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Lewis Shaw
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By Email: lewisshaw@kellenhomes.com

Dear Lewis,

GEOENVIRONMENTAL ASSESSMENT PUBLIC OPEN SPACE – HEYWOOD ROAD, CASTLETON

1. INTRODUCTION

1.1. BACKGROUND

E3P has previously completed intrusive ground investigations at the Site known as Castleton Sidings, located off Heywood Road, Castleton in Rochdale (Phase I and II Geoenvironmental Assessment, Report Ref: 14-768-R1-3, March 2023). These investigations were completed in the central sector of the ownership boundary (referred to as the Main Development Site) and did not include investigations in the western extent of the Site, currently greenbelt land to be retained as public open space, herein referred to as 'POS Area'.

Kellen Homes intend to transfer the POS Area to Sigma for retention as public open space and have therefore commissioned E3P to carry out a geoenvironmental assessment across this part of the Site for environmental indemnity insurance purposes.

1.2. CURRENT AND HISTORIC LAND USE

The Site falls within a designated area of Greenbelt land but is currently occupied by derelict railway sidings, covered by a mixture of self-seeded vegetation, relict sidings/tracks, hardstanding roads and slabs and areas of compacted gravel.

Access is gained from a gate off Heywood Road, and through an area of Network Rail Land and the Kellen Homes Main Development Area. Live railway lines are present along the southern site boundary.

Earliest historical mapping dated 1851 shows Brick Kiln Pits to encroach the Site. By 1898 the brick kiln is no longer referenced and an Engineering Stores and Saw Mill with associated structures were present across c. 50% of the Site, with the remainder of the Site occupied by rail tracks/sidings. Two chimneys are shown on the 1:2500 mapping, associated with the Saw Mill. By 1965, the majority of structures have been removed and only one unreferenced structure and a series of rail tracks/sidings remain. The last remaining structure is no longer shown by 1973. The Site appears to remain in a similar arrangement until becoming disused sometime in the early 2000s.

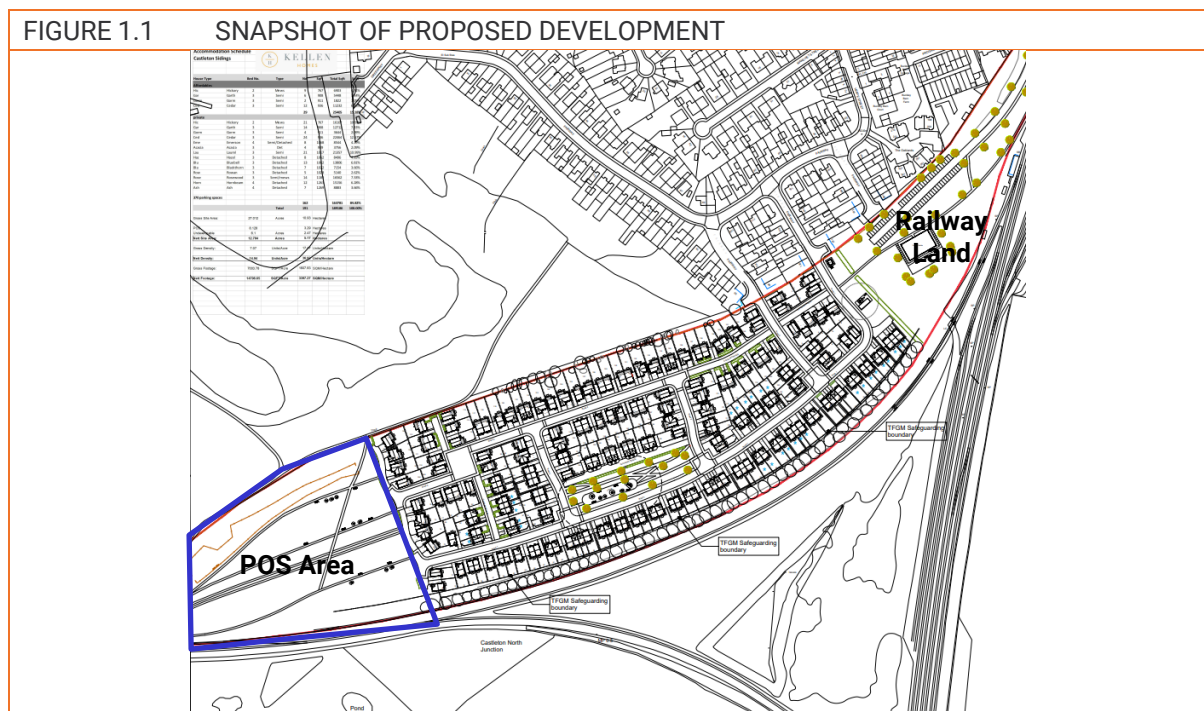
1.3. PROPOSED DEVELOPMENT

Kellen Homes intend to transfer the POS Area to Sigma. It is unknown whether the land will be retained by public open space/greenbelt or redeveloped in any capacity.

Kellen Homes are considering the proposed acquisition and future redevelopment of the site for a hybrid planning application comprising the following:

-  Full planning application for residential development, including access, car parking, landscaping, open space and associated engineering and infrastructure including an electric substation and foul water pump station.
-  Outline planning permission with all matters reserved for the principle of development to facilitate the East Lancashire Railway (ELR) extension.

Figure 1.1 shows the area of the Site to be transferred (outlined in red).



1.4. PREVIOUS REPORTS

1.4.1. E3P – PHASE I & II GEOENVIRONMENTAL SITE ASSESSMENT, CASTLETON SIDINGS, ROCHDALE REF: 14-768-R1-2, DATED APRIL 2022, ON BEHALF OF KELLEN HOMES.

The above referenced report was previously completed for the land immediately east of the Site (the Main Development Site) and should be read in conjunction with this report. A number of exploratory holes undertaken as part of this investigation fell within the POS curtilage which is considered within this letter report.

The key findings of the overall site investigation in respect of land contamination and ground stability are summarised below and where necessary data used to support the E3P Geoenvironmental Site Assessment for the POS Area.

Ground conditions were found to comprise the following general sequence:

- ✿ MADE GROUND to a maximum proven depth of 6.60 m bgl (R0227), comprising black slightly clayey gravelly medium sand / sandy gravel with mudstone, brick, clinker, coal, and ceramic with less frequent inclusions of metal, shale, glass and timber/wood. Obstructions (reinforced concrete slabs and redundant services) were encountered frequently across the Site, together with visual and olfactory evidence of (hydrocarbon) contamination.
- ✿ Blackish brown pseudo fibrous PEAT was encountered beneath the Made Ground in 26 no. locations, ranging in thickness from 0.20 to 2.60 m thick (CP102), although was predominantly 1.0 m thick or less, and noted to be generally thicker towards the south and west of the Site, and absent in the east.
- ✿ Drift deposits comprised alternating SAND/GRAVEL and sandy CLAY and extending to depths in excess of 60.50 m bgl (RB101). Where encountered, shallowest drift deposits were noted to be predominantly granular i.e. medium dense slightly clayey SAND with occasional gravel, sandy GRAVEL of medium subangular to rounded mudstone and sandstone and/or stiff to very stiff medium to high strength sandy CLAY with occasional gravel of fine to coarse angular to rounded mudstone.
- ✿ The solid geology was not encountered. A nearby BGS borehole indicates rockhead at circa 81.00 m bgl.

Chemical analysis found exceedances of heavy metals, non-volatile PAH, naphthalene, toluene, TPH C8-C35 and mercury in the soils at various locations across the Site (including in the POS area and stockpile in the Network Rail Land) between 0.50 m bgl and 4.90 m bgl. Asbestos in the form of chrysotile (<0.001%wt/wt) has also been identified in TP112 (Main Development Site). Visual and olfactory evidence of hydrocarbon impact was also identified at several locations across Site. A vapour risk assessment was carried out, which concluded a low overall risk from hydrocarbons and S/VOCs, except in the vicinity of WS110 (in the east of the Main Development Site).

*As part of the investigation, six shallow hand pits (HP101-HP107) were dug within the POS Area to a maximum depth of 0.80 m bgl in order to retrieve soil samples for chemical analysis. Several other exploratory holes encroached the eastern extent of the POS Area, including WS101, TP104, TP109, TP112, R0221 and R0222. Results of chemical analysis undertaken on samples from these exploratory holes were initially compared to Residential End Use with Plant Uptake generic assessment criteria (GAC) values. These have been reassessed using POS_{park} GAC values and are discussed further in Section 3 of this letter.

High concentrations of naphthalene and aromatic hydrocarbon fractions have been encountered in water samples from WS105 in the centre west of the main Site. Water samples taken from surrounding boreholes to the north west (WS101 and RO223) and west (RO221) of WS105 contained elevated heavy metal concentrations (copper, nickel and zinc), but did not identify elevated volatile compounds, thus indicating no significant migration of volatile contamination. An M-BAT assessment concluded a low overall risk to surface water networks and aquatic life. Further analysis of the surface water in the peripheral (accessible) drainage ditches is recommended as groundworks progress, to ensure no future mobilisation of contaminants is caused, which may pose a risk to the nearby Roeacre Brook.

In consideration of the nature of the Site, historical land uses, and prevalence of S/VOC impacted soils (albeit generally low vapour risk), E3P consider that gas protection measures in accordance with a CS2 (NHBC Amber 1) classification should be incorporated in all residential properties constructed at the Site.

The Arley Coal seam is conjectured to subcrop beneath the north east of the (main development) site, dipping to the west (away from the Network Rail Land). A nearby BGS borehole indicates drift deposits to extend to circa 80 m bgl. Verbal consultation with the Coal Authority indicated that, due to the depth of the seam, they do not consider it likely that the seam has been worked. Two ~60.0 m deep rotary boreholes were advanced within the identified development high risk areas. Rockhead was not proven due to extensive drift and difficulties drilling at depth leading to termination of the boreholes at circa 60.0 m bgl in granular drift. No evidence of shallow coal seams or historic shallow coal workings was recorded and the resultant risks from coal mining related subsidence were concluded to be low.

1.5. INITIAL CONCEPTUAL SITE MODEL

In accordance with EA LCRM (2019) and BSI 10175 (Code of Practice for Investigation of Potentially Contaminated Land), E3P has developed an initial conceptual site model (CSM) to identify potential contamination sources, migration pathways and receptors within the study area. This is summarised within Table 1.1.

ON-SITE SOURCES OF CONTAMINATION

The following potential on-site sources of contamination have been identified:

- ✿ Made Ground / Infilled Brick Kiln Pits / Engineering Stores / Saw Mills / Chimneys: non-volatile PAH, TPH, SVOC, VOC, BTEX compounds, heavy metals and asbestos
- ✿ Railway Sidings / fuel leaks and storage: TPH, SVOC, VOC, BTEX compounds
- ✿ Electrical features: PCBs

OFF-SITE SOURCES OF CONTAMINATION

The following potential off-site sources of contamination have been identified:

- ✿ Tanks
- ✿ Travelling Cranes; and
- ✿ Infilled off-site brick pits.

TABLE 1.1 INITIAL CONCEPTUAL SITE MODEL

SOURCE	PATHWAY	RECEPTOR
Human Health		
Heavy Metals and non volatile PAHs associated with Made Ground and Historical Site Use as Railway Sidings Engineering Works, Saw Mill and Brick Pit	Dermal Contact and Ingestion. Consumption of Homegrown Produce.	Construction Workers. POS End Users.
Discussion: Made Ground is likely to be present on Site, derived from the previous Site uses as Railway Sidings, Engineering Works, Saw Mill, Travelling Crane and Brick Kiln Pit. Made Ground may contain anthropogenic material and as such may be impacted by heavy metals, hydrocarbons and polycyclic aromatic hydrocarbons (PAH) derived from the various industrial processed, fuel and coal storage and combustion processes. Given proposals to retain / utilise the Site as public open space and theoretic possibility of direct contact between end user and contaminated soils on railway land, the risks to end users are considered moderate. If present, heavy metals and non-volatile PAHs may pose a short-term risk to construction workers who may come into contact with impacted soils during earthworks (if proposed). However, this risk can be mitigated through the use of appropriate Personal Protective Equipment (PPE) and the provision of adequate welfare facilities. A 300 mm cover system is generally acceptable to mitigate risks to end users.		
Volatile Hydrocarbon Compounds Associated with Historical Site Use as Railway Sidings Engineering Works, Saw Mill and Brick Pit (fuel, lubricant and oil leaks and storage)	Volatilisation/Accumulation. Vapour Inhalation.	Construction Workers. POS End Users.
Discussion: Historical land uses may give rise to the presence of volatile contaminants such as S/VOC, TPH and BTEX compounds (common fuel derivatives). There is potential for spillages and leakages to have occurred over time and the presence of railway sidings, chimneys and machinery on-site also increases the risk of contamination. Multiple tanks have been identified adjacent to the Site which may have leaked and associated contamination may have been mobilised and migrated beneath the Site. Given proposals to retain the Site as public open space (well ventilated and no confined spaces) the risks to end users is considered low. Volatile compounds may pose a risk to construction workers if they come into contact with impacted soils during further earthworks (if proposed), however appropriate PPE/ Respiratory Protective Equipment (RPE) will ensure they are at no unacceptable risk. Future end users may come into contact with impacted soils in garden and landscaped areas, though the main pathway of volatile compounds is considered to be vapour inhalation indoors. If identified, it is likely that additional remediation of impacted soils and/or perched groundwater will be required to mitigate the risk to future residential end users.		
Asbestos-Containing Materials (ACMs) within Made Ground	Fibre/Dust Inhalation.	Construction Workers. POS End Users. Site Neighbors.
Discussion: ACM may be present within Made Ground underlying the Site from former structures and activities on the Site is considered likely given its insulating and fire-resistant properties. Asbestos may be present in the Made Ground associated with historic developments, infilled features and demolition activities. Given proposals to retain the site POS (i.e. no soil disturbance), the risks to end users is considered low.		



SOURCE	PATHWAY	RECEPTOR
ACM poses a risk through fibre and dust inhalation and if present may pose a risk to construction workers during any future earthworks / demolition and to adjacent third-party property should dust be generated during those works (if proposed).		
Hazardous Ground Gases		
Methane and Carbon Dioxide Associated with Possible On-Site Fill Material, Organic Soils	Inhalation. Accumulation.	Construction Workers. POS End Users.
Discussion: Historical mapping indicates a brick pit encroached the north of the Site which may have been infilled. Dependent on the materials used for infilling, there is a possibility for the generation of hazardous ground gases. This poses a risk of inhalation of gas to future site users and explosion in confined spaces. Given proposals to retain the Site as public open space (well ventilated and no confined spaces) the risks to end users is considered low.		
Controlled Waters		
Hydrocarbon Compounds Associated Historical Land Uses	Vertical/Lateral Migration.	Secondary A Aquifers. Roeacre Brook.
Discussion: It is likely that chemicals will have been stored/present on/adjacent to the Site in the past and spillages of mobile contaminants (S/VOC/BTEX) are considered possible. Granular drift if present may permit downward or lateral migration, however, intervening low-permeability clay deposits would interrupt the pathway and afford some protection to the underlying aquifer. The closest groundwater abstraction is located 593 m to the north east of the Site, thus reducing the sensitivity of the receptor. The Rochdale Canal is located east of the Site. However, it is not within influencing distance or in hydraulic continuity of the Site. An inland rivers/drainage ditch is present along the northern boundary (tributary to Roeacre Brook). Lateral migration of contaminants is considered possible due variable nature of the Made Ground deposits and presence of shallow granular strata. The overall risk is considered low/moderate.		
Buildings and Infrastructure		
pH and Sulphate	Corrosion of Concrete.	Foundations/Concrete.
Discussion: Presence of high pH and sulphate within Made Ground deposits may result in corrosion of buried concrete within any potential proposed development. Assessment must be undertaken to confirm the levels of pH and sulphate within the underlying strata and in particular any Made Ground deposits so that a concrete classification can be determined.		
Ecology		
Phytotoxic Contaminants	Plant Uptake	On-site flora and fauna.
Discussion: Made Ground on Site is likely to contain levels of contamination which may inhibit plant growth. Further investigation is required to confirm the presence/absence of phytotoxic contaminants on Site will be required.		



2. SUPPLEMENTARY GROUND INVESTIGATION

2.1. GENERAL OVERVIEW

Investigation works have been designed to provide general coverage of the site area, target with exploratory hole locations advanced to further investigate the ground conditions and retrieve environmental samples spatially distributed to attain suitable coverage.

Seven shallow hand pits (HP101-HP107) and six deeper exploratory holes (WS101, TP104, TP109, TP112, R0221 and R0222) were advanced within the POS Area as part of the E3P Phase I and II Geoenvironmental Assessment, Report Ref: 14-768-R1-2, April 2022, in order to assess the ground conditions and retrieve soil samples for chemical analysis.

Results of chemical analysis undertaken on samples from these exploratory holes were initially compared to Residential End Use with Plant Uptake generic assessment criteria (GAC) values. These have been reassessed using POS_{park} GAC values and are discussed further in Section 3 of this letter.

2.2. LIMITATIONS

The following limitations constrained the extent and coverage of intrusive investigation:

- ✳ A live railway forms the southern boundary of the Site. A 15 m easement was applied to prevent any disturbance/vibration to infrastructure.
- ✳ The designated POS area was heavily vegetated/wooded, therefore vegetation clearance to access exploratory hole locations required a significant proportion of time during the investigation.
- ✳ WS104 refused on concrete obstructions. Additionally, access to the proposed exploratory hole locations to the north and south of the POS area was limited due to the presence of in-situ relict tracks and sidings which could not be traversed using standard rigs.

2.3. SUMMARY OF SUPPLEMENTARY GROUND INVESTIGATION

Supplementary exploratory fieldwork within the POS area was completed on 17th October 2022. These works, together with exploratory holes undertaken as part of the previous E3P Phase I and II Geoenvironmental Assessment (Report Ref: 14-768-R1-2, April 2022) are summarised in Table 2.1.



TABLE 2.1 SUMMARY OF FIELDWORK

PHASE	POTENTIAL SOURCE/RATIONALE	LOCATION HOLE	TYPE	MAXIMUM DEPTH (m bgl)	RESPONSE ZONE (m bgl)
March 2021	Preliminary Investigation of General Ground Conditions	WS101	Window Sample Probehole	4.45	1.00–3.50
		TP104, TP109 and TP112	Mechanically Excavated Trial Pit	2.80	N/A
July 2021	Sampling of Existing Soils in Greenbelt (Proposed POS)	HP101–HP107	Hand Dug Pit	0.80	N/A
	Investigation of Vertical and Lateral Extent of Peat Deposits	RO221–RO222	Rotary Borehole	10.00	2.00–5.00
October 2022	General Ground Conditions/ Including the Presence/Nature of Obstructions within the Railway Sidings	TP310–TP312	Mechanically Excavated Trial Pit	3.00	N/A
		WS204	Window Sample Probehole	0.50	N/A
		WS205		5.45	1.00–3.00

The sampling locations are illustrated in Drawing 14-768-105. The ground conditions encountered are presented on the logs, which are presented within Appendix III.

2.4. LABORATORY ANALYSIS

Selected soil samples were submitted for a range of chemical analysis comprising:

- ✳ Metals;
- ✳ pH, total sulphate, water-soluble sulphate (2:1 extract);
- ✳ Sulphide;
- ✳ Cyanide;
- ✳ Phenols;
- ✳ Total and speciated polycyclic aromatic hydrocarbons (PAHs);
- ✳ Semi volatile organic compounds (SVOC);
- ✳ Volatile organic compounds (VOC);
- ✳ Asbestos identification;



- ✳ Banded total petroleum hydrocarbon (TPH);
- ✳ Total organic carbon (TOC); and
- ✳ Soil leachate analysis.

I2 Analytical undertook the analytical work and the testing results are included in Appendix VI and discussed in Section 3.

2.5. SUMMARY OF GROUND CONDITIONS

The ground investigation generally confirms the published geology and identifies the strata set out in Table 2.2.

TABLE 2.2 SUMMARY OF STRATA

HOLE	DEPTH TO STRATUM (M BGL)				
	MADE GROUND (TOPSOIL)	MADE GROUND	SAND	SANDY CLAY	CLAY
WS101	–	0.00–1.40	–	–	1.40–4.45
TP104	–	0.00–1.50	1.50–2.40	–	–
TP109	–	0.40–0.70	0.70–2.80	–	–
TP112	–	0.00–2.70	–	–	–
RO221	0.00–0.30	0.30–1.20	1.20–10.00	–	–
RO222	0.00–0.20	0.20–1.60	1.60–10.00	–	–
TP310	0.00–0.20	0.20–1.50	–	1.50–3.00	–
TP311	0.00–0.30	0.30–1.30	–	1.30–3.00	–
TP312	0.00–0.40	0.40–1.00	–	–	1.00–1.50
WS204	0.00–0.20	0.20–0.50*	–	–	–
WS205	0.00–0.20	0.20–0.70	0.70–1.00	1.00–5.45	–
HP101	–	0.00–0.60*	–	–	–
HP102	–	0.00–0.70*	–	–	–
HP103	–	0.00–0.80*	–	–	–
HP104	–	0.00–0.50*	–	–	–
HP105	–	0.00–0.70*	–	–	–
HP106	–	0.00–0.50*	–	–	–
HP107	–	0.00–0.70*	–	–	–

Notes:

*Full extent of Made Ground not proven.

2.6. MADE GROUND

MADE GROUND was encountered in each of the exploratory hole locations to a maximum proven depth of 1.60 m bgl. The base of the MADE GROUND remained unproven in TP112 at 2.70 m bgl and in the hand excavated HP101-HP107.



The material generally comprised of black gravelly sand (reworked topsoil) with gravel of brick, mudstone, ballast, ceramic and glass, over a black/dark grey sandy gravel or gravelly sand with frequent mudstone, brick and occasional timber, clinker and concrete inclusions.

A concrete obstruction was encountered within WS204 resulting in a shallow refusal. Hydrocarbon odours were noted within TP311 and TP312 at depths of 0.60 m and 0.80 m bgl respectively, with an oily sheen noted within the groundwater seepage at 1.50m bgl.

2.7. DRIFT DEPOSITS

Drift deposits were encountered beneath the MADE GROUND in the majority of exploratory hole locations from depths of between 0.70 m and 1.60 m bgl.

The drift deposits generally comprise stiff greyish brown sandy CLAY and greyish/yellowish brown slightly clayey SAND.

PEAT has not been encountered in exploratory holes located within the POS Area, although it should be noted that no deep boreholes have been advanced across the subject site as part of this phase of investigation.

2.8. SOLID GEOLOGY

The solid geology was not encountered during the E3P intrusive investigation. The previous ground investigations over the wider Site also did not encounter the solid geology. A nearby BGS borehole indicates rockhead at circa 81.00 m bgl.

2.9. GROUNDWATER

Groundwater strikes were encountered as seepages. The depth of the seepages are shown on the exploratory hole records in Appendix V and are summarised in Table 2.3.

TABLE 2.3 SUMMARY GROUNDWATER STRIKES

LOCATION	DEPTH TO STRIKE (m)	NOTES
TP104	1.50	Water strike in sand
TP109	2.70	Water strike in sand
TP312	1.50	Seepage

Water strikes were encountered in natural SAND and as a seepage through natural CLAY in TP312.

Subsequent monitoring of installations recorded groundwater within WS205 between 1.02m and 2.58m bgl.

2.10. VISUAL AND OLFACTORY EVIDENCE OF CONTAMINATION

Visual and olfactory evidence of potential contamination has been identified during the site investigation within the POS area and these are summarised in Table 2.4.



TABLE 2.4 SUMMARY VISUAL AND OLFACTORY EVIDENCE OF CONTAMINATION

LOCATION	DEPTH (m)	STRATUM	NOTES
TP311	0.60	Made Ground	Slight hydrocarbon odour
TP312	0.40–1.00	Made Ground	Strong hydrocarbon odour encountered between 0.40 m and 1.00 m bgl. Oily sheen encountered on water ingress through land drain encountered at 0.80 m bgl.

2.11. SOIL CONSISTENCY

Undrained shear strength values were measured where natural cohesive materials were encountered using field hand shear vane tests.

Results of the tests are presented in Table 2.5, which indicates the underlying clay soils to be stiff.

TABLE 2.5 SUMMARY OF UNDRAINED SHEAR STRENGTH TEST RESULTS

LOCATION	DEPTH	SHEAR STRENGTH (kPa)	CALCULATED ALLOWABLE BEARING PRESSURE (kN/m ²)
TP310	1.6	138	Stiff
TP310	1.8	135	Stiff
TP310	2.2	132	Stiff
TP310	2.8	124	Stiff
TP311	1.5	137	Stiff
TP311	2.5	133	Stiff

Notes

ABP Calculated using Stroud and Butler et al 1974.

Results of the standard penetration tests, including undrained shear strengths derived from SPTs are included in Table 2.6.



TABLE 2.6 STANDARD/CONE PENETRATION TEST RESULTS

BOREHOLES	DEPTH (m bgl)	MATERIAL FIELD DESCRIPTION	CPT/SPT "N" VALUE	CORRECTED "N" VALUE (N ₁) ₆₀	TERZAGHI & PECK RELATIVE DENSITY (SANDS)	EUROCODE SOIL STRENGTH	CONSISTENCY (BS 5930)	TERZAGHI & PECK APPROXIMATE UNDRAINED SHEAR STRENGTH (kN/m ²)	ALLOWABLE BEARING PRESSURE (kN/m ²)*
WS205	1	Slightly sandy CLAY	10	10.08	N/A	Medium strength	Stiff	50.41	103.64
WS205	2	Slightly sandy CLAY	11	10.05	N/A	Medium strength	Stiff	50.24	103.30
WS205	3	Slightly sandy CLAY	15	13.04	N/A	Medium strength	Stiff	65.22	134.10
WS205	4	Slightly sandy CLAY	14	11.83	N/A	Medium strength	Stiff	59.14	121.59
WS205	5	Slightly sandy CLAY	14	11.61	N/A	Medium strength	Stiff	58.07	119.40

Notes

* The Allowable Bearing Pressure (ABP) should be considered indicative.

The interpretation of in situ mass undrained shear strength (cu) data from SPT Blow Count (N) results and the influence of the Plasticity Index (PI) was reported in Standard Penetration Test in Insensitive Clays and Soft Rocks. Stroud (1974). The standard penetration test and the engineering properties of glacial materials subsequently. Stroud and Butler (1975) and (1989).

Allowable bearing pressure on sands. Soil Mechanics in Engineering Practice Terzaghi, K. & Peck, R.B. 1996



2.12. SIDE STABILITY AND EASE OF EXCAVATION

The sides of the exploratory trial pit excavations appeared to be generally stable during excavation.

The presence of brick and concrete cobbles and ballast within the Made Ground deposits at shallow depths meant that in certain places, excavation was slow through the Made Ground. Excavation was relatively slow through the stiff clay.

2.13. PH AND SULPHATE

Chemical analyses for pH and soluble sulphate content contained in Appendix VI (summarised in Table 2.6), shows that the soils at the Site generally meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE Special Digest 1 (2005).

TABLE 2.7 SUMMARY OF pH AND SULPHATE DATA

LOCATION	DEPTH (m)	SO ₄ IN 2:1 WATER/SOIL (g/l)	pH VALUE	CLASSIFICATION
TP310	1.00	0.018	8.4	DS-1, AC-1S
TP311	0.80	0.022	8.2	DS-1, AC-1S
WS204	0.35	0.14	8.4	DS-1, AC-1S
TP312	0.50	0.064	8.1	DS-1, AC-1S
HP101	0.60	0.024	8.0	DS-1, AC-1S
HP102	0.70	0.077	7.0	DS-1, AC-1S
HP103	0.80	0.031	8.5	DS-1, AC-1S
HP104	0.50	0.062	11.3	DS-1, AC-1S
HP105	0.70	0.050	8.0	DS-1, AC-1S
HP106	0.50	0.049	7.3	DS-1, AC-1S
HP107	0.70	0.033	8.5	DS-1, AC-1S
TP112	1.30	0.240	7.6	DS-1, AC-1s



3. TIER I QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT

E3P has undertaken a Tier 1 qualitative risk assessment to determine if any potential contaminants within the underlying soils pose an unacceptable level of risk to the identified receptors.

3.1. HUMAN HEALTH RISK ASSESSMENT

At Tier 1 stage, the long term (chronic) human health toxicity of the soil has been assessed by comparing the on-site concentrations of organic and inorganic compounds with Generic Acceptance Criteria (GAC) values published in LQM/CIEH S4UL (S4UL3267) based on a continued POS_{PARK} end use with conservative Soil Organic Matter (SOM) of 1% in the first instance.

Where Tier 1 screening values are not provided by LQM, other screening values have been used and these are referenced in Table 3.1.

The results of this comparison have been summarised within Table 3.1.



TABLE 3.1 SUMMARY OF INORGANIC AND HYDROCARBON TOXICITY ASSESSMENT FOR A POS PARK

DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PATH -WAY	ASSESSMENT
Arsenic	mg/kg	170	11	74	N/A	1	No Further Action
Cadmium	mg/kg	532	11	<0.2	N/A	1	No Further Action
Chromium (VI)	mg/kg	220	11	4	N/A	1	No Further Action
Lead	mg/kg	1300	11	860	N/A	1	No Further Action
Mercury	mg/kg	30	11	4.7	N/A	3	No Further Action
Nickel	mg/kg	800	11	77	N/A	1	No Further Action
Selenium	mg/kg	1800	11	<1.0	N/A	1	No Further Action
Copper	mg/kg	44000	11	210	N/A	1	No Further Action
Zinc	mg/kg	170000	11	230	N/A	1	No Further Action
Cyanide – Total	mg/kg	791	11	1	N/A	1	No Further Action
Phenols – Total	mg/kg	210	11	1	N/A	1	No Further Action
Asbestos	Fibres	NFD	11	NFD	N/A	4	No Further Action
Naphthalene	mg/kg	1200	11	6.5	N/A	3	No Further Action
Acenaphthylene	mg/kg	29000	11	0.31	N/A	2	No Further Action
Acenaphthene	mg/kg	29000	11	2.8	N/A	1	No Further Action
Fluorene	mg/kg	20000	11	1.9	N/A	1	No Further Action
Phenanthrene	mg/kg	6200	11	8.2	N/A	2	No Further Action
Anthracene	mg/kg	150000	11	2.9	N/A	2	No Further Action
Fluoranthene	mg/kg	6300	11	11	N/A	2	No Further Action
Pyrene	mg/kg	15000	11	12	N/A	2	No Further Action
Benzo(a)Anthracene	mg/kg	49	11	7	N/A	2	No Further Action
Chrysene	mg/kg	93	11	5.6	N/A	2	No Further Action
Benzo(b)Fluoranthene	mg/kg	13	11	200	N/A	2	No Further Action
Benzo(k)Fluoranthene	mg/kg	77	11	3.1	N/A	2	No Further Action
Benzo(a)Pyrene	mg/kg	11	11	7.2	N/A	2	No Further Action
Indeno(123-cd)Pyrene	mg/kg	150	11	3.7	N/A	2	No Further Action
Dibenzo(a,h)Anthracene	mg/kg	1.1	11	17	N/A	2	No Further Action
Benzo(ghi)Perylene	mg/kg	1400	11	4.4	N/A	2	No Further Action
TPH C5-C6 (aliphatic)*	mg/kg	95000	10	<1.0	N/A	3	No Further Action
TPH C6-C8 (aliphatic)*	mg/kg	150000	10	<0.1	N/A	3	No Further Action
TPH C8-C10 (aliphatic)*	mg/kg	14000	10	<0.1	N/A	3	No Further Action
TPH C10-C12 (aromatic)*	mg/kg	9200	10	11	N/A	3	No Further Action
TPH C12-C16 (aromatic)*	mg/kg	10000	10	20	N/A	3	No Further Action
TPH C16-C21 (aromatic)*	mg/kg	7600	10	93	N/A	1	No Further Action



DETERMINANT	UNIT	GAC	N	MC	LOC. OF EX	PATH-WAY	ASSESSMENT
TPH C21-C35 (aromatic)*	mg/kg	7800	10	280	N/A	1	No Further Action
Benzene	mg/kg	0.087	2	<1.0	N/A	3	No Further Action
Toluene	mg/kg	130	2	<1.0	N/A	3	No Further Action
Ethylbenzene	mg/kg	47	2	<1.0	N/A	3	No Further Action
p & m-Xylene	mg/kg	56	2	<1.0	N/A	3	No Further Action
o-Xylene	mg/kg	60	2	<1.0	N/A	3	No Further Action
2-Methylnaphthalene**	mg/kg	720	2	0.3	N/A	3	No Further Action
Dibenzofuran**	mg/kg	230	2	0.4	N/A	3	No Further Action
Carbazole**	mg/kg	-	2	0.3	N/A	3	No Further Action
Anthraquinone**	mg/kg	380	2	0.8	N/A	3	No Further Action

Notes

Main pathways: PL1 = soil ingestion, PL2 = dermal contact and ingestion, PL3 = vapour inhalation (indoor), PL4 = dust inhalation; PL5 = vertical/lateral migration; PL6 = corrosion of concrete; PL7=tainting of water supply; PL8 = uptake by plants

Abbreviations: GAC = general assessment criteria, n = number of samples, MC = maximum concentration; Loc of Ex = location of exceedance; NFD = no fibres detected.

* The Tier 1 GAC for the hydrocarbon fraction is derived from the CIEH assessment for petroleum hydrocarbons Criteria Working Group (CWG) for both aliphatic and aromatic compounds. E3P has utilised the Tier 1 values for aliphatic compounds for the volatile and semi volatile fractions (C5-C12) and the Tier 1 values for aromatic compound for the non-volatile fractions (C12-C35). The comparison of a total (aliphatic/aromatic) compounds to an individual fraction is considered to be a conservative approach and satisfactory for the protection of human health.

**Derived from USEPA Risk Management Levels assuming a conservative residential end use.

Referring to Table 3.1, the results of this direct comparison indicate that no contaminant concentrations are in exceedance of the GAC values for a POS_{PARK} end use.

Asbestos has not been detected in the soil samples submitted for analysis.

S/VOC analysis was undertaken on 2 no. sample of MADE GROUND soil samples from TP311 and TP312 at 0.80 m and 0.50 m bgl, respectively, due to hydrocarbon odours being detected. Within these samples 2-Methylnaphthalene, Dibenzofuran Carbazole and Anthraquinone have been identified above the limit of detection (LOD). No S4UL or C4SL GAC values are available for these contaminants. Therefore, reference to USEPA Risk Management Levels has been made, which concludes none of the above-referenced VOCs to be in exceedance of GACs for industrial soil. There is no reference value for Carbazole, and however, based on the low concentration and low sensitivity end use, this is not considered to pose a risk to end users.

Elevated heavy metals (Lead) identified on Site have a primary exposure pathway relating to soil ingestion. The risk to chronic human health associated with the elevated lead in soil may be mitigated through the installation of a suitable cover system (if regeneration of the POS area is proposed). In its current state of use (infrequent and poorly accessible), the overall risks to end-users are considered low. It should be noted that there are not considered to be any suitable sources of topsoil currently available on-site.



3.2. CONTROLLED WATERS RISK ASSESSMENT

E3P has undertaken a controlled waters risk assessment for the Site based on the consideration of the conceptual site model and the sensitive receptors, which are summarised in Table 3.2.

TABLE 3.2 CONTROLLED WATERS CONCEPTUAL MODEL AND SENSITIVITY PROFILE

DISCUSSION		SENSITIVITY RATING
Contaminant Source		
Made Ground Made ground is present across the Site to depths of 2.70 m and greater. Detectable and elevated concentrations of potentially leachable heavy metals, PAH, TPH and S/VOC have been encountered within the soils (albeit largely not in exceedance of human health criteria), that have the potential to be mobilised if in contact with groundwater.		Medium
Pathway		
Vertical Migration The Site is underlain by Secondary A superficial and bedrock aquifers. Ground conditions beneath the POS Area have been found to be predominantly cohesive (reduced permeability). However, bands of moderate permeability granular drift deposits may be present, thus vertical migration of contaminants may be facilitated. However, significant bands of cohesive deposits are known to be present beyond circa 10.0 m bgl (based on previous investigations on adjacent land), thus likely inhibiting downward and lateral flow. Drift deposits are anticipated to be c. 80 m thick.		Low
Lateral migration Lateral migration of contaminants is considered possible due variable nature of the Made Ground deposits and presence of intervening shallow granular strata. An inland rivers/drainage ditch is present along the northern boundary, which may be a tributary to Roeacre Brook located c. 150 m north west of Site. The Rochdale Canal is located c. 600 m east of the POS Area and considered to be outside of influencing distance.		Medium
Receptor		
Aquifer Classification in Superficial Drift Deposits	Secondary Undifferentiated / Secondary A Aquifer	Medium
Aquifer Classification in Bedrock	Secondary A Aquifer – overlain by circa 80 m of drift, thus reducing the sensitivity.	Low/Medium
Groundwater Source Protection Zone or Drinking Water Safeguard Zone	The Site is not situated with a Groundwater Source Protection Zone.	Low
Distance to the Closest Groundwater Abstraction Point	None identified within a 1 km radius.	Low
Is the Site Located Within 50 m of a Surface Watercourse?	An inland rivers/drainage ditch is present along the northern boundary (tributary to Roeacre Brook 150 m NW of Site).	Medium
The ICSM developed within the context of the site setting has viable pollutant pathway, which would be the lateral migration of potentially mobile phase-soluble contaminants towards nearby surface water courses, including drainage ditches (northern boundary) and towards Roeacre Brook.		



TABLE 3.3 QUALITATIVE RISK TO CONTROLLED WATERS FROM SOIL ANALYTICAL RESULTS

CONTAMINANT	ASSESSMENT RATING	DISCUSSION
BTEX > 1 mg/kg	All concentrations are less than 1.0 mg/kg.	None
Total VOC > 1 mg/kg		
Total SVOC > 1 mg/kg	Elevated SVOCs concentrations are recorded in TP311 at 0.80 m bgl and TP312 at 0.50 m bgl.	Further discussion
C5-C10 > 5 mg/kg	All concentrations are less than 5.0 mg/kg.	None
C10-C12 > 10 mg/kg	All concentrations are less than 10.0 mg/kg.	None
C12-C16 > 50 mg/kg	All concentrations are less than 50.0 mg/kg.	None
Phenols > 2 mg/kg	All concentrations are less than 2.0 mg/kg.	None
Naphthalene > 2 mg/kg	All concentrations are less than 2.0 mg/kg.	None
Total PAH > 10 mg/kg	Elevated PAH concentrations are recorded in TP310, WS204, HP101, HP102, HP104 and HP107.	Further discussion
PCB > 1 mg/kg	No potential sources of PCB have been identified	None
Heavy metals > 500 mg/kg	Concentrations >500 mg/kg in TP311, HP102, and HP104.	Further discussion

The Tier I assessment has included a comparison of leachate analysis from samples of the Made Ground and groundwater samples to Environmental Quality Standards (EQS) in the first instance and Drinking Water Standards (DWS).

Water samples and leachate analysis has been undertaken on samples from exploratory holes located within the POS Area as part of this and previous phases of investigation.

For clarity, the Tier I assessment presented in Table 3.4 has therefore included a comparison of the following data:

- ✚ WS205 – Groundwater sample (November 2022)
- ✚ TP311 and TP312 – Soil leachate samples (November 2022)
- ✚ WS101 – Groundwater sample (September 2021)
- ✚ R0221 – Groundwater sample (November 2021)



TABLE 3.4 COMPARISON OF GROUNDWATER AND LEACHATE ANALYSIS WITH TIER 1 SCREENING LEVELS

DETERMINAND	UNIT	EQS ^{1, 2, 3}	DWS ^{3,4,5}	NO. OF GW SAMPLES	MAX CONC. IN GROUNDWATER	LOCATION OF EXCEEDANCE	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
		AA								
Arsenic	µg/l	50	10	3	0.66	N/A	2	2.7	N/A	No Further Action
Cadmium	µg/l	0.08-0.25	5	3	0.05	N/A	2	<0.08	N/A	No Further Action
Chromium (VI)	µg/l	3.4	–	3	< 5.0	N/A	2	<5.0	N/A	No Further Action
Chromium (III)	µg/l	4.7	50	3	< 0.2	N/A	2	1.6	N/A	No Further Action
Copper	µg/l	1	2000	3	6.8 3.0 5.2	WS205 (EQS) WS101 (EQS) RO221 (EQS)	2	10	TP311 at 0.80 m (EQS) TP312 at 0.50 m (EQS)	Further Action
Total Cyanide	µg/l	1	50	3	<1.0	N/A	2	<1.0	N/A	No Further Action
Lead	µg/l	1.2	10	3	<0.2	N/A	2	1.1	N/A	No Further Action
Mercury	µg/l	–	1.0	3	<0.05	N/A	2	<0.5	N/A	No Further Action
Nickel	µg/l	4	20	3	5.9	WS205 (EQS)	2	12	TP311 at 0.80 m (EQS)	Further Action
Selenium	µg/l	–	10	3	1.1	N/A	2	<4.0	N/A	No Further Action
Zinc	µg/l	10.9	–	3	13	WS101 (EQS)	2	8.9	N/A	No Further Action
pH	6–9	–	–	3	7.5	N/A	2	8.1	N/A	No Further Action
Naphthalene	µg/l	2	10*	3	<0.01	N/A	2	<0.01	N/A	No Further Action
Anthracene	µg/l	0.1	10*	3	<0.01	N/A	2	<0.01	N/A	No Further Action
Benzo[b]fluoranthene	µg/l	0.00017*	10*	3	<0.01	N/A	2	<0.01	N/A	No Further Action
Benzo[k]fluoranthene	µg/l	0.00017*	10*	3	<0.01	N/A	2	<0.01	N/A	No Further Action
Benzo(a)pyrene	µg/l	0.00017*	10*	3	<0.01	N/A	2	<0.01	N/A	No Further Action
Indeno(123-cd)pyrene	µg/l	0.00017*	10*	3	<0.01	N/A	2	<0.01	N/A	No Further Action
Fluoranthene	µg/l	0.0063	10*	3	0.34	WS205 (EQS)	2	<0.01	N/A	Further Action



DETERMINAND	UNIT	EQS 1, 2, 3	DWS 3,4,5	NO. OF GW SAMPLES	MAX CONC. IN GROUNDWATER	LOCATION OF EXCEEDANCE	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
		AA								
					0.95	WS101 (EQS)				
Benzo(ghi)perylene	µg/l	1.7–4	10*	3	<0.01	N/A	2	<0.01	N/A	No Further Action
TPH C5-C6 (benzene)	µg/l	10	1	3	<1.0	N/A	2	<1.0	N/A	No Further Action
TPH C6-C8 (toluene)	µg/l	74	700	3	<1.0	N/A	2	<1.0	N/A	No Further Action
TPH C8-C10 (ethyl benzene)	µg/l	20	300	3	<1.0	N/A	2	<1.0	N/A	No Further Action
TPH C10-C12 (xylene)	µg/l	30	500	3	<10	N/A	2	<1.0	N/A	No Further Action
TPH C12-C16	µg/l	2	90 ⁵	3	<10	N/A	2	<1.0	N/A	No Further Action
TPH C16-C35	µg/l	50#	90 ⁵	3	<20	N/A	2	<10	N/A	No Further Action
TPH C5-C6	µg/l	–	15000	3	<1.0	N/A	2	<1.0	N/A	No Further Action
TPH C6-C8	µg/l	–	15000	3	<1.0	N/A	2	<1.0	N/A	No Further Action
TPH C8-C10	µg/l	–	300	3	<1.0	N/A	2	<1.0	N/A	No Further Action
TPH C10-C12	µg/l	–	300	3	<10	N/A	2	<10	N/A	No Further Action
TPH C12-C16	µg/l	–	300	3	<10	N/A	2	<10	N/A	No Further Action
TPH C16-C21	µg/l	–	300**	3	<10	N/A	2	<10	N/A	No Further Action
TPH C21-C35	µg/l	–	300**	3	<10	N/A	2	<10	N/A	No Further Action

Notes

Solubility <0.01µg/l

AA – Annual Average

MAC- Maximum Admissible Concentration

* Polyaromatic hydrocarbons (PAH) - Benzo(a)pyrene (BaP), Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)-perylene and Indeno(1,2,3-cd)-pyrene. Benzo(a)pyrene can be considered as a marker for the other PAHs, hence only benzo(a)pyrene needs to be monitored for comparison with the biota EQS or the corresponding AA-EQS in water

** There are no WHO Guideline Values for aliphatic fractions C16-C21 and C21-C35, therefore the guideline value for aliphatic fractions inclusive of C8-C16 (300µg/l) has been applied.

The Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations (2015)

Directive establishing a framework for Community action in the field of water policy (Water Framework Directive)



Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances
Council Directive on the quality of water intended for human consumption (Drinking Water Directive)
WHO Guidelines for Drinking Water Quality. Third edition (2004)



3.3. CONTROLLED WATER RISK ASSESSMENT AND MITIGATION

This comparison indicates that the data exceeds the EQS values for the following inorganic compounds in both groundwater and leachate:

-  Copper
-  Nickel
-  Fluoranthene

Results have concluded a very low risk to the underlying aquifer based on no exceedances of DWS values.

In respect of the risk to surface waters, due to the exceedances in both copper and nickel, an m-BAT assessment has been completed to assess the bioavailability of the metals with respect to surface water receptors (drainage ditches, ponds and Roeacre Brook). The chemical values from the groundwater analysis have been input into the assessment.

Where the Risk Characterisation Ratio (RCR) is greater than 1, this indicates the bioavailable concentration is above the EQS and the receptor is therefore at risk.

The RCR value for Manganese in WS101 was calculated to be 3.58. All other determinants were calculated to have an RCR value of less than 1. Due to the very conservative screening value for manganese, this is widely found in exceedance and therefore not considered to pose a major risk and would not be considered to require remediation.

In light of the above assessment, E3P do not consider the Site to pose an unacceptable level of risk to surface waters.

However, further analysis of the surface water in the peripheral (accessible) drainage ditches may be prudent during and phases of groundworks/ground disturbance to ensure no future mobilisation of contaminants is caused, which may pose a risk to the nearby Roeacre Brook.

3.4. GROUND GAS RISK ASSESSMENT

Made Ground, infilled features and potential hydrocarbon impact has been identified as potential sources of ground gas. Given the continued use of the Site as POS (no permanent structures / confined spaces and reduced exposure duration) the risk to end users is reduced. A preliminary monitoring programme comprising three visits has therefore been considered sufficient.

The potential impact on the development from ground gases has been assessed with reference to standards and guidelines published in:

CIRIA Report 665 – Assessing risks posed by hazardous ground gases to buildings (2007)

BS8485:2015+A1:2019 – Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings

BS8485 provides guidance on the level of gas protection requirements based upon the characteristic situation (CS) and the proposed development based on building type.



Therefore, in accordance with BS8485, based on the measured flow rates and hazardous gas concentrations, individual hazardous gas flow rates (Q_{hg}) shall be derived for each monitoring point, from which the site characteristic hazardous gas flow rate (Q_{hgs}), and then the Characteristic Situation (CS) can be determined.

The following equation should be utilised:

$$Q_{hg} = q \left(\frac{C_{hg}}{100} \right)$$

Where:

q is the measured flow rate (in litres per hour) of combined gases from the monitoring standpipe
 C_{hg} is the measured hazardous gas concentration (in percentage volume/volume).

The subsequent derived gas screening value (GSV) should be the maximum Q_{hg} (flow rate x concentration as a percentage volume) for all the monitoring events.

A 'worst case check' may be carried out using the maximum recorded flow in any hole with the maximum concentration in any hole to present the plausible worst case conditions. Adoption of the worst case Q_{hg} requires thorough justification and reference to the CSM.

The final derived GSV can then be used to characterise the Site as summarised in Table 3.5.

TABLE 3.5 SITE CHARACTERISATION BY GSV (BS8485:2015)

CS	HAZARD POTENTIAL	GSV (l/hr) FOR METHANE AND CARBON DIOXIDE	ADDITIONAL FACTORS
CS1	Very Low	< 0.07	Typically <1% methane concentration and <5% carbon dioxide concentration (otherwise consider an increase to CS2)
CS2	Low	< 0.70	Typical measured flow rate <70 l/h (otherwise consider an increase to CS3)
CS3	Moderate	< 3.5	N/A
CS4	Moderate to High	< 15	N/A
CS5	High	< 70	N/A
CS6	Very High	> 70	N/A

Notes

1. The CS is equivalent to the characteristic GSV in CIRIA C665.
2. The worst-case ground gas regime identified on the Site, either methane or carbon dioxide, at the worst-case temporal conditions that the Site may be expected to encounter should be considered.
3. Gas Screening Value is the Borehole Gas Volume Flow Rate, in litres per hour, multiplied by the concentration in the air stream of the particular gas being considered.
4. The Gas Screening Value thresholds should not generally be exceeded without the completion of a detailed ground gas risk assessment taking into account site-specific conditions.



3.4.1. MONITORING METHODOLOGY

Concentrations of methane (CH_4), carbon dioxide (CO_2) and oxygen (O_2) (hydrogen sulphide) were measured using a calibrated infrared gas analyser (GFM435) with gas flow rates measured using an integrated flow meter.

Gas measurements were recorded for a minimum of 500 seconds at each location, at which point the maximum concentration of CH_4 and CO_2 , together with the lowest concentration of O_2 were recorded.

The results of the ground gas monitoring are presented in Table 3.5.

In addition to the raw data, the results for each individual standpipe have been assessed with reference to guidance provided in BS8485:2015. Based on the initial peak measured flow rates and hazardous gas concentrations, individual hazardous gas flow rates (Q_{hg}) have been derived for each monitoring point, from which an individual Characteristic Situation (CS) can ultimately be determined.



TABLE 3.5 GROUND GAS SUMMARY

WELL	STRATA	DATE	CH ₄ PEAK (%V/V)	CH ₄ STEADY (%V/V)	CH ₄ Q _{hg} (l/hr)	CO ₂ PEAK (%V/V)	CO ₂ STEADY (%V/V)	CO ₂ Q _{hg} (l/hr)	O ₂ (%V/V)	ATMOS (mb)	ATMOS. DYNAMIC	PEAK FLOW (l/hr)	STEADY FLOW (l/hr)	RESPONSE ZONE (m bgl)	DEPTH TO BASE (m bgl)	DEPTH TO WATER (m bgl)	CS CLASS
WS205	CLAY	26/10/2022	0.1	0.1	0.0001	0.1	0.1	0.0001	20.5	986	Rising	0.1	0.1	1.00-3.00	2.75	1.02	CS1
		08/11/2022	0.1	0.1	0.0001	0.2	0.1	0.0002	20.4	973	Steady	0.1	0.1		2.75	2.58	CS1
		21/11/2022	0.1	0.1	0.0001	0.1	0.1	0.0001	20.1	981	Falling	0.1	0.1		2.75	2.53	CS1

Notes

CIRIA Characteristic Situation

Q_{hg}



CS1
CS2
CS3
CS4

<0.07
<0.7
<3.5
<15

Typical Max CO₂ <5 % Typical Max CH₄ <1 %
Flow rate not to exceed 70 l/hr otherwise consider increase to CS3
Quantitative Risk Assessment required to evaluate scope of protective measures

Values in **BOLD** exceed CS1 Thresholds

Values in **BLUE** denote water above level of response zone (flooded)



3.4.2. SUMMARY OF MONITORING RESULTS

GROUNDWATER

Groundwater was recorded between 1.02 m and 2.58 m bgl within WS205.

BAROMETRIC PRESSURE

Visit 1 was undertaken during a period of rising pressure, visit 2 was undertaken during a period of relatively low steady pressure with pressure recorded to be 974 mbar and visit 3 was undertaken during a period of falling pressure.

It is therefore considered that the visits have been undertaken over representative conditions.

GAS FLOW

Throughout the monitoring period, flow rates were recorded to be 0.1 l/hr (limit of detection of the analyser).

GAS CONCENTRATIONS

The maximum methane value recorded within the monitoring wells was 0.1% v/v (limit of detection of the analyser).

Carbon dioxide concentrations were recorded at concentrations ranging from 0.1% v/v to 0.2% v/v.

CONCLUSION

The determined Characteristic Situation for each standpipe for each visit is summarised in Table 4.5. This indicates that based on the peak flow rates the Site can be classified as Characteristic Situation (CS)1 – Very Low Gas Risk.

Risk from inhalation of potential volatile contamination is also concluded to be low (refer to Section 3.1).



4. PRELIMINARY GEOTECHNICAL ASSESSMENT

Kellen Homes intend to transfer the POS Area to Sigma and have therefore commissioned E3P to carry out a geoenvironmental assessment across this part of the Site for environmental indemnity insurance purposes.

A detailed geotechnical assessment is outside the scope of this report; however, a brief summary of geotechnical considerations is included below based on information available from this and previous investigations.

4.1. FOUNDATION CONSIDERATIONS

It is currently understood that no development is proposed, and the land will be retained as POS under ownership of Sigma.

Should development be proposed in the future, based on the assessment of the relative undrained shear strength and corresponding safe net allowable bearing pressure, the suitable target founding stratum would be the underlying natural medium dense SAND or firm to stiff CLAY at c. 2.00 m bgl, with an estimated allowable bearing pressure (ABP) of 103 kN/m² to 141 kN/m².

Geotechnical laboratory analysis data from WS101 concluded the CLAY at 1.50-2.00 m bgl to have an undrained shear strength of 133 kN/m² (stiff) and to be of low to medium compressibility. The CLAY at this location was determined to have low volume change potential in accordance with NHBC industry guidance.

Based on the depth to suitable founding strata, depending on loadings, the following foundation options would be considered viable at this stage:

- ✚ Piled foundations terminating in natural drift (depth to be determined by structural engineer).
- ✚ Raft foundations (subject to re-engineering of a stiffened soil platform).
- ✚ Ground improvement (subject to re-engineering of a Made Ground to end performance criteria).

Peat/organic deposits have not been encountered in the POS Area due to the majority of exploratory holes being shallower than the likely depth of PEAT if present, but if encountered during any development works/future excavations would require removal from beneath roads and hardstanding as a minimum. Piled foundations would be required for all structures to mitigate the unacceptable risk of total and differential settlement.

Foundation depths should take account of the presence of existing and proposed trees, with foundations deepened locally to mitigate the potential for volumetric instability attributed to fluctuations in moisture content, in accordance with the requirements of NHBC standards.

It should be noted that if a change of use is proposed that would involve construction of structures, a suitable contamination risk re-assessment would be required for the proposed end-use.



5. CONCLUSION & RECOMMENDATIONS

Made ground is present across the Site to depths of 2.70 m and greater. Exceedances of lead have been encountered within the Made Ground when compared to POS_{park} GAC values. The risk to human health associated with the elevated lead in soil may be mitigated through the installation of a suitable cover system (if regeneration of the POS area is proposed). In its current state of use (infrequent and poorly accessible), the overall risks to end-users are considered low.

In respect of controlled waters, copper, nickel and fluoranthene have been found in exceedance of EQS GAC values in both groundwater and leachate. Given there are no exceedances of DWS GAC values, there is considered to be a very low risk to the underlying aquifer. However, due to the exceedances of heavy metals, an m-BAT assessment was completed to assess the bioavailability of the metals with respect to surface water receptors (drainage ditches, ponds and Roeacre Brook). The RCR value for Manganese in WS101 was calculated to be 3.58. All other determinants were calculated to have an RCR value of less than 1. Due to the very conservative screening value for manganese, this is widely found in exceedance and therefore not considered to pose a major risk and would not be considered to require remediation. In light of the above assessment, E3P do not consider the Site to pose an unacceptable level of risk to surface waters.

However, further analysis of the surface water in the peripheral (accessible) drainage ditches may be prudent during and phases of groundworks/ground disturbance to ensure no future mobilisation of contaminants is caused, which may pose a risk to the nearby Roeacre Brook.

Ground gas monitoring has recorded low concentrations of CO₂/CH₄. The Site is therefore characterised as CS1 (very low risk).

Should development be proposed in the future, further detailed geoenvironmental and geotechnical assessment would be required to fully appraise the Site in respect of the proposed development/end-user. The synopsis provided within this letter report is a preliminary overview based on a continued POS end-use and assumption that there will be no significant changes to the site arrangement. Other geoenvironmental and geotechnical hazards may be identified as part of a thorough and detailed Ground Investigation, Contaminated Land Risk Assessment and Geotechnical Design.

It should also be noted that if the Site is used as a temporary compound or stockpile area to the adjacent Kellen Homes Main Development Area during the enabling earthworks stage, associated contamination risks would need to be considered (e.g. stockpile run-off and cross contamination of near-surface soils).

I trust that the above information is sufficient currently, and if you require anything further, please do not hesitate to contact me

Yours sincerely,
For and on behalf of E3P Ltd

Eleanor Canham
Geo-Environmental Consultant

Approved by.
Jessica Sheridan
Senior Geo-Environmental Consultant

Enclosed:

Appendix I	Limitations
Appendix II	Glossary
Appendix III	Drawings
Appendix IV	Photographs



Appendix V	Exploratory Hole Logs
Appendix VI	Chemical Analysis Results
Appendix VII	Origin of Tier 1 Generic Assessment



APPENDIX I

LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between E3P and the client as indicated in Section 1.3.
2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the Site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.
3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.
4. During the site walkover, reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover, no attempt has been made to enter areas of the Site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not been made known or accessible.
5. Access considerations, the presence of services and the activities being carried out on the Site limited the locations where sampling locations could be installed and the techniques that could be used.
6. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.
7. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials, this is for indicative purposes only and do not constitute or replace full and proper surveys.
8. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.
9. E3P cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by E3P is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by E3P in this connection without their explicit written agreement there to by E3P.
10. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.



APPENDIX II

GLOSSARY

TERMS

ACM	Asbestos-containing material	MMP	Materials management plan
ADS	Acoustic design statement	ND	Not detected
AST	Above-ground storage tank	NDP	Nuclear density probe
BGS	British Geological Survey	NMP	Noise management plan
BSI	British Standards Institute	NPSE	Noise policy statement for England
BTEX	Benzene, toluene, ethylbenzene, xylenes	NR	Not recorded
CA	Coal Authority	PAH	Polycyclic aromatic hydrocarbon
CBR	California bearing ratio	PCB	Polychlorinated biphenyl
CIEH	Chartered Institute of Environmental Health	PI	Plasticity index
CIRIA	Construction Industry Research Association	PID	Photo ionisation detector
CLEA	Contaminated land exposure assessment	POS	Public open space
CML	Council of Mortgage Lenders	PPE	Personnel protective equipment
CoC	Contaminants of concern	ProPG	Professional practice guidance
CSM	Conceptual site model	QA	Quality assurance
DNAPL	Dense non-aqueous phase liquid (chlorinated solvents, PCB)	SGV	Soil guideline value
DWS	Drinking water standard	SPH	Separate-phase hydrocarbon
EA	Environment Agency	SPT	Standard penetration test
EQS	Environmental quality standard	SVOC	Semi-volatile organic compound
FFL	Finished floor level	TPH	Total and speciated petroleum hydrocarbon
GAC	General assessment criteria	TPH CWG	Total Petroleum Hydrocarbon (Criteria Working Group)
GL	Ground level	UKWIR	United Kingdom Water Infrastructure Risk
GSV	Gas screening value	UST	Underground storage tank
HCV	Health criteria value	VCC	Vibro-concrete column
ICSM	Initial conceptual site model	VOC	Volatile organic compound
LEL	Lower explosive limit	VRSC	Vibro-replacement stone columns
LMRL	Lower method reporting limit	VSC	Vibro-stone columns
LNAPL	Light non-aqueous phase liquid (petrol, diesel, kerosene)	WHO	World Health Organisation
MCV	Moisture condition value	WRAP	Waste and Resources Action Programme



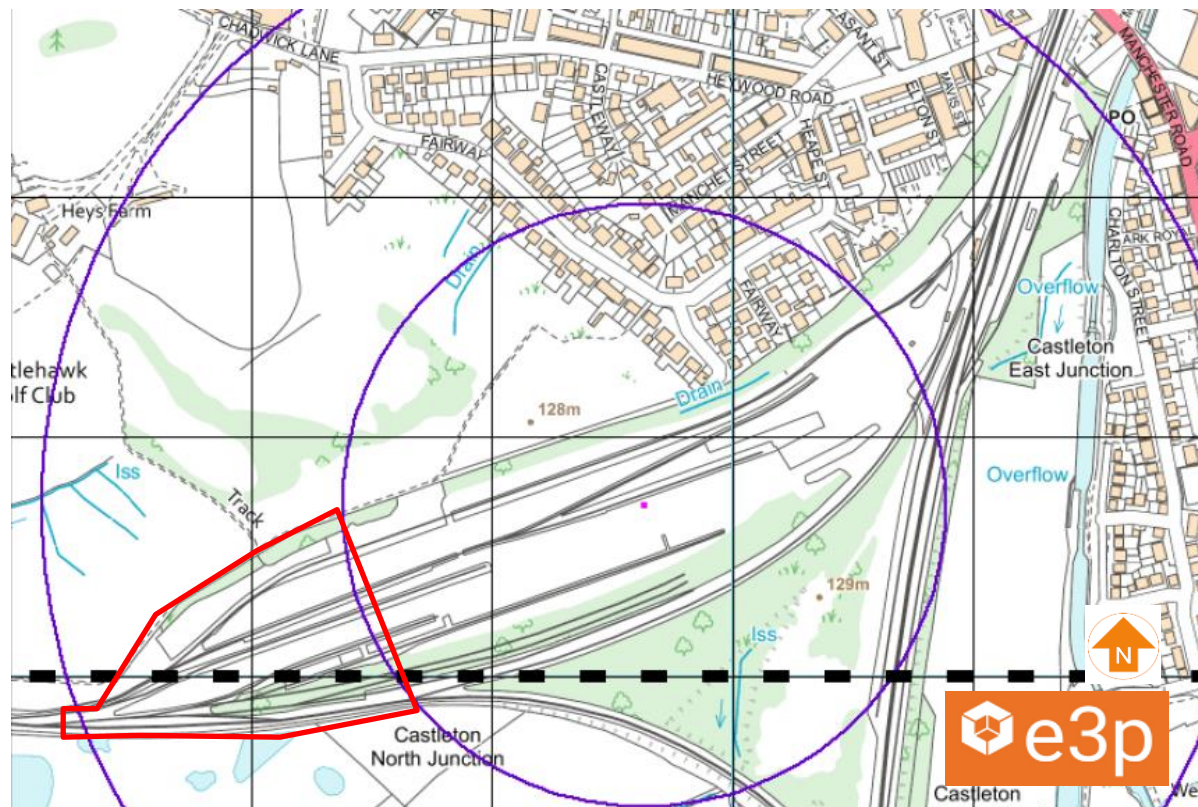
MIBK	Methyl isobutyl ketone	WTE	Water table elevation
m	Metres	ppm	Parts per million
km	Kilometres	mg/m³	Milligram per metre cubed
% v/v	Percent volume in air	m bgl bgl	Metres below ground level
mb	Millibars (atmospheric pressure)	m bcl	Metre below cover level
l/hr	Litres per hour	mAOD	Metres above ordnance datum (sea level)
µg/l	Micrograms per litre (parts per billion)	kN/m²	Kilonewtons per metre squared
ppb	Parts per billion	µm	Micrometre
mg/kg	Milligrams per kilogram (parts per million)	SSRT	Site Specific Remediation Target
PSD	Particle Size Distribution	DD	Dry Density
CL:AIRE	Contaminated Land: Applications in Real Environments	Mc	Moisture Content
ρ	Bulk Density	GPR	Ground Penetrating Radar
NDP	Nuclear Density Probe	FFL	Finished Floor Level
LEL	Lower Explosive Limit	UKWIR	UK Water Industry Research
CIRIA	Construction Industry Research and Information Association	LOD	Limit of Detection



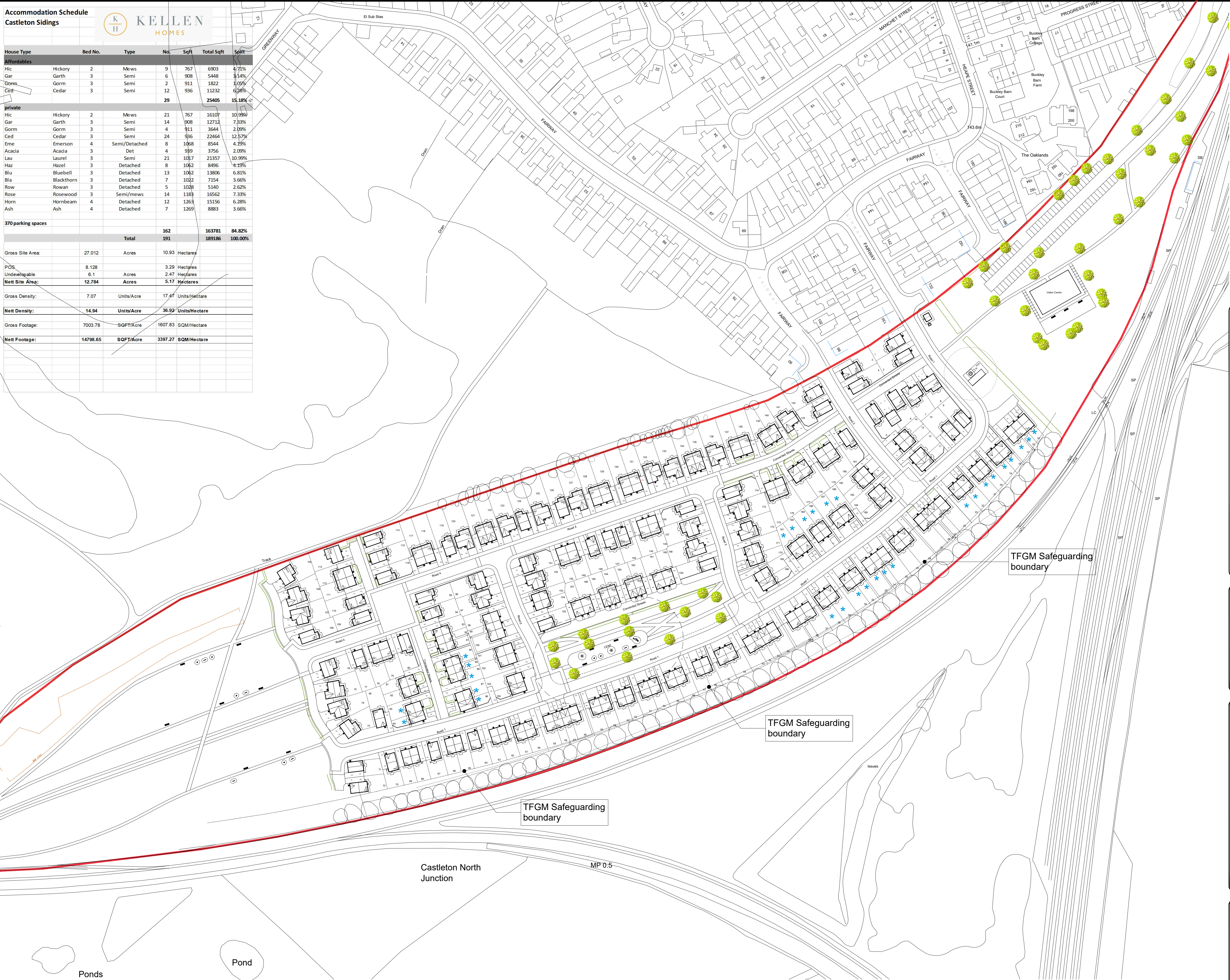
APPENDIX III

DRAWINGS

DRAWING 14-768-101 – SITE LOCATION PLAN



Accommodation Schedule						
Castleton Sidings						
K H KELLEN HOMES						
House Type	Bed No.	Type	No.	Sqft	Total Sqft	Split
Affordables						
Hic	Hickory	2	Mews	9	767	6903
Gar	Garth	3	Semi	6	908	5448
Gorm	Gorm	3	Semi	2	911	1822
Ced	Cedar	3	Semi	12	936	11232
			29		25405	15.18%
private						
Hic	Hickory	2	Mews	21	767	16107
Gar	Garth	3	Semi	14	908	12712
Gorm	Gorm	3	Semi	4	911	3644
Ced	Cedar	3	Semi	24	936	22464
Erne	Emerson	4	Semi/Detached	8	1068	8544
Acacia	Acacia	3	Det	4	999	3756
Laurel	Laurel	3	Semi	21	1017	21357
Haz	Hazel	3	Detached	8	1062	8496
Blu	Bluebell	3	Detached	13	1042	13806
Bla	Blackthorn	3	Detached	7	1022	7154
Row	Rowan	3	Detached	5	1028	5140
Rose	Rosewood	3	Semi/mews	14	1183	16562
Horn	Hornbeam	4	Detached	12	1263	15156
Ash	Ash	4	Detached	7	1269	8883
370 parking spaces			162		163781	84.82%
			Total	191	189186	100.00%
Gross Site Area:	27.012	Acres	10.93	Hectares		
PCS	8.128		3.29	Hectares		
Undevelopable	6.1	Acres	2.47	Hectares		
Net Site Area:	12.784	Acres	5.17	Hectares		
Gross Density:	7.07	Units/Acre	17.47	Units/Hectare		
Net Density:	14.94	Units/Acre	36.92	Units/Hectare		
Gross Footage:	7003.78	SQFT/Acre	1607.83	SQM/Hectare		
Net Footage:	14798.65	SQFT/Acre	3397.27	SQM/Hectare		



Legend

Indicates 1.8m high brick wall with piers

Indicates 1.8m high plot divisional screen fence.

Indicates 1.8m high closed boarded fence.

Indicates proposed tree planting subject to a landscape design and specification.

Indicates bin collection points.

Indicates principle entrance door to dwelling.

Indicates secondary entrance door to dwelling.

Indicates application site boundary.

Indicates parcel of land allocated to East Lancashire Railway.

Indicates affordable units

Rev	Date	Amend	Initials

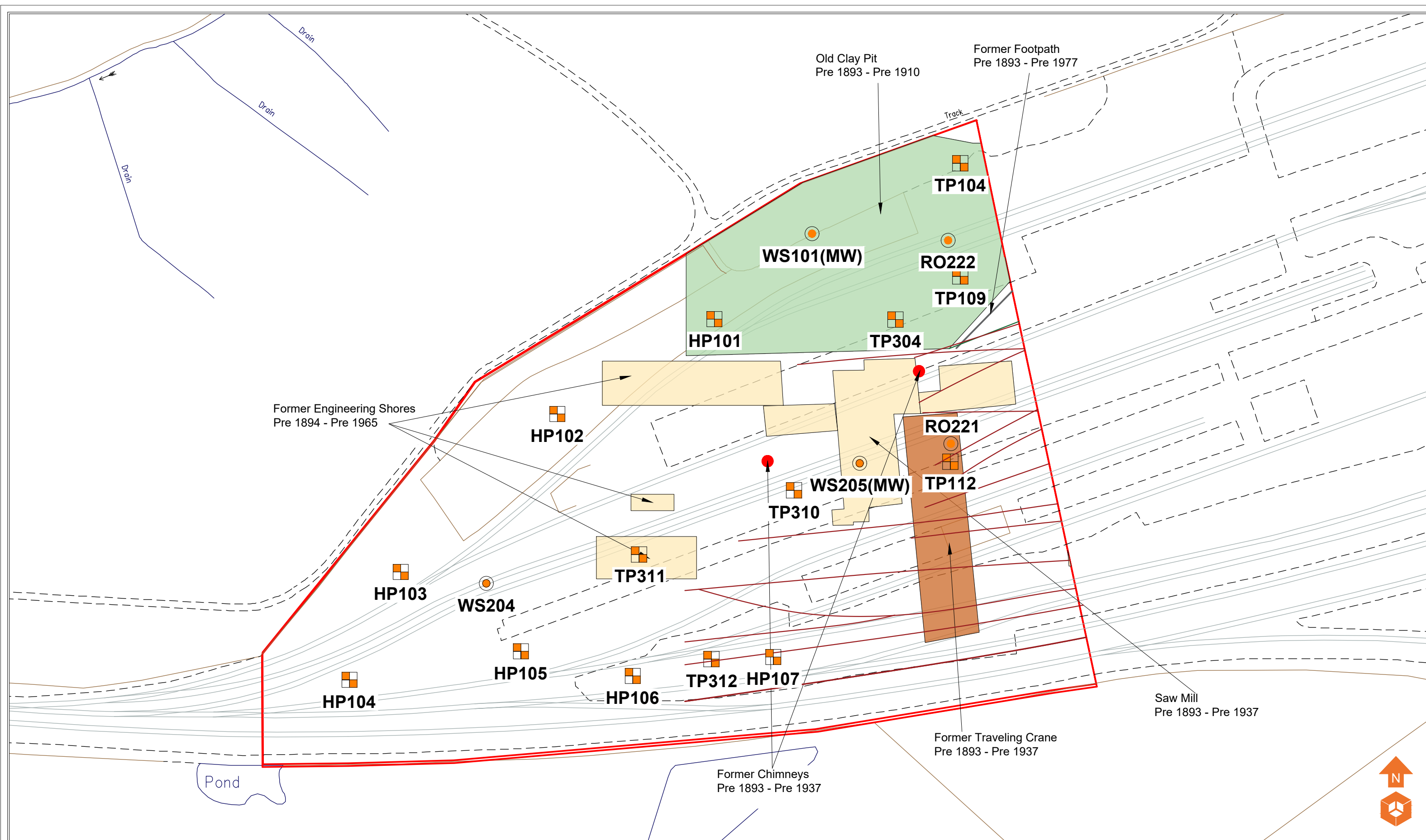
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CASTLETON SIDINGS	
Location	
ROCHDALE	
Drawing Title	
CAD Site Layout Opt 1	
Job Number	Drawing Number
KH003	KH003-A-100
Revision	Scale
-	1:1000 - A1
Drawn By	Date
BP	13.01.22
Checked by	Date Checked
RC	-

1st Floor, 103 Dalton Avenue, Birchwood Park,
Warrington WA3 6YE
T: 01925 363108 W: www.kellenhomes.com

K

H

KELLEN
HOMES



Historical Features

- Former Commercial Buildings / Structures
- Former Traveling Cranes
- Old Clay Pit
- Former Tanks
- Former Gasometer / Reservoir
- Former Footpath
- Former Field Boundaries
- Former Railway Tracks
- Former Earth Workings

Location Symbols

- Former Chimneys
- Approximate Trial Pit Location (March 2021)
- Approximate Hand Pit Location (March 2021)
- Approximate Rotary Borehole Location (March 2021)
- Approximate Rotary Borehole Location (July 2021)

Notes:

P1	REVC	07.12.2022	HM	BH
P1	REVB	25.03.2022	EB	JS
P1	REVA	31.03.2021	EB	EF
Phase	Issue	Date	Drawn	Checked

Client:

Kellen Homes

Job Title:

Heywood Road,
Castleton

Job No:

14-768

Drawing No:

103

Date:

07.12.2022

Scale:

NTS @ A3



Environmental Engineering
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Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

Drawing Title:

Historical Features
Plan

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Site Features

Overgrown Trees

Concrete Hardstanding

Historical Rail Tracks

Trees

Notes:

P1	REVC	08.12.2022	HM	EC
P1	REVB	11.03.2022	HM	JS
P1	REVA	15.04.2021	EB	EF
Phase	Issue	Date	Drawn	Checked

Client:

Kellen Homes

Job No:

14-768

Date:

08.12.2022

Drawing No:

104

Scale:

NTS @ A3

Job Title:

Heywood Road, Castleton

Drawing Title:

Site Features Plan

e3p

Environmental Engineering Partnership Ltd

Taylor Road, Trafford Park

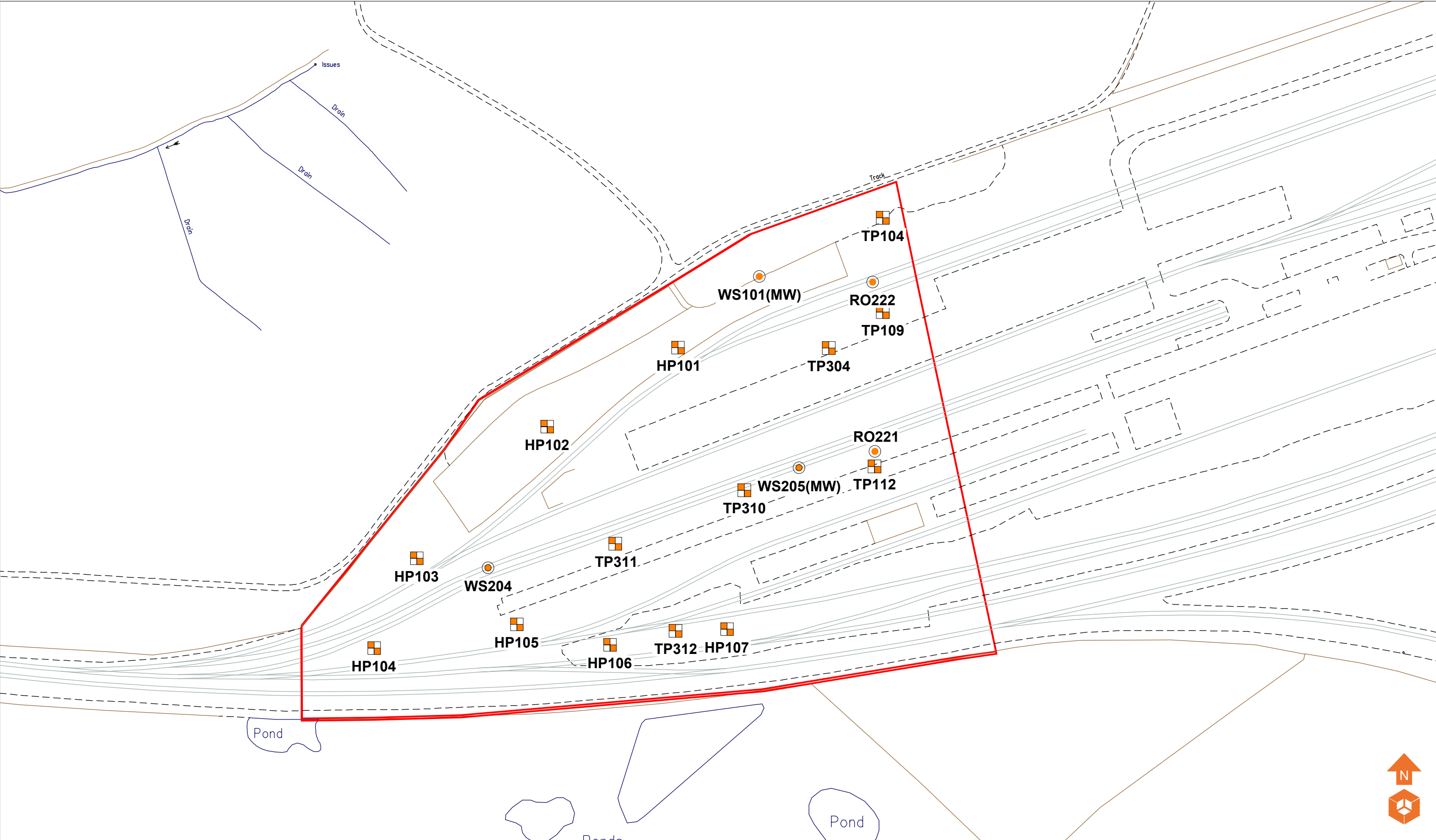
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Location Symbols

-  Approximate Trial Pit Location (March 2021)
-  Approximate Rotary Borehole Location (March 2021)
-  Approximate Rotary Borehole Location (July 2021)
-  Approximate Hand Pit Location (March 2021)

Notes:

P1	REVE	08.12.2022	HM	EC
P1	REVD	19.10.2022	HM	EC
P1	REVC	30.03.2022	EB	JS
P1	REVB	11.03.2022	HM	JS
P1	REVA	25.03.2021	EB	EF
Phase	Issue	Date	Drawn	Checked

Client:

Kellen Homes

Job Title:

Heywood Road,
Castleton

Job No:

14-768

Drawing No:

105

Date:

08.12.2022

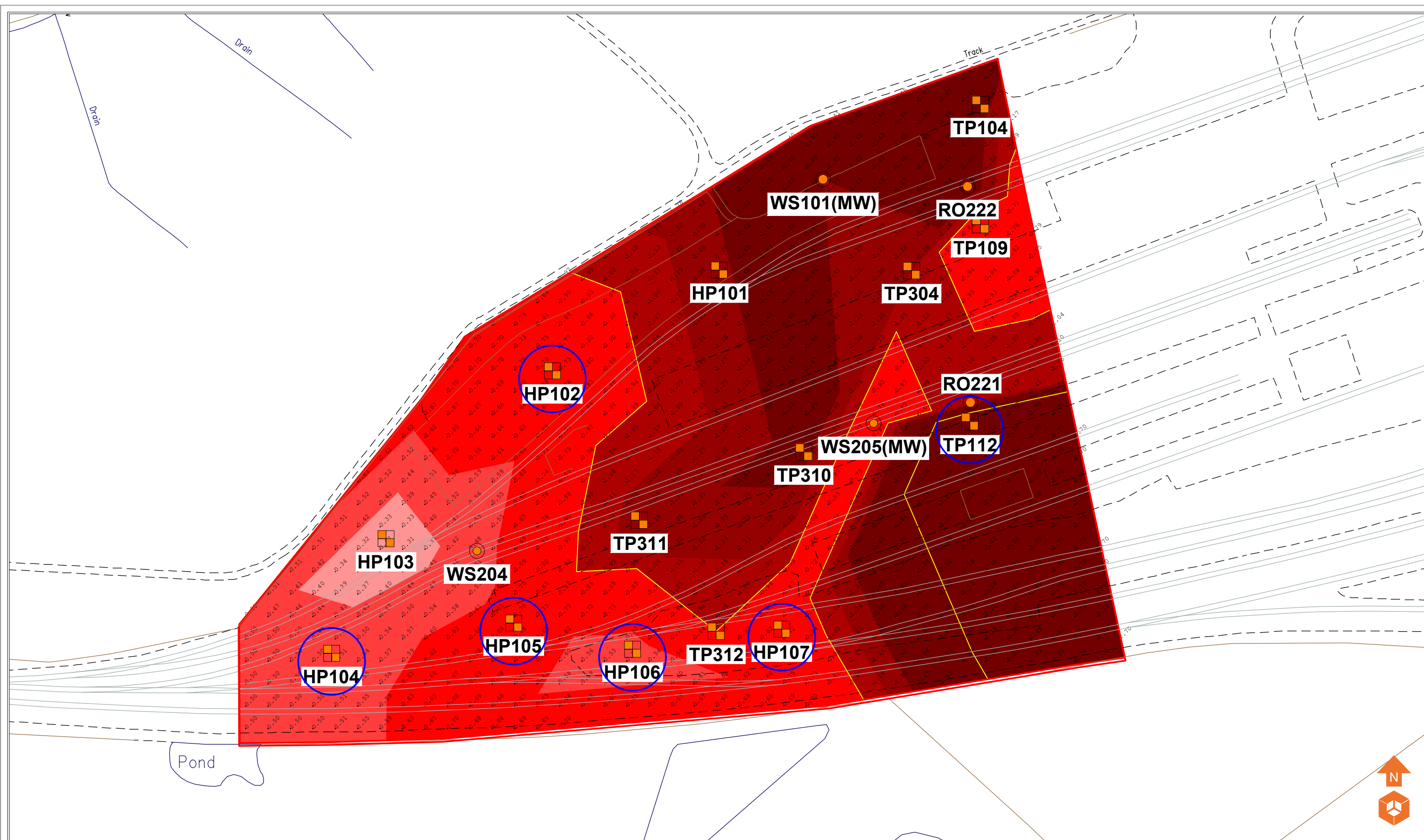
Scale:

NTS @ A3



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Location Symbols

- Approximate Window Sample Probehole Location (March 2021)
- Approximate Window Sample Probehole Location with Install (March 2021)
- Approximate Trial Pit Location (March 2021)
- Approximate Rotary Borehole Location (March 2021)
- Approximate Trial Pit Location (June 2021)
- Approximate Rotary Borehole Location (July 2021)
- Approximate Hand Dug Pit Location (July 2021)
- Approximate Stockpile Sample Location (July 2021)
- Approximate Location of Attempted Rotary Borehole (July 2021 - Not Completed Due to Access Limitations)

Made Ground Depth (m)

- Depth of Made Ground 0.00 - 0.19m
- Depth of Made Ground 0.20 - 0.39m
- Depth of Made Ground 0.40 - 0.59m
- Depth of Made Ground 0.60 - 0.79m
- Depth of Made Ground 0.80 - 0.99m
- Depth of Made Ground 1.00 - 1.19m
- Depth of Made Ground >1.20m

- Base of Made Ground Not Proven

Notes:

P1	REVE	09.12.2022	HM	EC
P1	REVD	30.03.2022	EB	JS
P1	REVC	11.03.2022	HM	JS
P1	REVB	07.05.2021	EB	JS
P1	REVA	31.03.2021	EB	EF
Phase	Issue	Date	Drawn	Checked

Client:

Kellen Homes

Job Title:

Heywood Road,
Castleton

Job No:

14-768

Drawing No:

106

Date:

09.12.2021

Scale:

NTS @ A3

Drawing Title:

Depth Of Made
Ground Plan



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APPENDIX IV PHOTOGRAPHS

PLATE 1 TP312 EXCAVATION



PLATE 2 TP312 ARISINGS



PLATE 3

WS205 ARISINGS



PLATE 4

RAILWAY SIDINGS THROUGH POS AREA



APPENDIX V

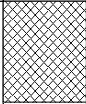
E3P EXPLORATORY HOLE LOGS



Trial Pit Log

TrialPit No
HP101
Sheet 1 of 1

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387593.00 - 409995.00 Level:	Date 20/07/2021
Location: Heywood Road, Rochdale		Dimensions (m): 0.40 Depth 0.60	Scale 1:45 Logged J.James
Client: Kellen Homes			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.60	ES		0.60			MADE GROUND: Black gravelly SAND. Gravel is fine to coarse angular to subangular of brick, mudstone, ceramic and glass (TOPSOIL). End of Pit at 0.60m	1 2 3 4 5 6

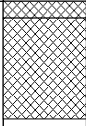
Remarks:	
Stability: Stable.	



Trial Pit Log

TrialPit No
HP102
Sheet 1 of 1

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387596.00 - 409985.00 Level:	Date 20/07/2021
Location: Heywood Road, Rochdale		Dimensions (m): 0.40 Depth 0.70	Scale 1:45 Logged J.James
Client: Kellen Homes			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.70	ES		0.10 0.70		 	MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to subrounded of brick, mudstone and sandstone. MADE GROUND: Black gravelly SAND. Gravel is fine to coarse angular to subangular of brick, clinker and ash. End of Pit at 0.70m	1 2 3 4 5 6

Remarks:	
Stability: Stable.	



Trial Pit Log

TrialPit No
HP103
Sheet 1 of 1

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387548.00 - 409977.00 Level:	Date 20/07/2021
Location: Heywood Road, Rochdale		Dimensions (m): 0.40 0.40	Scale 1:45
Client: Kellen Homes		Depth 0.80	Logged J.James

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.80	ES		0.25			MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to subrounded of brick, mudstone and clinker.	
				0.80			Soft brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse angular to subrounded of mudstone, sandstone, brick and coal	
							End of Pit at 0.80m	1
								2
								3
								4
								5
								6

Remarks:

Stability: Stable.





Trial Pit Log

TrialPit No
HP104
Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387494.00 - 409975.00
Level:

Date
20/07/2021

Location: Heywood Road, Rochdale

Dimensions (m): 0.40

Depth
0.50

Scale
1:45

Logged
J.James

Client: Kellen Homes

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.50	ES		0.20 0.50			MADE GROUND: Black gravelly SAND. Gravel is fine to coarse angular to subangular of brick, mudstone, ceramic and glass (TOPSOIL). MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to subrounded of brick, mudstone and sandstone. End of Pit at 0.50m	1 2 3 4 5 6

Remarks:

Stability: Stable.





Trial Pit Log

TrialPit No
HP105
Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387539.00 - 409989.00
Level:

Date
20/07/2021

Location: Heywood Road, Rochdale

Dimensions (m): 0.40

Scale
1:45

Client: Kellen Homes

Depth
0.70

0.40

Logged
J.James

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.60	ES		0.20			MADE GROUND: Black gravelly SAND. Gravel is fine to coarse angular to subangular of brick, mudstone, ceramic and glass (TOPSOIL).	
				0.70			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to subrounded of brick, mudstone and sandstone.	
							End of Pit at 0.70m	1
								2
								3
								4
								5
								6

Remarks:

Stability: Stable.





Trial Pit Log

TrialPit No
HP106
Sheet 1 of 1

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387576.00 - 409999.00 Level:	Date 20/07/2021
Location: Heywood Road, Rochdale		Dimensions (m): 0.40 Depth 0.50	Scale 1:45 Logged J.James
Client: Kellen Homes			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.70	ES		0.20 0.50			MADE GROUND: Black gravelly SAND. Gravel is fine to coarse angular to subangular of brick, mudstone, ceramic and glass (TOPSOIL). MADE GROUND: Black gravelly SAND. Gravel is fine to coarse angular to subangular of brick, clinker and ash. End of Pit at 0.50m	1 2 3 4 5 6

Remarks:	
Stability: Stable.	



Trial Pit Log

TrialPit No
HP107
Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387594.00 - 410016.00
Level:

Date
20/07/2021

Location: Heywood Road, Rochdale

Dimensions (m): 0.40

Scale
1:45

Client: Kellen Homes

Depth
0.70

0.40

Logged
J.James

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.70	ES		0.20			MADE GROUND: Black gravelly SAND. Gravel is fine to coarse angular to subangular of brick, mudstone, ceramic and glass (TOPSOIL).	
				0.70			MADE GROUND: Black gravelly SAND. Gravel is fine to coarse angular to subangular of brick, clinker and ash.	
							End of Pit at 0.70m	1
								2
								3
								4
								5
								6

Remarks:

Stability: Stable.



Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387709.00 - 410123.00 Level:	Date 04/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.40 Depth 2.40	Scale 1:45
Client: Kellen Homes			Logged E. Fearn

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
 1.50	0.30	ES		0.40		 MADE GROUND: Black slightly clayey gravelly medium sand. Gravel is fine to coarse angular to sub-rounded of mudstone, brick and ash.	1
						 MADE GROUND: Yellow brown clayey medium sand.	
	1.30	ES		1.50		 Light brown sandy GRAVEL. Gravel is fine to coarse angular to rounded of mudstone and sandstone.	2
				2.40		End of Pit at 2.40m	3
							4
							5
							6

Trial Pit Photographs



Trial Pit 104

Remarks: 1. Terminated due to side wall collapse within Made Ground. 2. Water strike encountered at 1.50m bgl.

Stability: Unstable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387723.00 - 410087.00 Level:	Date 04/03/2021
Location: Heywood Road, Rochdale		Dimensions (m): 2.00 Depth 2.80	Scale 1:45
Client: Kellen Homes			Logged E. Fearn

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.30	ES		0.40			MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to sub-rounded of mudstone, brick and ash.	
	0.80	ES		0.70			MADE GROUND: Light grey brown clayey medium sand.	
							Yellow brown slightly clayey medium SAND.	1
								2
								3
								4
								5
								6

Trial Pit Photographs



Trial Pit 109



Trial Pit 109 Spoil

Remarks: 1. Terminated due to side wall collapse within Made Ground. 2. Water strike encountered at 2.70m bgl.

Stability: Unstable.

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387628.00 - 410025.00
Level:

Date
17/10/2022

Location: Heywood Road, Rochdale

Dimensions (m): 3.30

Scale
1:45

Client: Kellen Homes

Depth
3.00

Logged
E.Canham

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.20			MADE GROUND: Brown gravelly clayey medium to coarse sand with frequent rootlets. Gravel is medium to coarse subangular to subrounded of brick, mudstone and concrete. (Topsoil)	
				0.80			MADE GROUND: Blackish brown sandy gravel. Gravel is fine to coarse subangular to angular of ballast, concrete and brick.	1
				1.50			MADE GROUND: Light brown slightly clayey gravelly SAND. Gravel is fine to coarse subrounded to rounded of mudstone.	
	1.60	HVP	138				Stiff greyish brown slightly sandy CLAY.	
	1.80	HVP	135					2
	2.20	HVP	132					
	2.80	HVP	124					
				3.00			End of Pit at 3.00m	3
								4
								5
								6

Trial Pit Photographs



TP310



TP310 spoil

Remarks: 1. Complete.

Stability: Stable.

Project Name: Castleton Sidings	Project No. 14768	Co-ords: 387571.00 - 410007.00 Level:	Date 17/10/2022
Location: Heywood Road, Rochdale		Dimensions (m): 3.30 1.80 Depth 3.00	Scale 1:45 Logged E.Canham
Client: Kellen Homes			

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.30 0.40 0.70 1.30 1.50 2.50 3.00			MADE GROUND: Brown gravelly clayey medium to coarse sand with frequent rootlets. Gravel is medium to coarse subangular to subrounded of brick, ballast, mudstone and concrete. (Topsoil) MADE GROUND: Yellowish grey clayey medium to coarse sand. MADE GROUND: Brown clay with band of black sandy gravel at 0.60m bgl. Gravel is medium to coarse of ash. MADE GROUND: Brown slightly clayey gravelly medium to coarse sand with occasional cobbles. Gravel is medium to coarse subrounded mudstone. Cobbles are subrounded mudstone. Stiff greyish brown slightly sandy CLAY. End of Pit at 3.00m	1 2 3 4 5 6
		HVP	137					
		HVP	133					

Trial Pit Photographs



TP311



TP311 spoil

Remarks: 1. Complete. 2. Slight hydrocarbon odour at 0.60m bgl.

Stability: Stable.



e3p

Trial Pit Log

TrialPit No

TP312

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768Co-ords: 387631.00 - 409992.00
Level:Date
17/10/2022

Location: Heywood Road, Rochdale

Dimensions (m): 3.50

Scale
1:45

Client: Kellen Homes

Depth
1.50Logged
E.Canham

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
▼ 1.50				0.40		  	MADE GROUND: Brown gravelly clayey medium to coarse sand with frequent rootlets. Gravel is medium to coarse subangular to subrounded of brick, ballast, mudstone and concrete. (Topsoil)	1
				1.00			MADE GROUND: Blackish brown clayey gravelly fine to medium sand with occasional cobbles of intact bricks. Gravel is fine to coarse subangular to angular of concrete and brick. Brown medium to coarse SAND encountered between 0.40m and 1.00m bgl.	
				1.50			Firm greyish brown CLAY.	
							End of Pit at 1.50m	2
								3
								4
								5
								6

Trial Pit Photographs



TP312



TP312 spoil

Remarks: 1. Complete 2. Land drain encountered at 0.80m bgl and oily sheen encountered on water ingress. 3. Strong hydrocarbon odour encountered between 0.40m and 1.00m bgl. 4. Water strike encountered at 1.50m bgl- seepage.

Stability: Stable.



Borehole Log

Borehole No.

WS101

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords:

Hole Type
WS

Location: Heywood Road, Rochdale

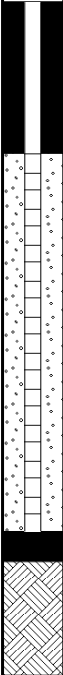
Level:

Scale
1:50

Client: Kellen Homes

Dates: 04/03/2021

Logged By
J. Craig

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description					
		Depth (m)	Type	Results									
								MADE GROUND: Black slightly sandy gravel. Gravel is fine to coarse angular to sub-angular of mudstone, brick and ash.	1				
		0.50	ES		0.50								
		0.70	ES										
				1.00	SPT	N=20 (5,6/6,6,4,4)							
				1.50 - 2.00	U		1.40			Stiff medium strength brown grey sandy CLAY.	2		
				1.60	PP	25.00							
				1.90	PP	49.00							
				2.00	SPT	N=15 (3,2/3,3,4,5)							
				2.10	PP	25.00							
				2.90	PP	25.00							3
				3.00	SPT	N=9 (1,2/2,2,2,3)							
				3.10	PP	25.00							
				3.70	PP	25.00							
		4.00	SPT	N=14 (3,3/3,4,3,4)							4		
					4.45								
								End of Borehole at 4.45m	5				
									6				
									7				
									8				
									9				
									10				

Remarks

1. Terminated due to collapse from 4.00m bgl. 2. Monitoring well installed.



Borehole Log

Borehole No.

WS204

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387541E - 409995N

Hole Type
WS

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

Dates: 17/10/2022

Logged By
E.Canham

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			MADE GROUND: Brown gravelly clayey medium to coarse sand with frequent rootlets. Gravel is medium to coarse subangular to subrounded of brick, ballast, mudstone and concrete. (Topsoil) MADE GROUND: Black clayey slightly gravelly fine to medium sand. Gravel is fine to coarse subangular to angular of ash and mudstone. End of Borehole at 0.50m	1
					0.50				2
									3
									4
									5
									6
									7
									8
									9
									10

Remarks

1. Terminated on concrete at 0.50m bgl.



Borehole Log

Borehole No.

WS205

Sheet 1 of 1

Project Name: Castleton Sidings

Project No.
14768

Co-ords: 387634E - 410025N

Hole Type
WS

Location: Heywood Road, Rochdale

Level:

Scale
1:50

Client: Kellen Homes

Dates: 17/10/2022

Logged By
E.Canham

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.20			MADE GROUND: Brown gravelly clayey medium to coarse sand with frequent rootlets. Gravel is medium to coarse subangular to subrounded of brick, mudstone and concrete. (Topsoil)	
					0.70			MADE GROUND: Greyish brown gravelly clayey medium to coarse sand. Gravel is fine to coarse subangular to angular of concrete.	
		1.00	SPT	N=10 (2,2/3,3,2,2)	1.00			Yellowish brown clayey medium to coarse SAND. Stiff medium strength greyish brown slightly sandy CLAY.	1
		1.00	SPT						
		2.00	SPT	N=11 (2,2/2,3,3,3)					2
		2.00	SPT						
		3.00	SPT	N=15 (3,3/4,4,4,3)					3
		3.00	SPT						
		4.00	SPT	N=14 (3,4/4,4,3,3)					4
		4.00	SPT						
		5.00	SPT	N=14 (4,4/4,4,3,3)					5
		5.00	SPT						
					5.45			End of Borehole at 5.45m	6
									7
									8
									9
									10

Remarks

1. Complete 2. Monitoring well installed- response zone: 1.00-3.00m bgl.

APPENDIX VI

CHEMICAL TESTING

RESULTS

Eleanor Canham

e3p
Taylor Road
Urmston
Manchester
M41 7JQ

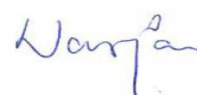
i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

t: 01923 225404
f: 01923 237404
e: reception@i2analytical.com

e:

Analytical Report Number : 22-91380

Project / Site name:	Heywood Road	Samples received on:	18/10/2022
Your job number:	14-768	Samples instructed on/ Analysis started on:	20/10/2022
Your order number:	003222	Analysis completed by:	27/10/2022
Report Issue Number:	1	Report issued on:	27/10/2022
Samples Analysed:	2 leachate samples - 4 soil samples		


Signed:

Dominika Warjan
Junior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

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

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

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

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

Excel copies of reports are only valid when accompanied by this PDF certificate.

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

Analytical Report Number: 22-91380
 Project / Site name: Heywood Road
 Your Order No: 003222

Lab Sample Number				2468711	2468712	2468713	2468714
Sample Reference				TP310	TP311	WS204	TP312
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.80	0.35	0.50
Date Sampled				17/10/2022	17/10/2022	17/10/2022	17/10/2022
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status				
Stone Content	%	0.1	NONE	< 0.1	< 0.1	22	< 0.1
Moisture Content	%	0.01	NONE	9.5	13	12	13
Total mass of sample received	kg	0.001	NONE	0.3	0.3	0.3	0.3

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

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.4	8.2	8.4	8.1
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphate as SO ₄	mg/kg	50	MCERTS	250	750	1300	590
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.018	0.022	0.14	0.064
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	37	44	280	130
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	18.4	22.1	141	64.2
Sulphide	mg/kg	1	NONE	8.3	3	24	6.4
Total Sulphur	mg/kg	50	MCERTS	290	580	1100	420
Total Organic Carbon (TOC) - Automated	%	0.1	MCERTS	1	1.9	3.5	1.5

Total Phenols

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

Naphthalene	mg/kg	0.05	NONE	0.41	-	1	-
Acenaphthylene	mg/kg	0.05	NONE	< 0.05	-	0.15	-
Acenaphthene	mg/kg	0.05	NONE	0.15	-	1.1	-
Fluorene	mg/kg	0.05	NONE	0.15	-	0.7	-
Phenanthrene	mg/kg	0.05	NONE	1.2	-	7.4	-
Anthracene	mg/kg	0.05	NONE	0.32	-	1.9	-
Fluoranthene	mg/kg	0.05	NONE	1.7	-	11	-
Pyrene	mg/kg	0.05	NONE	1.7	-	12	-
Benzo(a)anthracene	mg/kg	0.05	NONE	0.93	-	7	-
Chrysene	mg/kg	0.05	NONE	1	-	5.6	-
Benzo(b)fluoranthene	mg/kg	0.05	NONE	1.3	-	8	-
Benzo(k)fluoranthene	mg/kg	0.05	NONE	0.38	-	2.2	-
Benzo(a)pyrene	mg/kg	0.05	NONE	1.1	-	7.2	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	NONE	0.58	-	3.7	-
Dibenz(a,h)anthracene	mg/kg	0.05	NONE	0.18	-	1	-
Benzo(ghi)perylene	mg/kg	0.05	NONE	0.65	-	4.4	-

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	NONE	11.6	-	74	-
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Analytical Report Number: 22-91380
Project / Site name: Heywood Road
Your Order No: 003222

Lab Sample Number	2468711	2468712	2468713	2468714
Sample Reference	TP310	TP311	WS204	TP312
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	1.00	0.80	0.35	0.50
Date Sampled	17/10/2022	17/10/2022	17/10/2022	17/10/2022
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	13	31	28	38
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	16	16	32	25
Copper (aqua regia extractable)	mg/kg	1	MCERTS	49	190	210	140
Lead (aqua regia extractable)	mg/kg	1	MCERTS	56	630	460	360
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	1.4	3.8	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	20	32	39	41
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	67	130	230	210

Monoaromatics & Oxygenates

Benzene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Toluene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Ethylbenzene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
p & m-xylene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
o-xylene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	NONE	-	< 1.0	-	< 1.0

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6 HS_ID_AL	mg/kg	0.001	NONE	-	< 0.001	-	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8 HS_ID_AL	mg/kg	0.001	NONE	-	< 0.001	-	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10 HS_ID_AL	mg/kg	0.001	NONE	-	< 0.001	-	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12 EH_CU_ID_AL	mg/kg	1	NONE	-	< 1.0	-	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16 EH_CU_ID_AL	mg/kg	2	NONE	-	< 2.0	-	4.3
TPH-CWG - Aliphatic >EC16 - EC21 EH_CU_ID_AL	mg/kg	8	NONE	-	< 8.0	-	22
TPH-CWG - Aliphatic >EC21 - EC35 EH_CU_ID_AL	mg/kg	8	NONE	-	< 8.0	-	150
TPH-CWG - Aliphatic (EC5 - EC35) EH_CU+HS_ID_AL	mg/kg	10	NONE	-	< 10	-	170

TPH-CWG - Aromatic >EC5 - EC7 HS_ID_AR	mg/kg	0.001	NONE	-	< 0.001	-	< 0.001
TPH-CWG - Aromatic >EC7 - EC8 HS_ID_AR	mg/kg	0.001	NONE	-	< 0.001	-	< 0.001
TPH-CWG - Aromatic >EC8 - EC10 HS_ID_AR	mg/kg	0.001	NONE	-	< 0.001	-	< 0.001
TPH-CWG - Aromatic >EC10 - EC12 EH_CU_ID_AR	mg/kg	1	NONE	-	< 1.0	-	< 1.0
TPH-CWG - Aromatic >EC12 - EC16 EH_CU_ID_AR	mg/kg	2	NONE	-	< 2.0	-	< 2.0
TPH-CWG - Aromatic >EC16 - EC21 EH_CU_ID_AR	mg/kg	10	NONE	-	44	-	28
TPH-CWG - Aromatic >EC21 - EC35 EH_CU_ID_AR	mg/kg	10	NONE	-	76	-	71
TPH-CWG - Aromatic (EC5 - EC35) EH_CU+HS_ID_AR	mg/kg	10	NONE	-	120	-	99

TPH (C5 - C6) HS_ID_TOTAL	mg/kg	1	NONE	< 1.0	-	< 1.0	< 1.0
TPH (C6 - C8) HS_ID_TOTAL	mg/kg	0.1	NONE	< 0.1	-	< 0.1	< 0.1
TPH (C8 - C10) HS_ID_TOTAL	mg/kg	0.1	NONE	< 0.1	-	< 0.1	< 0.1
TPH (C10 - C12) EH_CU_ID_TOTAL	mg/kg	2	NONE	2.7	-	2.3	< 2.0
TPH (C12 - C16) EH_CU_ID_TOTAL	mg/kg	4	NONE	4.3	-	18	4.3
TPH (C16 - C21) EH_CU_ID_TOTAL	mg/kg	1	NONE	6.9	-	89	50
TPH (C21 - C35) EH_CU_ID_TOTAL	mg/kg	1	NONE	14	-	230	220
TPH (C35 - C40) EH_CU_ID_TOTAL	mg/kg	10	NONE	< 10	-	26	34
TPH Total C5 - C40 EH_CU+HS_ID_TOTAL	mg/kg	10	NONE	28	-	370	300

Analytical Report Number: 22-91380
Project / Site name: Heywood Road
Your Order No: 003222

Lab Sample Number	2468711	2468712	2468713	2468714
Sample Reference	TP310	TP311	WS204	TP312
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	1.00	0.80	0.35	0.50
Date Sampled	17/10/2022	17/10/2022	17/10/2022	17/10/2022
Time Taken	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	

VOCs

Chloromethane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Chloroethane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Bromomethane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Vinyl Chloride	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Trichlorofluoromethane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,1-Dichloroethene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Cis-1,2-dichloroethene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,1-Dichloroethane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
2,2-Dichloropropane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Trichloromethane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,1,1-Trichloroethane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,2-Dichloroethane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,1-Dichloropropene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Trans-1,2-dichloroethene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Benzene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Tetrachloromethane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,2-Dichloropropane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Trichloroethene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Dibromomethane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Bromodichloromethane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Cis-1,3-dichloropropene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Trans-1,3-dichloropropene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Toluene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,1,2-Trichloroethane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,3-Dichloropropane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Dibromochloromethane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Tetrachloroethene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,2-Dibromoethane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Chlorobenzene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,1,1,2-Tetrachloroethane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Ethylbenzene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
p & m-Xylene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Styrene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Tribromomethane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
o-Xylene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,1,2,2-Tetrachloroethane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Isopropylbenzene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Bromobenzene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
n-Propylbenzene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
2-Chlorotoluene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
4-Chlorotoluene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,3,5-Trimethylbenzene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
tert-Butylbenzene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,2,4-Trimethylbenzene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
sec-Butylbenzene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,3-Dichlorobenzene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
p-Isopropyltoluene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,2-Dichlorobenzene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,4-Dichlorobenzene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Butylbenzene	µg/kg	1	NONE	-	< 1.0	-	< 1.0

Analytical Report Number: 22-91380
Project / Site name: Heywood Road
Your Order No: 003222

Lab Sample Number				2468711	2468712	2468713	2468714
Sample Reference				TP310	TP311	WS204	TP312
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.80	0.35	0.50
Date Sampled				17/10/2022	17/10/2022	17/10/2022	17/10/2022
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status				
1,2-Dibromo-3-chloropropane	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,2,4-Trichlorobenzene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
Hexachlorobutadiene	µg/kg	1	NONE	-	< 1.0	-	< 1.0
1,2,3-Trichlorobenzene	µg/kg	1	NONE	-	< 1.0	-	< 1.0

SVOCs

Aniline	mg/kg	0.1	NONE	-	< 0.1	-	< 0.1
Phenol	mg/kg	0.2	NONE	-	< 0.2	-	< 0.2
2-Chlorophenol	mg/kg	0.1	NONE	-	< 0.1	-	< 0.1
Bis(2-chloroethyl)ether	mg/kg	0.2	NONE	-	< 0.2	-	< 0.2
1,3-Dichlorobenzene	mg/kg	0.2	NONE	-	< 0.2	-	< 0.2
1,2-Dichlorobenzene	mg/kg	0.1	NONE	-	< 0.1	-	< 0.1
1,4-Dichlorobenzene	mg/kg	0.2	NONE	-	< 0.2	-	< 0.2
Bis(2-chloroisopropyl)ether	mg/kg	0.1	NONE	-	< 0.1	-	< 0.1
2-Methylphenol	mg/kg	0.3	NONE	-	< 0.3	-	< 0.3
Hexachloroethane	mg/kg	0.05	NONE	-	< 0.05	-	< 0.05
Nitrobenzene	mg/kg	0.3	NONE	-	< 0.3	-	< 0.3
4-Methylphenol	mg/kg	0.2	NONE	-	< 0.2	-	< 0.2
Isophorone	mg/kg	0.2	NONE	-	< 0.2	-	< 0.2
2-Nitrophenol	mg/kg	0.3	NONE	-	< 0.3	-	< 0.3
2,4-Dimethylphenol	mg/kg	0.3	NONE	-	< 0.3	-	< 0.3
Bis(2-chloroethoxy)methane	mg/kg	0.3	NONE	-	< 0.3	-	< 0.3
1,2,4-Trichlorobenzene	mg/kg	0.3	NONE	-	< 0.3	-	< 0.3
Naphthalene	mg/kg	0.05	NONE	-	< 0.05	-	0.3
2,4-Dichlorophenol	mg/kg	0.3	NONE	-	< 0.3	-	< 0.3
4-Chloroaniline	mg/kg	0.1	NONE	-	< 0.1	-	< 0.1
Hexachlorobutadiene	mg/kg	0.1	NONE	-	< 0.1	-	< 0.1
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	-	< 0.1	-	< 0.1
2,4,6-Trichlorophenol	mg/kg	0.1	NONE	-	< 0.1	-	< 0.1
2,4,5-Trichlorophenol	mg/kg	0.2	NONE	-	< 0.2	-	< 0.2
2-Methylnaphthalene	mg/kg	0.1	NONE	-	< 0.1	-	0.3
2-Chloronaphthalene	mg/kg	0.1	NONE	-	< 0.1	-	< 0.1
Dimethylphthalate	mg/kg	0.1	NONE	-	< 0.1	-	< 0.1
2,6-Dinitrotoluene	mg/kg	0.1	NONE	-	< 0.1	-	< 0.1
Acenaphthylene	mg/kg	0.05	NONE	-	0.21	-	0.14
Acenaphthene	mg/kg	0.05	NONE	-	0.42	-	0.43
2,4-Dinitrotoluene	mg/kg	0.2	NONE	-	< 0.2	-	< 0.2
Dibenzofuran	mg/kg	0.2	NONE	-	0.3	-	0.4
4-Chlorophenyl phenyl ether	mg/kg	0.3	NONE	-	< 0.3	-	< 0.3
Diethyl phthalate	mg/kg	0.2	NONE	-	< 0.2	-	< 0.2
4-Nitroaniline	mg/kg	0.2	NONE	-	< 0.2	-	< 0.2
Fluorene	mg/kg	0.05	NONE	-	0.42	-	0.43
Azobenzene	mg/kg	0.3	NONE	-	< 0.3	-	< 0.3
Bromophenyl phenyl ether	mg/kg	0.2	NONE	-	< 0.2	-	< 0.2
Hexachlorobenzene	mg/kg	0.3	NONE	-	< 0.3	-	< 0.3
Phenanthrene	mg/kg	0.05	NONE	-	4.6	-	2.3
Anthracene	mg/kg	0.05	NONE	-	1	-	3.4
Carbazole	mg/kg	0.3	NONE	-	< 0.3	-	0.3
Dibutyl phthalate	mg/kg	0.2	NONE	-	< 0.2	-	< 0.2
Anthraquinone	mg/kg	0.3	NONE	-	0.8	-	0.5
Fluoranthene	mg/kg	0.05	NONE	-	4.7	-	3.9
Pyrene	mg/kg	0.05	NONE	-	4.6	-	3.7
Butyl benzyl phthalate	mg/kg	0.3	NONE	-	< 0.3	-	< 0.3

Analytical Report Number: 22-91380
Project / Site name: Heywood Road
Your Order No: 003222

Lab Sample Number				2468711	2468712	2468713	2468714
Sample Reference				TP310	TP311	WS204	TP312
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.00	0.80	0.35	0.50
Date Sampled				17/10/2022	17/10/2022	17/10/2022	17/10/2022
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status				
Benzo(a)anthracene	mg/kg	0.05	NONE	-	1.3	-	1.7
Chrysene	mg/kg	0.05	NONE	-	1.9	-	2.1
Benzo(b)fluoranthene	mg/kg	0.05	NONE	-	1.6	-	2.6
Benzo(k)fluoranthene	mg/kg	0.05	NONE	-	0.78	-	0.76
Benzo(a)pyrene	mg/kg	0.05	NONE	-	1.4	-	1.6
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	NONE	-	0.73	-	0.84
Dibenz(a,h)anthracene	mg/kg	0.05	NONE	-	0.23	-	0.26
Benzo(ghi)perylene	mg/kg	0.05	NONE	-	0.87	-	0.78

U/S = Unsuitable Sample I/S = Insufficient Sample



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Analytical Report Number: 22-91380
Project / Site name: Heywood Road

Your Order No: 003222

Lab Sample Number				2468817	2468818
Sample Reference				TP311	TP312
Sample Number				None Supplied	None Supplied
Depth (m)				0.80	0.50
Date Sampled				17/10/2022	17/10/2022
Time Taken				None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)				Units	Limit of detection Accreditation Status

General Inorganics

pH (automated)	pH Units	N/A	ISO 17025	8.1	8.1
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	< 1.0	< 1.0

Total Phenols

Total Phenols (monohydric)	µg/l	1	ISO 17025	1.4	1.4
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Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	NONE	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	NONE	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	NONE	< 0.01	< 0.01

Total PAH

Total EPA-16 PAHs	µg/l	0.2	NONE	< 0.2	< 0.2
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Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	1	ISO 17025	2.7	1.4
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08	< 0.08
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0
Chromium (dissolved)	µg/l	0.4	ISO 17025	1.6	0.8
Copper (dissolved)	µg/l	0.7	ISO 17025	7	10
Lead (dissolved)	µg/l	1	ISO 17025	1.1	< 1.0
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	12	0.5
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0	< 4.0
Zinc (dissolved)	µg/l	0.4	ISO 17025	8.9	8.1

Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	10	NONE	< 10	< 10



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Analytical Report Number: 22-91380

Project / Site name: Heywood Road

Your Order No: 003222

Lab Sample Number		2468817	2468818
Sample Reference		TP311	TP312
Sample Number		None Supplied	None Supplied
Depth (m)		0.80	0.50
Date Sampled		17/10/2022	17/10/2022
Time Taken		None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status

Petroleum Hydrocarbons

TPH1 (C10 - C40) EH_ID_TOTAL_MS	µg/l	10	NONE	< 10	< 10
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TPH-CWG - Aliphatic >C5 - C6 HS_ID_AL	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aliphatic >C6 - C8 HS_ID_AL	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10 HS_ID_AL	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12 EH_ID_AL_MS	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16 EH_ID_AL_MS	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21 EH_ID_AL_MS	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35 EH_ID_AL_MS	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35) HS+EH_ID_AL_MS	µg/l	10	NONE	< 10	< 10

TPH-CWG - Aromatic >C5 - C7 HS_ID_AR	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8 HS_ID_AR	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10 HS_ID_AR	µg/l	1	ISO 17025	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12 EH_ID_AR_MS	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aromatic >C12 - C16 EH_ID_AR_MS	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aromatic >C16 - C21 EH_ID_AR_MS	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aromatic >C21 - C35 EH_ID_AR_MS	µg/l	10	NONE	< 10	< 10
TPH-CWG - Aromatic (C5 - C35) HS+EH_ID_AR_MS	µg/l	10	NONE	< 10	< 10

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number : 22-91380

Project / Site name: Heywood Road

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

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

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
2468711	TP310	None Supplied	1	Brown sandy clay with vegetation.
2468712	TP311	None Supplied	0.8	Brown sandy clay with gravel.
2468713	WS204	None Supplied	0.35	Brown loam and sand with vegetation and stones.
2468714	TP312	None Supplied	0.5	Brown sandy clay with gravel and vegetation.

Analytical Report Number : 22-91380

Project / Site name: Heywood Road

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L038-PL	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
BS EN 12457-1 (2:1) Leachate Prep	2:1 (as recieved, moisture adjusted) end over end extraction with water for 24 hours. Eluate filtered prior to analysis.	In-house method based on BSEN12457-1.	L043-PL	W	NONE
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Metals by ICP-OES in leachate	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Hexavalent chromium in leachate	Determination of hexavalent chromium in leachate by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	ISO 17025
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Monohydric phenols in leachate - LOW LEVEL 1 ug/l	Determination of phenols in leachate by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	MCERTS
Speciated EPA-16 PAHs in leachate	Determination of PAH compounds in leachate by extraction in dichloromethane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
pH at 20oC in leachate (automated)	Determination of pH in leachate by electrometric measurement.	In house method.	L099B	W	ISO 17025
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode.	In-house method	L010-PL	D	NONE
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE

Analytical Report Number : 22-91380
Project / Site name: Heywood Road

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds in soil by extraction in dichloromethane and hexane followed by GC-MS.	In-house method based on USEPA 8270	L064-PL	D	NONE
TPH1 (Leachates)	Determination of dichloromethane extractable hydrocarbons in leachate by GC-MS.	In-house method	L070-PL	W	NONE
TPHCWG (Leachates)	Determination of dichloromethane extractable hydrocarbons in leachate by GC-MS.	In-house method	L070-PL	W	ISO 17025
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	MCERTS
Total organic carbon (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	NONE
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	NONE
BTEX and MTBE in leachates (Monoaromatics)	Determination of BTEX and MTBE in leachates by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	ISO 17025
TPHCWG (Soil)	Determination of hexane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method with silica gel split/clean up.	L088/76-PL	W	NONE
TPH in (Soil)	Determination of TPH bands by HS-GC-MS/GC-FID	In-house method, TPH with carbon banding and silica gel split/cleanup.	L076-PL	D	NONE
Total cyanide in leachate - 1µg/l	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	ISO 17025
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
D.O. for Gravimetric Quant if Screen/ID positive	Dependent option for Gravimetric Quant if Screen/ID positive scheduled.	In house asbestos methods A001 & A006.	A006-PL	D	NONE
Sulphate, water soluble, in soil (1hr extraction)	Sulphate, water soluble, in soil (1hr extraction)	In-house method	L038-PL	D	MCERTS

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).

For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).

For method numbers ending in 'PL or B' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30°C.

Analytical Report Number : 22-91380
Project / Site name: Heywood Road

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector
GC	Gas Chromatography
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))
CU	Clean-up - e.g. by Florisil®, silica gel
1D	GC - Single coil/column gas chromatography
2D	GC-GC - Double coil/column gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics
AR	Aromatics
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
-	Operator - understore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total



4041



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Analytical Report Number : 22-93972

Project / Site name:	14-768 Heywood Road Castleton	Samples received on:	01/11/2022
Your job number:	14-768	Samples instructed on/ Analysis started on:	01/11/2022
Your order number:	003271	Analysis completed by:	08/11/2022
Report Issue Number:	1	Report issued on:	09/11/2022
Samples Analysed:	1 water sample		

Izabela Wójcik
Signed:

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

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

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

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

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

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



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Analytical Report Number: 22-93972

Project / Site name: 14-768 Heywood Road Castleton

Your Order No: 003271

Lab Sample Number	2484135			
Sample Reference	WS205			
Sample Number	None Supplied			
Depth (m)	None Supplied			
Date Sampled	31/10/2022			
Time Taken	None Supplied			
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status	

General Inorganics

pH	pH Units	N/A	ISO 17025	7.5
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	< 1.0
Dissolved Organic Carbon (DOC)	mg/l	0.1	ISO 17025	4.55

Total Phenols

Total Phenols (monohydric)	µg/l	1	ISO 17025	< 1.0
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Heavy Metals / Metalloids

Calcium (dissolved)	mg/l	0.012	ISO 17025	150
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0

Arsenic (dissolved)	µg/l	0.15	ISO 17025	0.66
Cadmium (dissolved)	µg/l	0.02	ISO 17025	0.05
Chromium (dissolved)	µg/l	0.2	ISO 17025	< 0.2
Copper (dissolved)	µg/l	0.5	ISO 17025	6.8
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2
Manganese (dissolved)	µg/l	0.05	ISO 17025	530
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	5.9
Selenium (dissolved)	µg/l	0.6	ISO 17025	1.1
Zinc (dissolved)	µg/l	0.5	ISO 17025	7.8

Monoaromatics & Oxygenates*

Benzene	µg/l	1	NONE	< 1.0
Toluene	µg/l	1	NONE	< 1.0
Ethylbenzene	µg/l	1	NONE	< 1.0
p & m-xylene	µg/l	1	NONE	< 1.0
o-xylene	µg/l	1	NONE	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	NONE	< 1.0

Petroleum Hydrocarbons

TPH1 (C10 - C40) EH_ID_TOTAL_MS	µg/l	10	ISO 17025	< 10
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TPH-CWG - Aliphatic >C5 - C6 HS_ID_AL	µg/l	1	NONE	< 1.0*
TPH-CWG - Aliphatic >C6 - C8 HS_ID_AL	µg/l	1	NONE	< 1.0*
TPH-CWG - Aliphatic >C8 - C10 HS_ID_AL	µg/l	1	NONE	< 1.0*
TPH-CWG - Aliphatic >C10 - C12 EH_ID_AL_MS	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic >C12 - C16 EH_ID_AL_MS	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic >C16 - C21 EH_ID_AL_MS	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic >C21 - C35 EH_ID_AL_MS	µg/l	10	NONE	< 10
TPH-CWG - Aliphatic (C5 - C35) HS+EH_ID_AL_MS	µg/l	10	NONE	< 10

TPH-CWG - Aromatic >C5 - C7 HS_ID_AR	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aromatic >C7 - C8 HS_ID_AR	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aromatic >C8 - C10 HS_ID_AR	µg/l	1	ISO 17025	< 1.0
TPH-CWG - Aromatic >C10 - C12 EH_ID_AR_MS	µg/l	10	NONE	< 10
TPH-CWG - Aromatic >C12 - C16 EH_ID_AR_MS	µg/l	10	NONE	< 10
TPH-CWG - Aromatic >C16 - C21 EH_ID_AR_MS	µg/l	10	NONE	< 10
TPH-CWG - Aromatic >C21 - C35 EH_ID_AR_MS	µg/l	10	NONE	< 10
TPH-CWG - Aromatic (C5 - C35) HS+EH_ID_AR_MS	µg/l	10	NONE	< 10



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Analytical Report Number: 22-93972

Project / Site name: 14-768 Heywood Road Castleton

Your Order No: 003271

Lab Sample Number				2484135
Sample Reference				WS205
Sample Number				None Supplied
Depth (m)				None Supplied
Date Sampled				31/10/2022
Time Taken				None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status	

VOCs*

Chloromethane	µg/l	1	NONE	< 1.0
Chloroethane	µg/l	1	NONE	< 1.0
Bromomethane	µg/l	1	NONE	< 1.0
Vinyl Chloride	µg/l	1	NONE	< 1.0
Trichlorofluoromethane	µg/l	1	NONE	< 1.0
1,1-Dichloroethene	µg/l	1	NONE	< 1.0
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/l	1	NONE	< 1.0
Cis-1,2-dichloroethene	µg/l	1	NONE	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	NONE	< 1.0
1,1-Dichloroethane	µg/l	1	NONE	< 1.0
2,2-Dichloropropane	µg/l	1	NONE	< 1.0
Trichloromethane	µg/l	1	NONE	< 1.0
1,1,1-Trichloroethane	µg/l	1	NONE	< 1.0
1,2-Dichloroethane	µg/l	1	NONE	< 1.0
1,1-Dichloropropene	µg/l	1	NONE	< 1.0
Trans-1,2-dichloroethene	µg/l	1	NONE	< 1.0
Benzene	µg/l	1	NONE	< 1.0
Tetrachloromethane	µg/l	1	NONE	< 1.0
1,2-Dichloropropane	µg/l	1	NONE	< 1.0
Trichloroethene	µg/l	1	NONE	< 1.0
Dibromomethane	µg/l	1	NONE	< 1.0
Bromodichloromethane	µg/l	1	NONE	< 1.0
Cis-1,3-dichloropropene	µg/l	1	NONE	< 1.0
Trans-1,3-dichloropropene	µg/l	1	NONE	< 1.0
Toluene	µg/l	1	NONE	< 1.0
1,1,2-Trichloroethane	µg/l	1	NONE	< 1.0
1,3-Dichloropropane	µg/l	1	NONE	< 1.0
Dibromochloromethane	µg/l	1	NONE	< 1.0
Tetrachloroethene	µg/l	1	NONE	< 1.0
1,2-Dibromoethane	µg/l	1	NONE	< 1.0
Chlorobenzene	µg/l	1	NONE	< 1.0
1,1,1,2-Tetrachloroethane	µg/l	1	NONE	< 1.0
Ethylbenzene	µg/l	1	NONE	< 1.0
p & m-Xylene	µg/l	1	NONE	< 1.0
Styrene	µg/l	1	NONE	< 1.0
Trichloromethane	µg/l	1	NONE	< 1.0
o-Xylene	µg/l	1	NONE	< 1.0
1,1,2,2-Tetrachloroethane	µg/l	1	NONE	< 1.0
Isopropylbenzene	µg/l	1	NONE	< 1.0
Bromobenzene	µg/l	1	NONE	< 1.0
n-Propylbenzene	µg/l	1	NONE	< 1.0
2-Chlorotoluene	µg/l	1	NONE	< 1.0
4-Chlorotoluene	µg/l	1	NONE	< 1.0
1,3,5-Trimethylbenzene	µg/l	1	NONE	< 1.0
tert-Butylbenzene	µg/l	1	NONE	< 1.0
1,2,4-Trimethylbenzene	µg/l	1	NONE	< 1.0
sec-Butylbenzene	µg/l	1	NONE	< 1.0
1,3-Dichlorobenzene	µg/l	1	NONE	< 1.0
p-Isopropyltoluene	µg/l	1	NONE	< 1.0
1,2-Dichlorobenzene	µg/l	1	NONE	< 1.0
1,4-Dichlorobenzene	µg/l	1	NONE	< 1.0



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Analytical Report Number: 22-93972

Project / Site name: 14-768 Heywood Road Castleton

Your Order No: 003271

Lab Sample Number				2484135
Sample Reference				WS205
Sample Number				None Supplied
Depth (m)				None Supplied
Date Sampled				31/10/2022
Time Taken				None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status	
Butylbenzene	µg/l	1	NONE	< 1.0
1,2-Dibromo-3-chloropropane	µg/l	1	NONE	< 1.0
1,2,4-Trichlorobenzene	µg/l	1	NONE	< 1.0
Hexachlorobutadiene	µg/l	1	NONE	< 1.0
1,2,3-Trichlorobenzene	µg/l	1	NONE	< 1.0

SVOCs

Aniline	µg/l	0.05	NONE	< 0.05
Phenol	µg/l	0.05	NONE	< 0.05
2-Chlorophenol	µg/l	0.05	NONE	< 0.05
Bis(2-chloroethyl)ether	µg/l	0.05	NONE	< 0.05
1,3-Dichlorobenzene	µg/l	0.05	NONE	< 0.05
1,2-Dichlorobenzene	µg/l	0.05	NONE	< 0.05
1,4-Dichlorobenzene	µg/l	0.05	NONE	< 0.05
Bis(2-chloroisopropyl)ether	µg/l	0.05	NONE	< 0.05
2-Methylphenol	µg/l	0.05	NONE	< 0.05
Hexachloroethane	µg/l	0.05	NONE	< 0.05
Nitrobenzene	µg/l	0.05	NONE	< 0.05
4-Methylphenol	µg/l	0.05	NONE	< 0.05
Isophorone	µg/l	0.05	NONE	< 0.05
2-Nitrophenol	µg/l	0.05	NONE	< 0.05
2,4-Dimethylphenol	µg/l	0.05	NONE	< 0.05
Bis(2-chloroethoxy)methane	µg/l	0.05	NONE	< 0.05
1,2,4-Trichlorobenzene	µg/l	0.05	NONE	< 0.05
Naphthalene	µg/l	0.01	ISO 17025	< 0.01
2,4-Dichlorophenol	µg/l	0.05	NONE	< 0.05
4-Chloroaniline	µg/l	0.05	NONE	< 0.05
Hexachlorobutadiene	µg/l	0.05	NONE	< 0.05
4-Chloro-3-methylphenol	µg/l	0.05	NONE	< 0.05
2,4,6-Trichlorophenol	µg/l	0.05	NONE	< 0.05
2,4,5-Trichlorophenol	µg/l	0.05	NONE	< 0.05
2-Methylnaphthalene	µg/l	0.05	NONE	< 0.05
2-Chloronaphthalene	µg/l	0.05	NONE	< 0.05
Dimethylphthalate	µg/l	0.05	NONE	< 0.05
2,6-Dinitrotoluene	µg/l	0.05	NONE	< 0.05
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01
2,4-Dinitrotoluene	µg/l	0.05	NONE	< 0.05
Dibenzofuran	µg/l	0.05	NONE	< 0.05
4-Chlorophenyl phenyl ether	µg/l	0.05	NONE	< 0.05
Diethyl phthalate	µg/l	0.05	NONE	< 0.05
4-Nitroaniline	µg/l	0.05	NONE	< 0.05
Fluorene	µg/l	0.01	ISO 17025	< 0.01
Azobenzene	µg/l	0.05	NONE	< 0.05
Bromophenyl phenyl ether	µg/l	0.05	NONE	< 0.05
Hexachlorobenzene	µg/l	0.05	NONE	< 0.05
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01
Carbazole	µg/l	0.05	NONE	< 0.05
Dibutyl phthalate	µg/l	0.05	NONE	< 0.05
Anthraquinone	µg/l	0.05	NONE	< 0.05
Fluoranthene	µg/l	0.01	ISO 17025	0.34
Pyrene	µg/l	0.01	ISO 17025	0.62



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Analytical Report Number: 22-93972

Project / Site name: 14-768 Heywood Road Castleton

Your Order No: 003271

Lab Sample Number				2484135
Sample Reference				WS205
Sample Number				None Supplied
Depth (m)				None Supplied
Date Sampled				31/10/2022
Time Taken				None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status	
Butyl benzyl phthalate	µg/l	0.05	NONE	< 0.05
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01
3&4-Methylphenol	µg/l	0.1	NONE	< 0.10

U/S = Unsuitable Sample I/S = Insufficient Sample

*The compound reported unaccredited due to failure of the drift standard in this batch

Analytical Report Number : 22-93972
Project / Site name: 14-768 Heywood Road Castleton

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited Matrices SW, GW, PW, PrW.(Al, Cu,Fe,Zn).	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil.	L039-PL	W	ISO 17025
Metals in water by ICP-MS (dissolved)	Determination of metals in water by acidification followed by ICP-MS. Accredited Matrices: SW, GW, PW except B=SW,GW, Hg=SW,PW, Al=SW,PW.	In-house method based on USEPA Method 6020 & 200.8 *for the determination of trace elements in water by ICP-MS.	L012-PL	W	ISO 17025
Hexavalent chromium in water	Determination of hexavalent chromium in water by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method by continuous flow analyser. Accredited Matrices SW, GW, PW.	L080-PL	W	ISO 17025
Monohydric phenols in water - LOW LEVEL 1 ug/l	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080-PL	W	ISO 17025
Semi-volatile organic compounds in water	Determination of semi-volatile organic compounds in leachate by extraction in dichloromethane followed by GC-MS.	In-house method based on USEPA 8270	L102B-PL	W	ISO 17025
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	ISO 17025
Volatile organic compounds in water	Determination of volatile organic compounds in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	NONE
Dissolved Organic Carbon in water	Determination of dissolved inorganic carbon in water by TOC/DOC NDIR Analyser.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L037-PL	W	ISO 17025
BTEX and MTBE in water (Monoaromatics)	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW GW	In-house method based on USEPA8260	L073B-PL	W	NONE
Low level total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080-PL	W	ISO 17025
pH at 20oC in water (automated)	Determination of pH in water by electrometric measurement. Accredited matrices: SW PW GW	In house method.	L099-PL	W	ISO 17025
TPH1 (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS.	In-house method	L070-PL	W	ISO 17025

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).

For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).

For method numbers ending in 'PL or B' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC
Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Information in Support of Analytical Results

List of HWOL Acronyms and Operators

Acronym	Descriptions
HS	Headspace Analysis
MS	Mass spectrometry
FID	Flame Ionisation Detector

Analytical Report Number : 22-93972

Project / Site name: 14-768 Heywood Road Castleton

Water matrix abbreviations:

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

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
GC	Gas Chromatography				
EH	Extractable Hydrocarbons (i.e. everything extracted by the solvent(s))				
CU	Clean-up - e.g. by Florisil®, silica gel				
1D	GC - Single coil/column gas chromatography				
2D	GC-GC - Double coil/column gas chromatography				
Total	Aliphatics & Aromatics				
AL	Aliphatics				
AR	Aromatics				
#1	EH_2D_Total but with humics mathematically subtracted				
#2	EH_2D_Total but with fatty acids mathematically subtracted				
-	Operator - understore to separate acronyms (exception for +)				
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total				

APPENDIX VII

ORIGIN OF TIER I GENERIC ASSESSMENT CRITERIA

CONSTITUENT	ORIGIN OF RISK ASSESSMENT VALUE
Arsenic	2014 LQM/CIEH S4ULs
Cadmium	2014 LQM/CIEH S4ULs
Chromium	2014 LQM/CIEH S4ULs
Lead	2014 LQM/CIEH S4ULs
Mercury	2014 LQM/CIEH S4ULs – methylmercury
Nickel	2014 LQM/CIEH S4ULs
Selenium	2014 LQM/CIEH S4ULs
Copper	2014 LQM/CIEH S4ULs
Zinc	2014 LQM/CIEH S4ULs
Cyanide – Total	2014 LQM/CIEH S4ULs
Phenols – Total	2014 LQM/CIEH S4ULs
Naphthalene	General assessment criteria (GAC) developed by CIEH/LQM Suitable 4 Use Levels with supporting data from SR3, SR7 and existing Tox report where applicable. 1% SOM.
Acenaphthylene	
Acenaphthene	
Fluorene	
Phenanthrene	
Anthracene	
Fluoranthene	
Pyrene	
Benzo(a)Anthracene	
Chrysene	
Benzo(b/k)Fluoranthene (iii)	
Benzo(a)Pyrene	
Indeno(123-cd)Pyrene	
Dibenzo(a,h)Anthracene	
Benzo(ghi)Perylene	
TPH C₅-C₆ (aliphatic)	
TPH C₆-C₈ (aliphatic)	
TPH C₈-C₁₀ (aliphatic)	
TPH C₁₀-C₁₂ (aliphatic)	
TPH C₁₂-C₁₆ (aromatic)	
TPH C₁₆-C₂₁ (aromatic)	
TPH C₂₁-C₃₅ (aromatic)	



