or near surface deposits over consolidated by surface drying. Average SPT N value was 10.

Chemical Properties

8 no. samples underwent water and acid soluble sulphate, total sulphur and pH testing. The results gave:

- water-soluble sulphate content: <10 (i.e. below the limit of detection) to 470 mg/l,
- acid-soluble sulphate content: 0.04 to 0.32%,
- total sulphur content: 0.04 to 0.21%, and
- pH – 7.8 to 10.5.

7.2.3 Laminated Clays

Classification

57 no. samples underwent Atterberg limit tests, these gave:

- moisture content of 13-38% (average 28%)
- liquid limit of 30-56% (average 43%)
- plastic limit of 13-25% (average 20)
- plasticity index of 8-31% (average 23%)

These classify all samples as clay, mostly of intermediate plasticity, although a few samples were just within low plasticity, and several of marginally high plasticity.

The consistency indices derived from the above Atterberg Limit analysis are between 0.09 and 1.1, with an average of 0.66 indicating an overall firm consistency, matching field descriptions.

Geotechnical Assessment

Three samples underwent a particle size distribution:

- All three samples, silt/clay in the range 93-98%
- All three samples, sand in the range 2 – 7%.
- No gravels

These data generally confirm the soil descriptions of silty Clay

Bulk Density

30 no. bulk density measurements were carried out, these gave a bulk density range of 1.87 to 2.1 Mg/m³ (mean 1.97Mg/m³), corresponding to an average unit weight of 19.3 kN/m³

Shear Strength (Total Stress)

40 no. direct measurements of peak undrained shear strength were carried out;

- 10 no. hand shear vane tests from depths between 1.3m and 3.0 m bgl gave a peak undrained shear strength range of 30-96 kPa (low to high strength), an average of 72kPa (medium strength),
- 30 no. triaxial tests (unconsolidated undrained compression tests without measurement of pore water pressure) giving an undrained shear strength range of 15-131 (very low to high strength), average 49 kPa (medium strength).

Coefficient of Volume compressibility

11No oedometer consolidation tests have been carried out on Laminated Clays:

Table 7.4 - Oedometer Consolidation Tests: Laminated Clay

Borehole	Depth (m)	Coefficient of volume compressibility, m_v (m ² /MN)						
		Pressure increment (kPa)						
		50	100	200	400	200	100	
BH02C	2.3*	0.416	0.264	0.229	0.179	0.027		0.081
BH02C	4.3*	0.044	0.453	0.287	0.174	0.025		0.092
BH05	3.0**	0.439	0.177	0.122	0.086	0.006		0.04
BH06	3.3*	0.63	0.293	0.202	0.132	0.015		0.068
BH06	6.2**	0.735	0.201	0.198	0.118	0.015		0.058
BH07	3.5**	0.573	0.313	0.239	0.145	0.021		0.071
BH07	5.5**	0.755	0.398	0.319	0.194	0.031		0.097
BH08	1.2*	0.459	0.134	0.091	0.058	0.002		0.011
BH12	3.0**	0.910	0.375	0.272	0.158	0.019		0.069
BH14	6.3*	0.621	0.398	0.262	0.172	0.029		0.089
BH15D	4.5*	0.535	0.137	0.092	0.056	0.004		0.015

*Soft to firm *Firm

These results are typical of what might be expected of a moderately compressible material

CBR testing

One laboratory CBR test, without soaking, was undertaken on a recompacted sample described as a soft to firm Clay (TP09, 1.8m) and gave a CBR of 3.15%. Natural moisture content was 28%.

Compaction testing

Geotechnical Assessment

One light compaction test on a sample described as a soft to firm Clay (TP09, 1.8m) gave a maximum dry density (MDD) of 1.65Mg/m³, at an optimum moisture content (OMC) of 19.5%. The natural moisture content of the sample was 28%.

SPT testing

75 no. SPT tests were carried in cohesive laminated clay and 1 No in a fine sand. In cohesive material the uncorrected SPT N values were from 4 to 29, average 11. The SPT N value in the sand was 9 (loose).

Chemical Properties

6 no. samples underwent water and acid soluble sulphate, sulphur and pH testing, the results gave:

- water-soluble sulphate content 310 to 940 mg/l,
- acid-soluble sulphate content 0.11 to 0.24 %,
- total sulphur content 0.17 to 0.29 %, and
- pH – 8.6 to 10.2

7.2.4 Glacial Till

Classification

36 no. samples underwent Atterberg limits analysis; these gave:

- moisture content of 7.4 -31.7% (average 15.6%)
- liquid limit of 20-39% (average 30%)
- plastic limit of 10-20% (average 16)
- plasticity index of 9-22% (average 16%)

These classify most samples as clay of low plasticity (BSI, 2015).

The consistency indices derived from the above Atterberg Limit analysis are between 0.33 and 1.73, with an average of 0.92 (stiff consistency), matching the field descriptions.

Two cohesive glacial till samples underwent a particle size distribution, results as follows:

- Clay and silt: 70 and 47 % respectively
- Sand: 21 and 28% respectively
- Gravel: 9 and 25% respectively.

Two samples of sand and gravel from the glacial till horizon underwent a particle size distribution, results as follows:

- Clay and silt: 23 and 25 % respectively
- Sand: 27 and 25 % respectively
- Gravel: 50 and 50 % respectively.

Bulk Density

19 no. bulk density measurements were carried out, these gave a bulk density range of 1.94 to 2.32 Mg/m³ (mean 2.19 Mg/m³), corresponding to an average unit weight of 21.5 kN/m³

Shear Strength (Total Stress)

Geotechnical Assessment

19 no. triaxial tests (unconsolidated undrained compression tests without measurement of pore water pressure) were undertaken giving an undrained shear strength range of 44-482 (medium to extremely high strength), average 166 kPa (very high strength).

Coefficient of Volume Compressibility

One oedometer consolidation test was carried out:

Table 7.5 - Oedometer Consolidation Test : Glacial Till

Borehole	Depth (m)	Coefficient of volume compressibility, m_v (m^2/MN)					
		Pressure increment (kPa)					
		50	100	200	400	200	100
BH11D	5.5*	0.308	0.289	0.210	0.146	0.026	0.087

*Firm gravelly Clay

SPT testing

SPT tests in the glacial till varied widely, with SPT N values from 8 through to well in excess of 50 (the majority of SPT tests were terminated at blow counts exceeding 50 i.e. the N value in excess of 50). This reflects the high strength of the glacial till and also the gravel content, which would also generate high N values.

Chemical Properties

3 no. samples underwent water and acid soluble sulphate, total sulphur and pH testing, the results gave:

- water-soluble sulphate content : 200 to 490 mg/l,
- acid-soluble sulphate content : 0.10 to 0.13 %,
- total sulphur content : 0.07 to 0.25 %, and
- pH – 8.6 to 10.8

7.2.5 Bedrock

Shear Strength

Strength testing was undertaken on cores of the mudstone bedrock, results were as follows:

- 5 no. uniaxial unconfined compression tests – unconfined compressive strength was between 0.196 and 13.7 MPa
- 91 no. axial / diametral point load strength tests – point load index (Is50) ranging from 0.032 to 1.373 MPa

Chemical Properties

14 no. samples underwent water and acid soluble sulphate, total sulphur and pH testing. The results gave:

- water-soluble sulphate content: 180 to 3600mg/l,
- acid-soluble sulphate content: 0.08 to 27%,
- total sulphur content - 0.02 to 7.7%, and
- pH – 6.8 to 8.7.

Geotechnical Assessment

Gypsum was recorded in a significant number of the rock cores giving rise to the high measured sulphate contents.

7.2.6 Groundwater

Chemical Properties

9 no. groundwater samples underwent sulphate and pH testing. The results gave:

- water-soluble sulphate content - 55 to 530mg/l,
- pH – 8.2 to 12.3.

8.0 RECOMMENDATIONS

8.1 SUITABILITY FOR MATERIAL RE-USE ON SITE

It is proposed to re-use excavated materials from the top 2.5m of soils across the development areas with the intention to re-use under a Materials Management Plan (MMP) following the CL:AIRE Definition of Waste Code of Practice (DoW CoP) under a direct transfer scenario. Where soils are to be re-used under an MMP, the re-use needs to be certain and justified in addition to the suitability of soils with regards to the protection of human health and the environment (including controlled waters). Soils must also be suitable for re-use from a geotechnical perspective.

The soil chemical results from AEG's 2020 ground investigation are discussed below in terms of potential risk to human health and the environment (controlled waters) at the site. Consideration of geotechnical suitability for re-use is also discussed.

8.1.1 Human Health

Chemical data for 109 soil samples collected at the site has been screened against generic assessment criteria (GAC) protective of human health receptors at the proposed re-use location (i.e. commercial scenario). Of the 109 soil samples, no exceedances in commercial GAC were detected across the site, including both Made Ground and naturally occurring soils.

However, following a hazardous properties assessment, 33 of the 109 soil samples showed hazardous properties, largely due to elevated pH levels across the site. In addition, asbestos was detected in 22 Made Ground samples.

Some material has already been excavated and stockpiled at the site. If this is to be reused, sampling and testing of these stockpile materials is recommended for further risk assessment.

8.1.2 Environment (Controlled Waters)

Soil leachate testing was performed on 24 of the 109 soil samples. These results showed exceedances of GAC for several metals, cyanide (total and free), certain TPH aliphatic and aromatic bands, and PAHs. A similar pattern was shown for grab water samples and groundwater sample analysis, with a small number of additional exceedances in VOCs.

Despite exceedances of groundwater GAC across the site in both soil leachates and groundwater samples, groundwater at the site is not considered to be a particularly sensitive receptor for contamination. There are no potable water abstractions on site or nearby, and the nearest surface water body - the River Tees – is located 1.3km from the site. The site is not underlain by a principal aquifer and it is not within a groundwater SPZ. In addition, the underlying till and mudstone bedrock are low hydraulic conductivity materials. It is therefore recommended that no further groundwater sampling is required at the site. However, given uncertainty over the accuracy of the leachate data collected to date when compared to corresponding soil concentrations, it is recommended that the previously mentioned additional soil samples collected from the already stockpiled material are subject to leachate testing.

8.1.3 Geotechnical Suitability

No specific details are available of the proposed development at the site so only general foundation recommendations are possible.

Due to relatively high compressibility and low shear strength, made ground and alluvium is normally too compressible and too low a bearing capacity to be suitable to support anything but the very lightest structures, and ones which are not sensitive to differential settlement.

Geo-Environmental and Geotechnical Ground Investigation Report – Tees Valley ERF Site

Recommendations

Shallow foundations such as footings and pad foundations will in most cases need to be carried down to the underlying laminated clay strata provided this is at reasonably shallow depth say no more than 2 – 2.5 m bgl.

The suitability of the laminated clay to support shallow foundations will be dependent on the actual foundation bearing pressure and sensitivity of the structure to differential settlement. It may be possible to found footings and pad foundations carrying moderate loads on the laminated clays but this would be subject to specific analysis.

The glacial till and bedrock would provide a high bearing capacity and expected to undergo only limited settlement, but depth to both is too great for construction of traditional foundations. Piled foundations would in this case be required.

Heavy structures will likely require piled foundations, bored or driven down into the glacial till and bedrock. Length and diameter will depend on the load to be supported.

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Figure 1 - Soil Sample Locations: Showing Sample Depths and Material Types



Site Boundary

Soil Sample Depth and Material

- Made Ground
- Natural Ground to 5 m BGL
- Natural Ground > 5 m BGL



Client
Tees Valley Combined Authority

Tees Valley ERF Site
Soil Sample Locations: Showing Sample Depths and Material Types

0 50 100 m

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:2,100 @ A3	Date: 25/11/2020
Drawn: IB	Checked: BD
Figure 01	Rev A

Figure 2 - Made Ground – Metals (0.1 to 1.0 x GAC)



Site Boundary
 All other locations
 where Made Ground was sampled

Metals

Arsenic
 Lead
 Nickel

Note: Where more than one sample was taken of Made Ground the location of the points are centered around the sample site.



Client
 Tees Valley Combined Authority

Tees Valley ERF Site
 Soil Sample Survey Results
 Made Ground – Metals (0.1 to 1.0 x GAC)

0 50 100
 m

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:2,100 @ A3	Date: 26/11/2020
Drawn: IB	Checked: BD
Figure 02	Rev A

Figure 3 - Asbestos Detection – Made Ground



Client
Tees Valley Combined Authority

Tees Valley ERF Site
Soil Sample Survey Results
Asbestos Detection - Made Ground

0 50 100 m

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:2,100 @ A3	Date: 26/11/2020
Drawn: IB	Checked: BD
Figure 03	Rev A

Figure 4 - Groundwater Sample Locations



Client
Tees Valley Combined Authority

Tees Valley ERF Site
Groundwater Sample Locations

0 50 100
m

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:2,100 @ A3	Date: 25/11/2020
Drawn: IB	Checked: BD
Figure 04	Rev A

Figure 5 - Metals exceeding 1 or more GAC values



Client
Tees Valley Combined Authority

Tees Valley ERF Site
Groundwater Survey
Metals exceeding 1 or more GAC values

0 50 100
m
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:2,100 @ A3	Date: 25/11/2020
Drawn: IB	Checked: BD
Figure 05	Rev A

Figure 6 - Inorganics exceeding 1 or more GAC values



Client
Tees Valley Combined Authority

Tees Valley ERF Site
Groundwater Survey
Inorganics exceeding 1 or more GAC values

0 50 100
m
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:2,100 @ A3	Date: 26/11/2020
Drawn: IB	Checked: BD
Figure 06	Rev A

Figure 7 - Petroleum Hydrocarbons exceeding 1 or more GAC values



Client
 Tees Valley Combined Authority

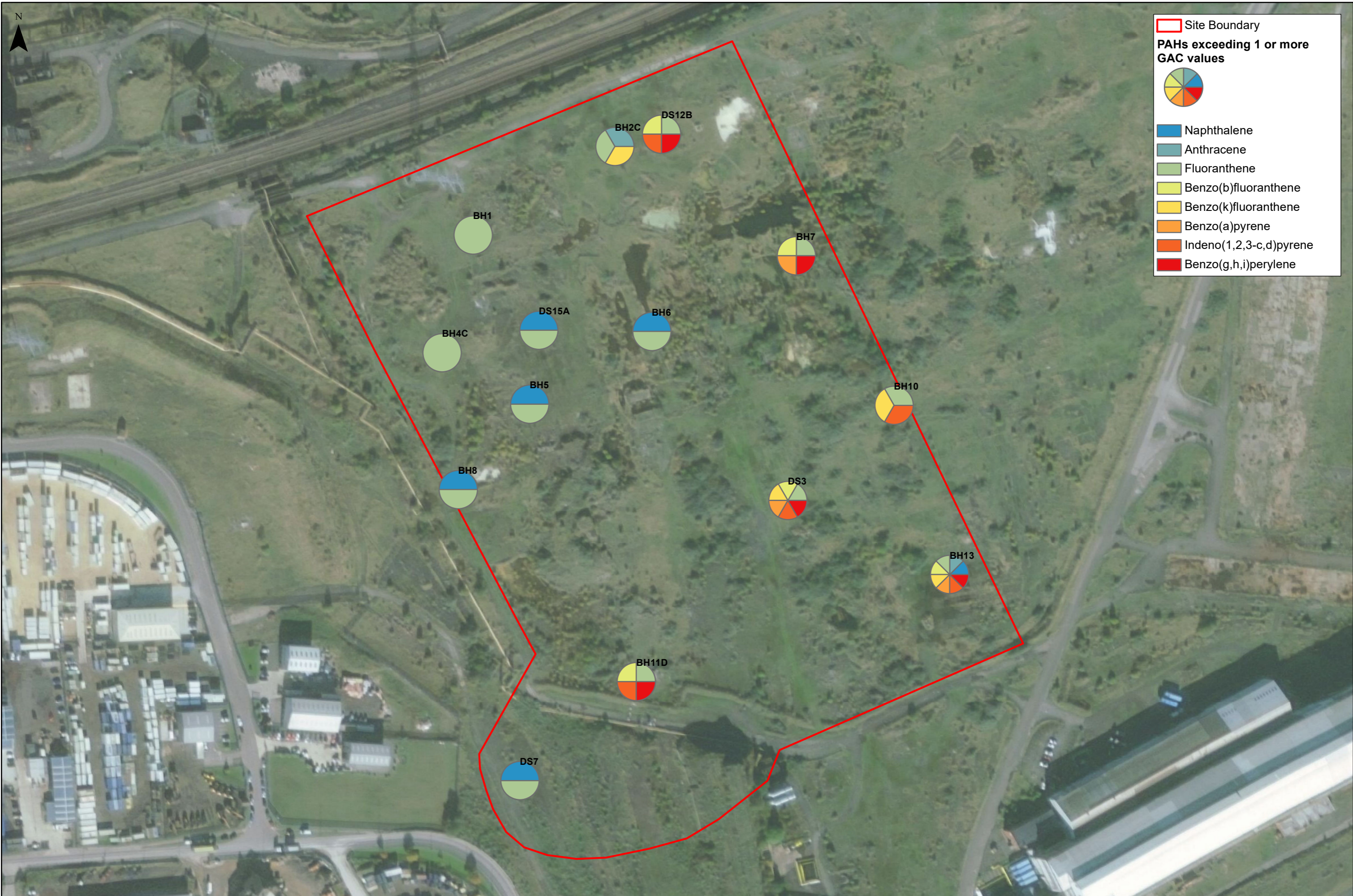
Tees Valley ERF Site
 Groundwater Survey
 Petroleum Hydrocarbons exceeding 1 or more GAC values

0 50 100
 m

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:2,100 @ A3	Date: 25/11/2020
Drawn: IB	Checked: BD
Figure 07	Rev A

Figure 8 - PAHs exceeding 1 or more GAC values



Client
Tees Valley Combined Authority

Tees Valley ERF Site
Groundwater Survey
PAHs exceeding 1 or more GAC values

0 50 100
m
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:2,100 @ A3	Date: 25/11/2020
Drawn: IB	Checked: BD
Figure 08	Rev A

Figure 9 - VOCs exceeding 1 or more GAC values



Client
Tees Valley Combined Authority

Tees Valley ERF Site
Groundwater Survey
VOCs exceeding 1 or more GAC values

0 50 100
m

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:2,100 @ A3	Date: 25/11/2020
Drawn: IB	Checked: BD
Figure 09	Rev A

Appendices

Appendix A Factual Report on Ground Investigation

(Bound separately)

Appendix B Summary of Chemical Analysis

B.1 SOIL RESULTS

Summary of Chemical Analysis

Soil Samples

Key
Bold Text Exceeds Limit of Detection for analyte
 Exceeds Vapour Saturation Limit
 Exceeds Screening Criteria
 ND Not Detected

Sample ID	BH08	BH08	BH08	BH09B	BH09B	BH10	BH10	BH10	BH11D	BH11D	BH12	BH12	BH13	BH13	BH13	BH13	BH14	BH14	BH14	BH15D	BH15D	BH15D					
Depth	0.25	5.50	13.50	1.00	3.70	0.50	1.00	2.00	0.25	6.00	0.40	1.70	0.50	1.00	1.70	2.70	0.50	5.10	9.80	0.50	6.00	10.70					
Sampling Date	15/07/2020	15/07/2020	17/07/2020	15/07/2020	15/07/2020	08/07/2020	08/07/2020	08/07/2020	13/07/2020	14/07/2020	09/07/2020	09/07/2020	08/07/2020	08/07/2020	08/07/2020	08/07/2020	28/07/2020	28/07/2020	28/07/2020	17/07/2020	20/07/2020	n/s					
Screening																											
Test	Criteria		LOD	Units																							
Asbestos Quantification	0.001		%	< 0.001		ND		< 0.001		ND		0.002		ND		0.004		ND		ND		ND					
Preparation																											
Dry Matter	0.1		%	83		94		95		95		18		17		20		22		81		84					
Moisture Content	0.1		%	17		20		16		5.6		19		9.2		9.1		23		4.7		14		7.4			
Metals																											
Arsenic	640	0.2	mg/kg	36	8.9	4	6.3	8.6	8.9	6.7	11	8.1	6.7	6.2	12	51	24	12	9.7	50	6.5	9.1	26	8.1	7.3		
Cadmium	190	0.1	mg/kg	1.3	0.2	0.1	0.4	0.1	0.4	0.2	0.6	0.1	0.6	0.4	0.5	0.2	0.3	0.2	1.5	0.3	0.2	0.8	0.3	0.1	0.1		
Chromium	8600	0.15	mg/kg	100	26	32	29	360	290	49	84	28	360	68	260	220	81	36	28	17	68	28	91	32	29		
Copper	68000	0.2	mg/kg	230	32	23	31	32	29	24	38	28	23	37	36	63	31	33	32	100	25	27	110	33	28		
Lead	1100	0.3	mg/kg	200	22	7.9	25	22	32	31	36	36	14	58	57	33	27	29	23	200	26	19	180	23	17		
Manganese	20	0.1	mg/kg	4700	600	1400	36	530	18000	9300	910	11000	2600	2700	600	590	3700	610	600	600	590	3700	610	600			
Mercury	1100	0.05	mg/kg	2.3	< 0.05	< 0.05	0.13	< 0.05	0.73	0.66	0.05	0.25	< 0.05	1.3	0.71	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.7	< 0.05	0.8	< 0.05	< 0.05		
Molybdenum		0.4	mg/kg	3.3	0.6	1.3	1.5	0.7	2.5	2	0.9	3.6	2	0.7	3.2	< 0.4	0.8	2.3	0.6	0.9							
Nickel	980	1	mg/kg	36	35	28	10	34	10	8.8	21	17	27	11	42	46	27	38	36	70	23	31	41	39	35		
Selenium	12000	0.5	mg/kg	2.2	< 0.5	< 0.5	0.6	< 0.5	5.4	4.9	< 0.5	4.2	< 0.5	2.9	7.4	2.3	4.9	3.1	< 0.5	1.2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5		
Zinc	73000	1	mg/kg	460	74	63	77	72	80	80	91	120	51	190	180	54	73	81	70	630	98	77	270	79	70		
Inorganics																											
Loss on Ignition at 440°C	0.01		%	7.6		4.4		2		3.5		4.8		2.6		2.4		3.5		4.3		8.6		6.1			
pH	0.1		pH	9.8		8.5		12.7		11.4		10.3		10.2		12		10.6		8.3		10.6		10.3		8.5	
Acid Neutralisation Capacity (pH4)	1		mols/kg	< 1.0		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0	
Acid Neutralisation Capacity (pH7)	1		mols/kg	< 1.0		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0	
Cyanide, Total	0.1		mg/kg	47		0.4		0.2		1.9		0.2		1.6		1.4		0.4		3.2		0.2		74		12	
Cyanide, Free	0.1		mg/kg	0.4		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1		< 0.1	
Thiocyanate	0.6		mg/kg	1.3		< 0.6		< 0.6		< 0.6		< 0.6		< 0.6		< 0.6		< 0.6		< 0.6		< 0.6		< 0.6		< 0.6	
Total Organic Carbon	0.1		%	3.1		1.8		0.3		0.5		1.5		1.4		0.5		0.9		0.4		0.8		1.2		1	
Volatile Solids	0.01		%	1.6		4.9		2.3		< 0.50		3.1		0.91		< 0.50											
Ammoniacal Nitrogen as NH3	0.5		mg/kg	< 0.50		31.2		72.6		41.4		146		237		30.5		25		24.3		0.91		< 0.50		12.5	
Chloride	1		mg/kg	14		56		3.1		100		27		8.9		22		66		19		15		< 1.0		2.8	
Nitrate as NO3	1		mg/kg	14		56		3.1		100		27		8.9		22		66		19		15		< 1.0		2.8	
Ortho Phosphate as P	0.1		mg/kg	< 0.10		< 0.10		< 0.10		< 0.10		< 0.10		< 0.10		< 0.10		< 0.10		< 0.10		< 0.10		< 0.10		< 0.10	
Sulphide	10		mg/kg	310		76		96		180		32		170		200		621		130		52		64		76	
Sulphur (free)	0.75		mg/kg	< 0.75		< 0.75		< 0.75		2.6		< 0.75		29		< 0.75		29		< 0.75		< 0.75		< 0.75		< 0.75	
Sulphate as SO4, Total	0.01		%	0.26		0.13		0.12		0.38		0.35		0.39		0.16		0.63		0.11		0.36		0.37		0.98	
Sulphate as SO4, Total	100		mg/kg	2590		1270		1190		3830		746		6340		1150										6420	
Petroleum Hydrocarbons																											
Aliphatic C5-C6	3300 (304*)	0.01	mg/kg	< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01	
Aliphatic C6-C8	7800 (144*)	0.01	mg/kg	< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01	
Aliphatic C8-C10	2900 (78*)	0.01	mg/kg	< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01	
Aliphatic C10-C12	9700 (48*)	1.5	mg/kg	< 1.5		< 1.5		< 1.5		< 1.5		< 1.5		< 1.5		< 1.5		< 1.5		< 1.5		< 1.5		< 1.5		< 1.5	
Aliphatic C12-C16	59000 (24*)	1.2	mg/kg	< 1.2		< 1.2		5		< 1.2		< 1.2		< 1.2		< 1.2		< 1.2		< 1.2		< 1.2		< 1.2		< 1.2	
Aliphatic C16-C21		1.5	mg/kg	< 1.5		< 1.5		16		< 1.5		< 1.5		3		< 1.5		< 1.5		< 1.5		< 1.5		< 1.5		< 1.5	
Aliphatic C21-C35		3.4	mg/kg	< 3.4		< 3.4		32		< 3.4		< 3.4		110		< 3.4		< 3.4		< 3.4		< 3.4		< 3.4		< 3.4	
Aliphatic C35-C44	160000	3.4	mg/kg	< 3.4		< 3.4		3.4		< 3.4		< 3.4		3.4		< 3.4		< 3.4		< 3.4		< 3.4		< 3.4		< 3.4	
Aliphatic C10-C44		10	mg/kg	< 10		< 10		50		< 10		< 10		110		< 10		< 10		< 10		< 10		< 10		< 10	
Aromatic C5-C7	26000 (1320*)	0.01	mg/kg	< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01	
Aromatic C7-C9	56000 (869)	0.01	mg/kg	< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01	
Aromatic C8-C10	3500 (613)	0.01	mg/kg	< 0.01		< 0.01		0.05		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01	
Aromatic C10-C12	16000 (364*)	0.9	mg/kg	< 0.9		< 0.9		3		< 0.9		2.5		2.1		< 0.9		< 0.9		< 0.9		< 0.9		< 0.9		< 0.9	
Aromatic C12-C16	36000 (169*)	0.5	mg/kg	0.7		< 0.5		3		< 0.5		4.4		3.5		< 0.5		< 0.5		< 0.5		< 0.5		< 0.5		< 0.5	
Aromatic C16-C21	28000	0.6	mg/kg	7		< 0.6		18		< 0.6		5.1		6.7		< 0.6		7.2		< 0.6		7.2		< 0.6		< 0.6	
Aromatic C21-C35	28000	1.4	mg/kg	19		< 1.4		77		< 1.4		55		54		< 1.4		1.7		< 1.4		63		< 1.4		< 1.4	
Aromatic C35-C44	28000	1.4	mg/kg	< 1.4		< 1.4		1.4		< 1.4		1.4		1.4		< 1.4		1.4		< 1.4		1.4		< 1.4		< 1.4	
Aromatic C10-C44		10	mg/kg	22		< 10		98		< 10		73		71		< 10		67		< 10		67		< 10		< 10	
Alkyl Aro C10-C44		10	mg/kg	22		< 10		140		< 10		73		71		< 10		67		< 10		67		< 10		< 10	
EPH (C10-C40)		10	mg/kg	180		< 10		240		< 10		190		260		82		370		< 10		460		24		85	
Benzene	27	0.01	mg/kg	< 0.01		< 0.01		2.01		< 0.01		< 0.01		< 0.01		< 0.01		0.06		< 0.01		< 0.01		< 0.01		< 0.01	
Ethylbenzene	5700 (518)	0.01	mg/kg	< 0.01		< 0.01		0.																			

**Summary of Chemical Analysis
Soil Samples**

Key
Bold Text Exceeds Limit of Detection for analyte
 Exceeds Vapour Saturation Limit
 Exceeds Screening Criteria
 ND Not Detected

Sample ID	BH08	BH08	BH08	BH09B	BH09B	BH10	BH10	BH10	BH11D	BH11D	BH12	BH12	BH13	BH13	BH13	BH13	BH14	BH14	BH14	BH15D	BH15D	BH15D
Depth	0.25	5.50	13.50	1.00	3.70	0.50	1.00	2.00	0.25	6.00	0.40	1.70	0.50	1.00	1.70	2.70	0.50	5.10	9.80	0.50	6.00	10.70
Sampling Date	15/07/2020	15/07/2020	17/07/2020	15/07/2020	15/07/2020	08/07/2020	08/07/2020	08/07/2020	13/07/2020	14/07/2020	09/07/2020	09/07/2020	08/07/2020	08/07/2020	08/07/2020	08/07/2020	28/07/2020	28/07/2020	28/07/2020	17/07/2020	20/07/2020	n/s

Test	Screening Criteria	LOD	Units	BH08	BH08	BH08	BH09B	BH09B	BH10	BH10	BH10	BH11D	BH11D	BH12	BH12	BH13	BH13	BH13	BH14	BH14	BH14	BH15D	BH15D
OCPs																							
alpha-BHC		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
gamma-BHC (Lindane)		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
beta-BHC		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
delta-BHC		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Heptachlor		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Aldrin	170	0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Heptachlor epoxide		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
gamma-Chlordane		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Endosulphan I & Alpha-chlorodane		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
4,4'-DDE		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Dieldrin	170	0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Endrin		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Endosulphan II & 4,4'-DDD		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Endrin aldehyde		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
4,4'-DDT		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Endosulphan sulphate		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Methoxychlor		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Endrin ketone		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
OPPs																							
Dichlorvos	140	0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Mevinphos		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Demeton-O		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Ethoprop		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Naled		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Phorate		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Demeton-S		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Diazinon		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Disulfoton		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Methylparathion		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Ronnel		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Fenthion		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Chlopyrifos		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Trichlorinate		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Merphos		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Spirifos		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Toluthion		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Fensulfotion		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Bolstar		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Azinphos methyl		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Coumaphos		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Triazines																							
Atraton		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Prometon		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Simazine		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Atrazine	9300	0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Propazine		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Terbutylazine		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Secbumeton		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Symetryn		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Ametryn		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Prometryne		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1
Terbutryn		0.1	mg/kg	<0.1			<0.1	<0.1				<0.1							<0.1	<0.1		<0.1	<0.1

**Summary of Chemical Analysis
Soil Samples**

Key
Bold Text Exceeds Limit of Detection for analyte
 Exceeds Vapour Saturation Limit
 Exceeds Screening Criteria
 ND Not Detected

Sample ID	BH08	BH08	BH08	BH09B	BH09B	BH10	BH10	BH10	BH11D	BH11D	BH12	BH12	BH13	BH13	BH13	BH13	BH14	BH14	BH14	BH15D	BH15D	BH15D
Depth	0.25	5.50	13.50	1.00	3.70	0.50	1.00	2.00	0.25	6.00	0.40	1.70	0.50	1.00	1.70	2.70	0.50	5.10	9.80	0.50	6.00	10.70
Sampling Date	15/07/2020	15/07/2020	17/07/2020	15/07/2020	15/07/2020	08/07/2020	08/07/2020	08/07/2020	13/07/2020	14/07/2020	09/07/2020	09/07/2020	08/07/2020	08/07/2020	08/07/2020	08/07/2020	28/07/2020	28/07/2020	28/07/2020	17/07/2020	20/07/2020	20/07/2020

Test	Screening Criteria	LOD	Units	BH08	BH08	BH08	BH09B	BH09B	BH10	BH10	BH10	BH11D	BH11D	BH12	BH12	BH13	BH13	BH13	BH13	BH14	BH14	BH14	BH15D	BH15D	BH15D
VOCs																									
Vinyl Chloride	0.059	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1-dichloroethylene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Trans-1,2-dichloroethylene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1-dichloroethane		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cis-1,2-dichloroethylene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2,2-dichloropropane		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Bromochloromethane		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chloroform	99	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,1-trichloroethane	660	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1-dichloropropene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Carbon tetrachloride	2.9	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Benzene	27	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2-dichloroethane	0.67	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Trichloroethylene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2-dichloropropane		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dibromomethane		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Bromodichloromethane		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cis-1,3-dichloropropene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Toluene	56000 (869)	0.01	mg/kg	<0.01	<0.01	0.09	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	0.07	<0.01	<0.01
trans-1,3-dichloropropene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,2-trichloroethane		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tetrachloroethylene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,3-dichloropropane		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dibromochloromethane		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2-dibromoethane		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chlorobenzene	96	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,1,2-tetrachloroethane	110	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ethylbenzene	5700 (518)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
m,p-Xylene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o-Xylene	6600 (478*)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Styrene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Bromoforn		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Isopropylbenzene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Bromobenzene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2,3-trichloropropane		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
n-propylbenzene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2-chlorotoluene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,3,5-trimethylbenzene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4-chlorotoluene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tert-butylbenzene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,2,4-trimethylbenzene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
sec-butylbenzene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
p-isopropyltoluene		0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,3-dichlorobenzene	30	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01				<0.01	<0.01							<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,4-dichlorobenzene	4400 (224)	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01																	

B.2 LEACHATE RESULTS

B.3 GRAB WATER SAMPLE RESULTS

B.4 GROUNDWATER MONITORING SAMPLE RESULTS

B.5 WAC RESULTS

**Summary of Chemical Analysis
Waste Acceptance Criteria Testing**

Key

- Waste does not exceed threshold criteria for an Inert Landfill
- Waste exceeds threshold criteria for Inert Landfill and is suitable for disposal as Non-Hazardous Waste
- Waste exceeds threshold criteria for Non-Hazardous waste and is suitable for disposal as Hazardous Waste
- Waste exceeds criteria for Hazardous Waste Landfill

* A higher TOC limit may be permissible at an Inert Landfill, provided the DOC value of 500mg/kg is achieved in leachate

TP02	TP02	TP02	TP05	TP05	TP06B	TP06B	TP07A	TP07A	TP08	TP08	TP09	TP09	TP11	TP11	TP11	TP12	TP12	TP13	TP13	TP13	TP14	TP14	TP15	TP15	TP16A
0.25	1.00	1.80	0.50	1.80	0.25	3.00	0.25	1.30	0.50	2.00	0.50	2.50	1.00	2.00	3.00	1.40	2.40	1.00	2.00	3.00	1.00	3.00	0.25	2.00	1.00
23/07/2020	23/07/2020	17/07/2020	24/07/2020	24/07/2020	24/07/2020	15/07/2020	15/07/2020	14/07/2020	14/07/2020	14/07/2020	13/07/2020	22/07/2020	22/07/2020	22/07/2020	22/07/2020	n/s	n/s	n/s	n/s	n/s	n/s	14/07/2020	14/07/2020	23/07/2020	15/07/2020

Determinand and Method Reference		Units	TP02	TP02	TP02	TP05	TP05	TP06B	TP06B	TP07A	TP07A	TP08	TP08	TP09	TP09	TP11	TP11	TP11	TP12	TP12	TP13	TP13	TP13	TP14	TP14	TP15	TP15	TP16A			
DETSC 2084# Total Organic Carbon		%	1.5	4.8*	1.3	2.1	1.6	2.4	4.7*	7.2*	1.6	1.7	1	7.8*	1.7	7.9*	3.9*	3.1*	1	1.4	2.9	2.2	1.7	9.9*	1.7	4.3*	3.4*	5.1*			
DETSC 2003# Loss On Ignition		%	9.3	13	4.3	4.2	5	5.4	5.5	5.4	5	4.5	3.3	5.8	5	26	2.8	5.3	3.2	4.4	4.8	5.4	5.5	6.2	5.7	6.2	7.1	4.8			
DETSC 3321# BTEX		mg/kg	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04			
DETSC 3401# PCBs (7 congeners)		mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01			
DETSC 3311# TPH (C10 - C40)		mg/kg	< 10	550	< 10	510	2200	170	370	880	< 10	110	< 10	300	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	65	< 10	1300	1000	< 10	
DETSC 3301 PAHs		mg/kg	5.6	170	< 1.6	12	< 1.6	5.3	10	7.2	< 1.6	6.9	< 1.6	10	< 1.6	< 1.6	3.9	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6	7.9	< 1.6	56	38	6.3
DETSC 2008# pH		pH Units	11.8	11.3	8.8	11.6	8.3	10.8	10.5	9.6	8.4	12.0	10.1	10.9	8.6	11.9	12.5	9.0	9.1	8.3	8.2	9.2	8.0	11.0	8.2	9.9	11.0	9.6			
DETSC 2073* Acid Neutralisation Capacity (pH4)		mol/kg	1.8	1.8	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
DETSC 2073* Acid Neutralisation Capacity (pH7)		mol/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	

Determinand and Method Reference		Units	TP02	TP02	TP02	TP05	TP05	TP06B	TP06B	TP07A	TP07A	TP08	TP08	TP09	TP09	TP11	TP11	TP11	TP12	TP12	TP13	TP13	TP13	TP14	TP14	TP15	TP15	TP16A	
DETSC 2306 Arsenic as As		mg/kg	< 0.01	< 0.01	< 0.01	0.2	0.02	0.06	0.03	0.05	< 0.01	< 0.01	< 0.01	0.04	0.02	0.01	0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.06	< 0.01	0.03	0.03	0.03	
DETSC 2306 Barium as Ba		mg/kg	0.5	0.4	< 0.1	< 0.1	< 0.1	0.2	0.3	0.3	0.1	0.4	< 0.1	0.3	0.6	0.1	< 0.1	0.1	< 0.1	< 0.1	0.5	< 0.1	< 0.1	0.1	0.2	0.4	0.4	< 0.1	
DETSC 2306 Cadmium as Cd		mg/kg	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
DETSC 2306 Chromium as Cr		mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
DETSC 2306 Copper as Cu		mg/kg	0.06	0.07	0.03	0.06	0.03	0.07	0.06	0.12	0.03	0.03	< 0.02	0.08	0.12	0.11	0.05	0.03	0.07	0.09	0.04	0.03	0.03	0.06	0.04	0.02	0.02	0.05	
DETSC 2306 Mercury as Hg		mg/kg	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.003	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
DETSC 2306 Molybdenum as Mo		mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
DETSC 2306 Nickel as Ni		mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
DETSC 2306 Lead as Pb		mg/kg	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.08	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
DETSC 2306 Antimony as Sb		mg/kg	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
DETSC 2306 Selenium as Se		mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
DETSC 2306 Zinc as Zn		mg/kg	0.34	0.25	0.13	0.02	0.03	0.04	0.03	0.04	< 0.01	< 0.01	0.03	< 0.01	0.16	0.05	0.02	0.04	0.03	0.03	0.23	< 0.01	0.02	< 0.01	0.02	0.02	0.04	0.05	
DETSC 2055 Chloride as Cl		mg/kg	< 100	< 100	< 100	< 100	180	< 100	210	< 100	< 100	< 100	170	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100	< 100
DETSC 2055* Fluoride as F		mg/kg	1.4	< 0.1	2.2	< 0.1	3.1	3.7	1.6	5.6	2.5	1.6	1.7	4.5	1.4	< 0.1	< 0.1	2.1	1.2	4.4	6.3	3	2.9	10	4.5	6.8	8.5	1.9	
DETSC 2055 Sulphate as SO4		mg/kg	150	140	< 100	280	180	460	310	330	180	170	200	330	120	< 100	140	160	< 100	110	180	130	300	210	260	540	540	240	
DETSC 2009* Total Dissolved Solids		mg/kg	1700	1400	240	730	1100	1300	1500	750	610	2500	920	1200	550	2400	560	270	430	830	< 50	890	860	850	1400	1800	720		
DETSC 2130 Phenol Index		mg/kg	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	
DETSC 2085 Dissolved Organic Carbon		mg/kg	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	

Appendix C HazWasteOnline Certificates

(Bound separately)