



e3p

Phase II Geoenvironmental Site Assessment
Proposed Industrial Development,
Pacific Park, Wrexham

Reference: 14-255-R2-1
Date: May 2021



PHASE II GEOENVIRONMENTAL SITE ASSESSMENT

Land to the South of Bridge Road North
Pacific Park
Wrexham
LL13 9PN

Prepared for:
Multimaq Limited

Report Ref: 14-255-R2-1
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Pacific Park, Wrexham

Phase II Geoenvironmental Site Assessment
May 2021

E3P

Taylor Road
Trafford Park
Urmston
M41 7JQ

+ 44 (0) 161 707 9612
<https://e3p.co.uk/>

Registered in England
CRN: 807255262

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CHECKED BY	R. Hodnett		
QUALIFICATIONS	BSc (Hons), FGS		
SIGNATURE			
AUTHORISED BY	D. Cox		
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EXECUTIVE SUMMARY

Site Address	Land south of Bridge Road North, Pacific Park, Wrexham, LL13 9PN	
Grid Reference	E338540 N349910	
Site Area	0.62 Hectares	
Proposed Development	E3P understands that the proposed development will comprise of two industrial units with associated access roads, external yard areas, parking, haulage turning circles and utility infrastructure.	
Current Site Use	The majority of the site is utilised as haulage parking for the UnimaQ building to the south west. The southern tip of the site is used as the staff carpark for UnimaQ. Across the site there are several rubble stockpiles, with overgrown vegetation, and there are various materials, such as steel girders, stored at the site. The site is bound an area of commercial / light industrial units and bound to the west by Bridge Road North, south west by Unimaq with mature trees forming the boundary to the north and east of the site with commercial beyond. Medium and intermediate pressure gas pipelines runs across the west of the site, orientated north to south. A gas enclosure is present along the western boundary of the site.	
Site History	Historical mapping suggests that the site was undeveloped agricultural land until the 1950's when the land was redeveloped as part of a wider industrial park. Circa 1961 the site had a series of railway lines bisecting the central and eastern areas. By the 1970's the railway lines were no longer present, and the land was left vacant. Circa 1989 the land was cleared and a pond appears to be present in the south-west of the site. Circa 2003 the pond was no longer present and the site is being used as a haulage storage yard for HGV trailers and remains in the same configuration until present day. A review of the plans and desk study provided by the EHO appear to show that the subject site was in the wider area of works associated with ROF Wrexham, but no historical buildings have been identified on the subject site which may be associated with the manufacture of explosives. However, the railway associated with ROF Wrexham is present on-site. Various works within the wider area are noted on historical plans which are likely to have been associated with ROF Wrexham.	
Environmental Setting	Drift Geology	Till (Devensian – CLAY) across the site.
	Bedrock Geology	Salop Formation – Mudstone, Sandstone and Conglomerate.
	Faults	No faults located on or in proximity to the site.
	Hydrogeology	Secondary Undifferentiated aquifer strata overlying a Secondary A Aquifer (Bedrock Geology).
	Hydrology	There is a small surface stream located 86m to the east of the site.
	Flood Risk	The site is located within Flood Risk Zone A and is considered to be at little or no risk of river flooding.



Utility Locations	Utilising online records and data sets the following services have been identified for the subject site: - Intermediate and high-pressure gas mains as well as a gas box are present within the adjacent road and along the north western boundary of the site. Furthermore, electricity infrastructure is present within the north western boundary of the site. - Drainage infrastructure is present in the south of the site linking the current building on the wider site to an on-site sewage system tank in the east of the site.
Landfill Sites and Ground Gases	The Envirocheck report indicates that no historic landfills are present within 250 m of the site. A current landfill entry is present 52 m south of the site, however the site is closed. There are a number of waste treatment sites within 250 m of the site. It was confirmed from the EHO that a former PCB landfill cell is adjacent to the southern corner of the site.
Radon	Unaffected – no special precautions required.
Coal Mining/Land Stability	The site is not located within an area deemed to be at risk from ground instability arising from historic coal mining activities.
Hazardous Installations	No hazardous installations that could potentially prejudice the proposed construction of highly sensitive residential dwellings have been identified within influencing distance of the subject site.
Initial Conceptual Site Model	Contaminant Sources - Heavy metals, petroleum hydrocarbons and PAHs (Made Ground); - Volatile Contaminants such as hydrocarbons, chlorinated solvents; - Asbestos Containing Materials in Made Ground; - Polychlorinated Biphenyl (PCB) associated with off-site PCB landfill cell - Methane and carbon dioxide associated with on-site infilled pond; - Mobile contaminants such as metals, PAHs, hydrocarbons, volatile compounds (Made Ground) - Sulphate (potential ash within Made Ground).



Initial Conceptual Site Model Cont.	Pathways ☼ Dermal contact. ☼ Dermal contact and ingestion. ☼ Inhalation of vapours. ☼ Migration through permeable strata and preferential pathways. ☼ Inhalation of dust. ☼ Inhalation of gas. ☼ Explosion in confined spaces. ☼ Sulphate attack on concrete. ☼ Lateral migration ☼ Perched waters migration ☼ Surface runoff. Receptors ☼ Future site users ☼ Off-site receptors. ☼ Buildings ☼ Off-site land users. ☼ Groundwater (Secondary A Aquifer). ☼ Building structure. ☼ Vegetation and Fauna
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GROUND INVESTIGATION

Ground Investigation Works	E3P has completed an intrusive ground investigation comprising: ☼ 11 x mechanically excavated trial pits, ☼ 6 x window sample boreholes, ☼ 2 x Cable percussive boreholes and ☼ Construction of environmental monitoring installations.
Ground Conditions	Made Ground – 0.00mbgl to 2.10mbgl Made Ground deposits were encountered within all exploratory hole locations to depths of between 0.21m and 2.10m bgl (TP106), however, generally Made Ground was encountered to a depth of less than 1.60m bgl. Made Ground



Ground Conditions Cont.	Within TP101 a layer of black reworked clay (0.09-0.20m bgl) was observed overlying a layer of limestone gravel. The trial pit was terminated due to the likely presence of underlying services. Made Ground deposits comprise a grey sandy gravel of concrete, limestone and asphalt overlying the majority of the site with the exception of TP103 where the location was overlain with a grey slightly silty, sandy gravel of limestone. Underlying the above strata varying Made Ground deposits were encountered including localised areas of a black sandy gravel of concrete and brick was encountered to depths of 0.61-0.70m bgl. Within a number of locations across the site a reddish brown sandy gravel was encountered with gravel of brick, metal wire and plastic with large boulders of concrete and sections of brick wall encountered at depths of between 0.14-1.21m bgl. Made Ground has also been noted to comprise a stiff blackish brown sandy gravelly clay was observed. Within centre and northern areas a brownish black sandy gravel with pockets of clay was encountered where the gravel consisted of ash, clinker and mudstone likely to be associated with the former railway tracks. DRIFT – 0.82mbgl to 26.00mbgl Drift deposits were encountered within the majority of exploratory location with the exception of TP101 where the full depth of Made Ground could not be proven due to potential underlying services. The drift deposits generally comprised a stiff to very stiff, high to very high strength brown slightly gravelly CLAY with gravel of sandstone and quartz. CLAY deposits were interbedded with a brown slightly clayey medium SAND within CP101 at a depth of 15.70-15.90m bgl and in CP102 at depths of between 21.20-21.40m bgl. SOLID – Not encountered Solid geology was not encountered during the ground investigation. A review of BGS borehole records in the vicinity of the site have not encountered the underlying bedrock geology, and it is assumed to be in excess of 30.00mbgl. GROUNDWATER – Groundwater strikes were encountered as strikes, seepages and perched water between 0.60m and 21.20mbgl. True groundwater is considered to be between 15.70m and 21.20mbgl within SAND bands within the CLAY drift deposits.
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CONTAMINATED LAND ASSESSMENT

Human Health	A Tier I human health risk assessment has been undertaken using the chemical analysis results of the soils and comparing to the relevant Tier I criteria for a commercial development. This assessment has identified the presence of elevated levels of asbestos, non-volatile PAHs, PCBs and detectable SVOC presence. All of the identified elevated concentrations have primary exposure pathways related to dermal contact and ingestion of soils, inhalation of particulate and inhalation of vapours. The risk to chronic human health associated with the elevated concentrations on non-volatile PAH compounds can be mitigated through the installation of a suitable cover system in all, landscaping and public open space to remove any potential for direct exposure to impacted soils or for the commercial premises covered by suitable hardstanding. Asbestos in the form of chrysotile and amosite has also been identified within localised areas in shallow Made Ground deposits. Asbestos quantification has been completed with concentrations between <0.001% and 0.002%. No visual signs of ACM were encountered during the ground investigation; it is therefore likely that only trace fibres are present. It is likely that trace fibres are present within all Made Ground deposits on site. Impacted soils should be managed according to the asbestos risk mitigation conceptual site model. Asbestos has been identified in WS101 and TP108 at a concentration of 0.002%. These areas should therefore be isolated and undergo a phase of delineation and hotspot removal with placement within an area of low sensitivity in line with the asbestos risk mitigation conceptual site model. PCBs have been identified within Made Ground and CLAY drift deposits within WS101 and are considered to be elevated. As such a phase of hotspot removal should be undertaken with the area delineated and impacted materials removed, and the resulting area validated. Assessment will then be required as to whether the materials can remain on site in an area of low sensitivity or will require removal from site. It is recommended a watching brief is completed during works in this area as part of the enabling works. Concentrations of SVOCs above the laboratory limit if detection have been identified however given the properties of the SVOCs identified they are unlikely to cause a vapour risk at the site.
Controlled Waters	Elevated concentrations of chromium (VI), zinc, pH, naphthalene and TPH Aromatic C12-C16 have been identified within leachate analysis. Within the groundwater analysis elevated levels of selenium and zinc were identified. The underlying Made Ground is considered to be the source of potential elevated determinants. The site is underlain by cohesive CLAY drift deposits which are of low permeability and will limit lateral and vertical migration of any possible contaminants. The site is not located within influencing distance of any surface water features. Furthermore, the closest abstraction point is located 686m south of the site and utilised for process water. Given the distance from site and presence of low permeability CLAY deposits the risk is considered to be low.
Ground Gas	Characteristic Situation 1 (pending completion of gas monitoring).



Potable Water Infrastructure	This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different from those identified during this site investigation, however an allowance for barrier pipe should be considered.
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GEOTECHNICAL ASSESSMENT

Underground Obstructions	A number of concrete and brick obstructions have been encountered within the Made Ground indicative of fill material used to raise levels for the subject site. These were encountered as large boulders of brick and concrete and will require removal during site enabling works in order to prepare the development platform.
Allowable Bearing Pressure	The underlying natural clay drift deposits have been assessed as being stiff to very stiff, medium strength to very high strength with a net ABP in the order of 103-112 kN/m ² at circa 1.00-2.45 m bgl increasing to 186-447 kN/m ² at circa 2.00-26.00 m bgl. Very stiff high to very high strength CLAYs were generally first encountered at circa 2.00-4.00mbgl.
Foundation Options	Upon completion of enabling works, the Made Ground is likely to be present at varying depths and as such it is likely that the most cost-effective option for the site would comprise either pad foundations bearing at least 500mm below the stiff to very stiff medium to very high strength cohesive soils at circa 2.00mbgl. or to re-engineer the Made Ground using vibro-stone columns (VSCs) to support a pad foundation at a shallower depth subject to the required loadings. During development, consideration of completing VSC in close proximity to sensitive infrastructure (electricity, gas mains, on-site sewage system) must be taken. Furthermore, consideration of the structural loadings that will induce a bulb of pressure should be taken into account. In the event structural loadings require increased safe ABP, it will be necessary to transfer structural loading to the deeper CLAY drift deposits by a pile foundation. Sporadic trees surround the site periphery and as such their influence will need to be modelled to assess the requirement to deepen foundations (below current elevations) to mitigate the potential for volumetric instability attributed to fluctuations in moisture content in accordance with the requirements of LABC standards.
Building Floor Slabs	A ground-bearing slab will be viable, but it will need to be constructed on a granular sub-base with the thickness designed by a structural engineer to ensure that settlement tolerances are taken into consideration and that sufficient surface clays have been removed from tree influence areas to mitigate any seasonal volume changes in the clay influence zones. Proposed levels and the requirement for ground treatment should be considered at the detailed design stage.
Heave Precautions	Given that the underlying clay is of medium volume change potential, heave precautions will be required to the internal face of a foundation and to the underside of floor slabs (where there is no 250 mm void) or ground beams within the modelled influencing distance of trees.



Soakaway Drainage	The site is predominantly underlain by in excess of 5.00 m of likely low-permeability gravelly CLAY. Falling head permeability tests have been completed, and a poor soakaway potential was calculated. As such, it is not recommended that soakaways are utilised for disposal of surface water runoff.
Sulphate Assessment	Concrete classification will be DS1 AC1s.
Cut/Fill	Development levels unknown at this time; however, minimal cut-and-fill works are anticipated in order to prepare the development platform.
Waste Characterisation	Any material that is to be disposed off-site should undergo assessment using Technical Guidance WM3: <i>Waste Classification – Guidance on the classification and assessment of waste</i> .

RECOMMENDATIONS

Based on the findings of the geoenvironmental site assessment, the following additional works are recommended to be completed in due course:

- ✿ Further investigation of inaccessible areas in the vicinity of the former pond.
- ✿ Arboricultural survey.
- ✿ Geotechnical earthworks strategy (infrastructure).
- ✿ Remediation and enabling works strategy.
- ✿ Construction phase Surface Water Management Plan.



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DRAWING LIST

14-255-001 – Site Location Plan
14-255-002 – Proposed Development Plan
14-255-003 – Historical Features Plan
14-255-004 – Site Features Plan
14-255-005 – Exploratory Hole Location Plan
14-255-006 – Depth of Made Ground Plan
14-255-008 – Depth to Founding Strata Plan
14-255-010 – Conceptual Site Model
14-255-015 – Development Constraints Plan
14-255-018 – Contamination Issues Plan – Soils
14-255-019 – Contamination Issues Plan - Waters



1. INTRODUCTION

1.1. BACKGROUND

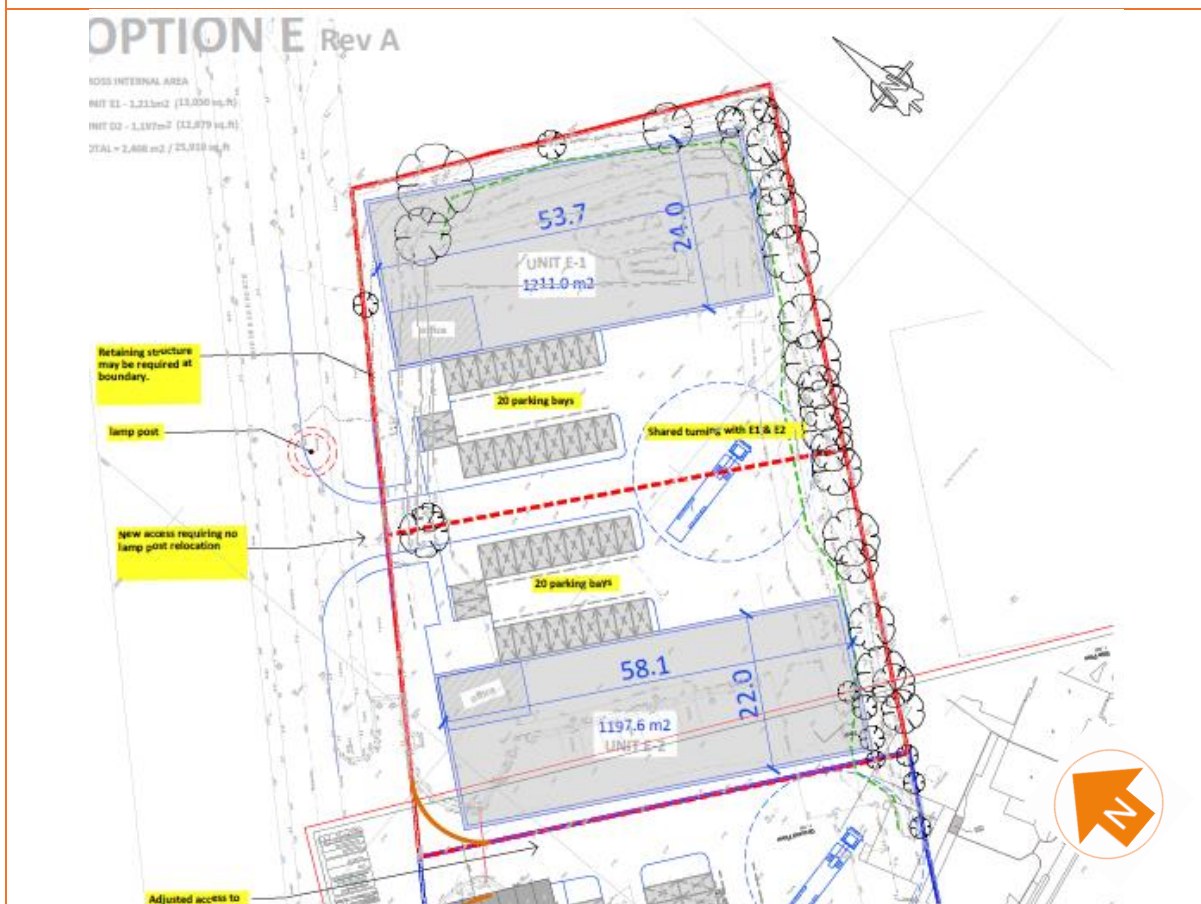
E3P Ltd has been commissioned by Multimaq Ltd (the client) to undertake a Phase II Geoenvironmental Site Assessment for a parcel of land to the south of Bridge Road North, Wrexham; herein referred to as the site.

This report is required to determine potential contaminated land and geotechnical liabilities associated with a proposed future commercial development.

1.2. PROPOSED DEVELOPMENT

E3P understands that the proposed development will comprise of two industrial units with associated adopted estate roads and utility infrastructure. A snapshot of the proposed development layout is indicated in Figure 1.1.

FIGURE 1.1 SNAPSHOT OF PROPOSED DEVELOPMENT



1.3. OBJECTIVES

The objectives of the geoenvironmental assessment are as follows:

- ✦ Review historical plans, geology, hydrogeology, site sensitivity, floodplain issues, mining records and any local authority information available in order to complete a desk study in line with Environment Agency (EA) document *Land Contamination: Risk Management (LCRM) (2019)*.
- ✦ Undertake a preliminary stage of sampling and analysis to provide an overview of environmental issues identified.
- ✦ Assess the implications of any potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the site and in relation to off-site receptors.
- ✦ Assess the geotechnical information and provide preliminary recommendations in relation to foundations, pavement construction and floor slabs.
- ✦ Provide recommendations regarding future works required.

1.4. SCOPE OF WORKS

The scope of work includes the following elements:

- ✦ Design of suitable intrusive ground investigation;
- ✦ Window sample probeholes with, and construction of, environmental monitoring installations;
- ✦ Deep cable percussive boreholes with groundwater monitoring installations;
- ✦ Mechanically excavated trial pits;
- ✦ In-situ geotechnical testing;
- ✦ Chemical and geotechnical laboratory analysis;
- ✦ Groundwater monitoring and sampling;
- ✦ Ground gas monitoring;
- ✦ Contamination risk assessment and conceptual site model;
- ✦ Geotechnical assessment and interpretation; and
- ✦ Factual and interpretive reporting.

1.5. LIMITATIONS

The limitations of this report are presented in Appendix I.



1.6. CONFIDENTIALITY

E3P has prepared this report solely for the use of the client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from E3P; a charge may be levied against such approval.



2. GROUND INVESTIGATION

2.1. GENERAL OVERVIEW

A ground investigation has been designed based on the findings of the desk study, with exploratory holes advanced to target specific potential contaminant sources.

The investigation has also been used to collect geotechnical information to assist in the design and construction of the proposed development.

Exploratory fieldwork was completed between 10th February 2021 and 19th February 2021. The works are summarised in Table 2.1.

2.2. LIMITATIONS OF THE INVESTIGATION

The following limitations were encountered during the ground investigation:

- ✿ Intermediate and high-pressure gas mains as well as a gas box are present within the adjacent road and along the north western boundary of the site, requiring a 15m easement on works. Furthermore, electricity infrastructure is present along the north western boundary of the site which impeded exploratory work in this area in which the former pond is located.
- ✿ Drainage infrastructure is present in the south of the site linking the current building on the wider site to an on-site sewage system tank in the east of the site.
- ✿ Works could not be completed on the area of concrete hardstanding in the south of the site as it is currently utilised by the operational building in the wider site, south of the proposed development, for car parking.



2.3. SCOPE OF INVESTIGATION

TABLE 2.1 SUMMARY OF FIELDWORK

POTENTIAL SOURCE/RATIONALE	LOCATION HOLE	TYPE	MAXIMUM DEPTH (m bgl)	MONITORING WELLS RESPONSE ZONE (m bgl)
General ground conditions including the presence/nature of obstructions in the northern sector of the site.	TP102-TP104, TP110	Mechanically Excavated Trial Pit	2.40	N/A
	WS102	Window Sample Probehole	3.45	N/A
	WS105		4.45	1.00-4.00
	WS106		3.45	0.50-1.00
General ground conditions including the presence/nature of obstructions in the southern sector of the site.	TP106, TP108-TP109	Mechanically Excavated Trial Pit	3.00	N/A
	WS104	Window Sample Probehole	4.45	N/A
Investigation of ground conditions and potential presence of PCBs from off-site PCB cell	WS101	Window Sample Probehole	3.45	1.00-3.00
Investigation of ground conditions in the vicinity of former railway tracks	WS103	Window Sample Probehole	3.45	0.50-1.20
	TP105, TP107, TP111	Mechanically Excavated Trial Pit	2.40	N/A
Investigation of ground conditions in the vicinity of the historically infilled pond	TP101	Trial Pit	0.21	N/A
Investigation of deep ground conditions to identify suitable founding strata	CP101	Cable Percussive borehole	20.00	15.00-16.00
	CP102	Cable Percussive borehole	26.00	21.00-22.00

Mechanically excavated trial pits were advanced to investigate ground conditions and to retrieve environmental samples, spatially distributed to offer the maximum site coverage whilst also being advanced to target specific contaminant sources.

Window sample probeholes were advanced to undertake in-situ detailed geotechnical testing, obtain environmental samples and install groundwater and ground gas monitoring wells.

Cable percussive boreholes were advanced to investigate deep ground conditions and undertake in-situ detailed geotechnical testing.

The sampling locations are illustrated in Drawing 14-255-005 (Appendix III). The ground conditions encountered are indicated on the logs, which are provided in Appendix V.



Return visits were made to monitor installations for groundwater level and gas concentrations. In addition, selected wells were purged and samples of groundwater recovered for chemical analysis.

2.4. IN-SITU STANDARD PENETRATION TESTING (SPT)

In-situ geotechnical testing was conducted using the standard penetration test (SPT) and, where the ground is granular, a 60° cone (SPT(C)) was used instead of the sampling tube. The results are shown in the probehole logs in Appendix V and presented in Table 3.6 and discussed in Section 5.

2.5. PERMEABILITY TESTS

Two falling head permeability tests were undertaken within environmental monitoring wells (WS101, WS105) in order to assess the likely permeability of the underlying strata to determine the potential suitability for soakaway drainage within the proposed development. The results are presented in Table 3.9 and the test certificates are included within Appendix IX.

2.6. 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 and quantification.
-  Speciated and banded total petroleum hydrocarbon (TPH).
-  Polychlorinated biphenyls (PCBs).

I2 Analytical undertook the analytical work and the testing results are included in Appendix VI and discussed in Section 4.



Selected samples were submitted to PSL Laboratory where the following geotechnical tests were undertaken:

-  Atterberg limits determinations;
-  Particle Size Distribution (PSD),
-  One dimensional consolidation test; and;
-  Single-stage triaxial tests.

Laboratory analysis sheets are included in Appendix VIII and are summarised in Section 3.



3. GROUND AND GROUNDWATER CONDITIONS

3.1. SUMMARY OF GROUND CONDITIONS

The ground investigation generally confirms the published geology and identifies the strata set out in Table 3.1.

TABLE 3.1 SUMMARY OF STRATA

HOLE	DEPTH TO STRATUM (m bgl)		
	MADE GROUND	CLAY	SAND
TP101	0.00–0.21	–	–
TP102	0.00–1.42	1.42–2.10	–
TP103	0.00–1.38	1.38–2.00	–
TP104	0.00–1.88	1.88–2.40	–
TP105	0.00–1.40	1.40–2.40	–
TP106	0.00–2.10	2.10–3.00	–
TP107	0.00–1.40	1.40–2.40	–
TP108	0.00–1.35	1.35–2.20	–
TP109	0.00–1.23	1.23–1.90	–
TP110	0.00–1.40	1.40–2.30	–
TP111	0.00–1.30	1.30–2.00	–
WS101	0.00–0.82	0.82–3.45	–
WS102	0.00–1.30	1.30–3.45	–
WS103	0.00–1.32	1.32–3.45	–
WS104	0.00–1.51	1.51–4.45	–
WS105	0.00–1.00	1.00–4.45	–
WS106	0.00–1.00	1.00–3.45	–
CP101	0.00–1.60	1.60–15.70 15.90–20.00	15.70–15.90
CP102	0.00–1.30	1.30–21.20 21.40–26.00	21.20–21.40

3.2. MADE GROUND

Made Ground deposits were encountered within all exploratory hole locations to depths of between 0.21m and 2.10m bgl (TP106), however, generally Made Ground was encountered to a depth of less than 1.60m bgl. Made Ground

Within TP101 a layer of black reworked clay (0.09–0.20m bgl) was observed overlying a layer of limestone gravel. The trial pit was terminated due to the likely presence of underlying services.

Made Ground deposits comprise a grey sandy gravel of concrete, limestone and asphalt overlying the majority of the site with the exception of TP103 where the location was overlain with a grey slightly silty, sandy gravel of limestone (MOT).



Underlying the above strata varying Made Ground deposits were encountered. Within WS101 a black sandy gravel of concrete and brick was encountered to depths of 0.61-0.70m bgl.

In locations (WS104, WS105, TP102, TP103, TP106, TP107, TP109, CP101) a reddish brown sandy gravel with gravel of brick, metal wire and plastic with large boulders of concrete and sections of brick wall encountered at depths of between 0.14-1.21m bgl.

In locations TP106 and TP108 a stiff blackish brown gravelly clay was observed overlying the reddish brown gravel at depth of between 0.60-1.00 mbgl and 0.50-1.20mbgl respectively.

In locations (WS102, WS103, TP104) a brownish black sandy gravel with pockets of clay were encountered where the gravel consisted of ash, clinker and mudstone at depths of between 0.33-1.88m bgl. In the case of TP104 a clay layer was observed overlying this layer. This strata is likely to be associated with the former railway tracks.

A layer of firm brownish black sandy gravelly clay was observed in (WS101, WS104, TP102, TP103, TP107, TP108, TP109 and CP101) at depths of between 0.48-1.60m bgl. This was observed as a layer of reworked natural stratum.

Within TP102 a layer of asphalt (0.04-0.07m bgl) was observed to be overlying a layer of concrete (0.07-0.19m bgl) which was underlain with a layer of reddish brown sandy gravel (0.19-0.72m bgl), which was in turn underlain with a layer of reworked clay (0.72-1.42m bgl).

A Depth of Made Ground Plan is presented as Drawing 14-255-006 in Appendix III.

3.3. DRIFT DEPOSITS

Drift deposits were encountered within the majority of exploratory location with the exception of TP101 where the full depth of Made Ground could not be proven due to potential underlying services.

The drift deposits generally comprised a stiff to very stiff, high to very high strength brown slightly gravelly CLAY with gravel of sandstone and quartz.

CLAY deposits were interbedded with a brown slightly clayey medium SAND within CP101 at a depth of 15.70-15.90m bgl and in CP102 at depths of between 21.20-21.40m bgl.

3.4. SOLID GEOLOGY

Solid geology was not encountered during the ground investigation. A review of BGS borehole records in the vicinity of the site have not encountered the underlying bedrock geology, and it is assumed to be in excess of 30.00mbgl.

3.5. GROUNDWATER

Groundwater strikes were encountered as perched water and seepages. The depth of the seepages are shown on the exploratory hole records in Appendix V and are summarised in Table 3.2.

TABLE 3.2 SUMMARY GROUNDWATER STRIKES

LOCATION	DEPTH TO STRIKE (m)	NOTES
TP104	1.88	Perched water between Made Ground and Natural Clay
TP111	0.60	Strike – Former land drain



LOCATION	DEPTH TO STRIKE (m)	NOTES
WS101	1.00	Perched water between Made Ground and Natural Clay
WS106	1.30	Seepage
CP101	15.70	Deep groundwater present within interbedded sand layer
CP102	21.20	Deep groundwater present within interbedded sand layer

Monitoring was undertaken using an electronic dip meter and interface probe to record the depth to groundwater. These results are summarised in Table 4.8.

3.6. VISUAL AND OLFACTORY EVIDENCE OF CONTAMINATION

Visual and olfactory evidence of potential contamination has been identified during the site investigation and these are summarised in Table 3.3.

TABLE 3.3 SUMMARY VISUAL AND OLFACTORY EVIDENCE OF CONTAMINATION

LOCATION	DEPTH (m)	STRATUM	NOTES
WS106	0.34-1.00m	Made Ground	Hydrocarbon odour

3.7. SOIL CONSISTENCY

Undrained shear strength values were measured using both field hand shear vane tests and laboratory undrained triaxial tests. Results of the tests are presented in Table 3.4 and Table 3.5, which indicate the clay soils to vary between stiff and very stiff. Strength test data is generally consistent with the field descriptions of the aforementioned soils.

TABLE 3.4 SUMMARY OF HAND SHEAR VANE TESTS

LOCATION	DEPTH	SHEAR STRENGTH (kPA)	CALCULATED ALLOWABLE BEARING PRESSURE (kN/m ²)
TP102	1.50	127	298
TP102	2.00	153	359
TP103	1.40	122	287
TP103	1.90	139	326
TP104	1.90	117	274
TP105	1.40	113	265
TP105	2.00	112	263
TP106	2.30	186	438
TP107	1.50	167	393
TP107	2.30	169	396
TP108	1.40	144	338



LOCATION	DEPTH	SHEAR STRENGTH (kPA)	CALCULATED ALLOWABLE BEARING PRESSURE (kN/m ²)
TP108	2.00	153	360
TP109	1.40	161	379
TP109	1.80	167	393
TP110	1.50	169	398
TP110	2.00	195	459
TP111	1.40	175	411
TP111	1.90	190	447

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 3.6.

TABLE 3.5 SUMMARY OF UNDRAINED SHEAR STRENGTH TEST RESULTS

LOCATION	SAMPLE DEPTH (m)	LAB DESCRIPTION	UNDRAINED SHEAR STRENGTH (kN/m ²)	CONSISTENCY
WS101	1.50-2.00	Very stiff brown slightly gravelly sandy CLAY.	201	Very Stiff
WS106	2.00-2.50	Very stiff brown slightly gravelly slightly sandy CLAY.	218	Very Stiff
CP101	3.00-3.45	Stiff brown mottled grey slightly gravelly slightly sandy CLAY.	110	Stiff
CP101	12.50-12.95	Firm brown slightly sandy CLAY.	55	Firm
CP102	6.50-6.95	Firm brown CLAY.	62	Firm
CP102	21.50-21.95	Stiff brown slightly gravelly slightly sandy CLAY.	80	Stiff

3.8. 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 boulders within the Made Ground deposits meant that in certain places, excavation was slow through the Made Ground and in TP101 Made Ground could not be fully penetrated due to the possible presence of underlying services. The natural strata was excavated with relative ease.



TABLE 3.6 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)*
WS101	1	CLAY	10	10.08	N/A	Medium strength	Stiff	50.41	103.64
WS101	2	CLAY	33	30.15	N/A	Very high strength	Very Stiff	150.73	309.91
WS101	3	CLAY	50	43.48	N/A	Very high strength	Very Stiff	217.41	447.00
WS102	1	Made Ground: Sand.	11	11.09	Medium Dense	N/A	N/A	N/A	110.9
WS102	2	CLAY	26	23.75	N/A	High strength	Very Stiff	118.76	244.17
WS102	3	CLAY	50	43.48	N/A	Very high strength	Very Stiff	217.41	447.00
WS103	1	Made Ground: Clay	14	14.11	N/A	Medium strength	Stiff	70.57	145.09
WS103	2	CLAY	21	19.18	N/A	High strength	Very Stiff	95.92	197.21
WS103	3	CLAY	50	43.48	N/A	Very high strength	Very Stiff	217.41	447.00
WS104	1	Made Ground: Clay	10	10.08	N/A	Medium strength	Stiff	50.41	103.64
WS104	2	CLAY	25	22.84	N/A	High strength	Very Stiff	114.19	234.78
WS104	3	CLAY	45	39.13	N/A	Very high strength	Very Stiff	195.67	402.30



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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)*
WS104	4	CLAY	50	42.24	N/A	Very high strength	Very Stiff	211.21	434.25
WS105	1	CLAY	18	18.15	N/A	High strength	Very Stiff	90.73	186.55
WS105	2	CLAY	12	10.96	N/A	Medium strength	Stiff	54.81	112.69
WS105	3	CLAY	27	23.48	N/A	High strength	Very Stiff	117.40	241.38
WS105	4	CLAY	50	42.24	N/A	Very high strength	Very Stiff	211.21	434.25
WS106	1	CLAY	10	10.08	N/A	Medium strength	Stiff	50.41	103.64
WS106	2	CLAY	18	16.44	N/A	High strength	Very Stiff	82.22	169.04
WS106	3	CLAY	50	43.48	N/A	Very high strength	Very Stiff	217.41	447.00
CP101	1	Made Ground: Clay	9	9.07	N/A	Medium strength	Stiff	45.37	93.27
CP101	2	CLAY	24	21.92	N/A	High strength	Very Stiff	109.62	225.39
CP101	4	CLAY	38	32.10	N/A	Very high strength	Very Stiff	160.52	330.03
CP101	5	CLAY	42	34.84	N/A	Very high strength	Very Stiff	174.22	358.20



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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)*
CP101	6.5	CLAY	45	36.74	N/A	Very high strength	Very Stiff	183.69	377.66
CP101	8	CLAY	38	30.76	N/A	Very high strength	Very Stiff	153.80	316.21
CP101	9.5	CLAY	49	39.49	N/A	Very high strength	Very Stiff	197.45	405.97
CP101	11	CLAY	41	31.71	N/A	Very high strength	Very Stiff	158.54	325.96
CP101	14	CLAY	36	24.94	N/A	High strength	Very Stiff	124.69	256.36
CP101	16.5	CLAY	40	25.51	N/A	High strength	Very Stiff	127.55	262.25
CP101	18	CLAY	43	26.17	N/A	High strength	Very Stiff	130.86	269.06
CP101	19.5	CLAY	40	23.28	N/A	High strength	Very Stiff	116.38	239.28
CP102	3	CLAY	46	40.00	N/A	Very high strength	Very Stiff	200.02	411.24
CP102	4	CLAY	50	42.24	N/A	Very high strength	Very Stiff	211.21	434.25
CP102	5	CLAY	50	41.48	N/A	Very high strength	Very Stiff	207.41	426.43
CP102	8	CLAY	36	29.14	N/A	High strength	Very Stiff	145.70	299.57
CP102	9.5	CLAY	36	29.01	N/A	High strength	Very Stiff	145.07	298.26



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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)*
CP102	11	CLAY	46	35.57	N/A	Very high strength	Very Stiff	177.87	365.71
CP102	14	CLAY	36	24.94	N/A	High strength	Very Stiff	124.69	256.36
CP102	15.5	CLAY	37	24.37	N/A	High strength	Very Stiff	121.86	250.53
CP102	17	CLAY	36	22.60	N/A	High strength	Very Stiff	113.00	232.33
CP102	18.5	CLAY	35	20.98	N/A	High strength	Very Stiff	104.91	215.70
CP102	20	CLAY	40	22.94	N/A	High strength	Very Stiff	114.69	235.80
CP102	23	CLAY	45	23.70	N/A	High strength	Very Stiff	118.51	243.65
CP102	24.5	CLAY	50	25.28	N/A	High strength	Very Stiff	126.39	259.87
CP102	26	CLAY	50	24.29	N/A	High strength	Very Stiff	121.43	249.65

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.



3.9. CONSOLIDATION

Two undisturbed samples of Glacial Till were submitted for oedometer analysis. The results are provided in Table 3.7.

TABLE 3.7 OEDOMETER CONSOLIDATION RESULTS

LOCATION	DEPTH (m)	SAMPLE TYPE	MOISTURE CONTENT (%)	OEDOMETER CONSOLIDATION		
				PRESSURE RANGE (kPa)	M _v (m ² /MN)	C _v (m ² /year)
WS101	1.50-2.00	U100	20	0-35	0.295	29.857
				35-70	0.141	4.597
				70-140	0.157	2.228
				140-280	0.103	1.461
				280-35	0.074	2.843
WS106	2.00-2.50	U100	20	0-45	0.527	38.983
				45-90	0.525	16.171
				90-180	0.163	6.151
				180-360	0.098	3.537
				360-45	0.058	1.725

3.10. PARTICLE SIZE DISTRIBUTION

Particle Size Distribution Tests have been undertaken on selected samples of granular material via wet sieve to obtain information on the soil fractions. The results are included in Table 3.8. The full results are presented in Appendix VIII.

TABLE 3.8 SUMMARY OF PARTICLE SIZE DISTRIBUTION TEST RESULTS

LOCATION	DEPTH (m)	SOIL FRACTION (%)			
		COBBLES	GRAVEL	SAND	SILT/CLAY
TP103	0.30 (Made Ground)	0	76	16	8
TP104	0.80 (Natural)	0	2	62	36

3.11. SOIL INFILTRATION

In-situ variable (falling) head permeability tests were undertaken within the monitoring well installations located in two probeholes (WS101 and WS105). Both tests were undertaken within monitoring wells with response zones located in the natural clay drift stratum.

The results are presented in Table 3.9 and the test certificates are included within Appendix IX.



TABLE 3.9 SOIL INFILTRATION RESULTS

LOCATION	DEPTH (m)	MATERIAL	TEST No.	SOIL INFILTRATION RATE (m/s)
WS101	1.00–3.00	Slightly gravelly CLAY	1	5.23E-07
WS105	1.00–4.00	Slightly gravelly CLAY	1	2.58E-07

Soil infiltration was taken over the wetted area from between 75% and 25% of the effective depth. All tests showed clay drift deposits to have a poor soakage potential.

Therefore considering the significant volumes of impermeable CLAY drift deposits on site, it is considered that soakaway drainage will not be suitable for the proposed development.

3.12. SOIL PLASTICITY

The Atterberg limits determinations, summarised in Table 3.10, show the CLAY to be of moderate plasticity.

TABLE 3.10 SUMMARY OF PLASTICITY INDEX TEST RESULTS

LOCATION	DEPTH (m)	NATURAL MOISTURE CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	PASSING 425 µm SIEVE (%)	MODIFIED PLASTICITY INDEX	NHBC VOLUME CHANGE POTENTIAL
WS101	2.00	19	23	48	25	95	23.75	Medium
WS103	2.00	19	22	45	23	97	22.31	Medium
WS106	1.00	22	23	47	24	97	23.28	Medium

The results of the Atterberg limits testing confirmed that the soils would be deemed to be “Medium Volume Change Potential” in accordance with the classification system utilised by the LABC/NHBC industry guidance.

3.13. pH AND SULPHATE

Chemical analyses for pH and soluble sulphate content contained in Appendix VI (summarised in Table 3.11), shows that the soils at the site meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE *Special Digest 1* (2005).

TABLE 3.11 SUMMARY OF pH AND SULPHATE DATA

LOCATION	DEPTH (m)	SO ₄ IN 2:1 WATER/SOIL (g/l)	pH VALUE	CLASSIFICATION
WS101	0.65	0.056	9.1	DS-1, AC-1s
WS101	1.00	0.04	8.3	DS-1, AC-1s
WS102	0.70	0.072	8.1	DS-1, AC-1s



LOCATION	DEPTH (m)	SO ₄ IN 2:1 WATER/SOIL (g/l)	pH VALUE	CLASSIFICATION
WS103	1.00	0.047	8.5	DS-1, AC-1s
WS105	0.15	0.075	10.1	DS-1, AC-1s
WS106	0.30	0.04	8.8	DS-1, AC-1s
WS106	0.50	0.12	8.3	DS-1, AC-1s
WS106	1.20	0.11	8.2	DS-1, AC-1s
TP101	0.17	0.012	8.3	DS-1, AC-1s
TP104	1.38	0.16	7.8	DS-1, AC-1s
TP104	1.90	0.02	8	DS-1, AC-1s
TP105	1.00	0.016	8.2	DS-1, AC-1s
TP110	0.60	0.17	7.5	DS-1, AC-1s



4. 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 and groundwater pose an unacceptable level of risk to the identified receptors.

4.1. DEVIATING SAMPLES

Deviating samples were to be avoided during the ground investigation by using best practice sampling procedures including use of appropriate sampling containers and adhering to the laboratory holding times for each contaminant analysis undertaken. The following is noted regarding sample deviations:

4.2. 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 reference values published in LQM/CIEH S4UL (S4UL3267).

The results of this comparison have been summarised within Table 4.1.



TABLE 4.1 SUMMARY OF INORGANIC AND HYDROCARBON TOXICITY ASSESSMENT FOR A COMMERCIAL END USE

DETERMINAND	UNIT S	GAC	N	MC	LOC. OF EX	PAT H-WAY	ASSESSMENT
Arsenic	mg/kg	640	20	35	N/A	1	No Further Action
Cadmium	mg/kg	190	20	1.1	N/A	1	No Further Action
Chromium (VI)	mg/kg	33	20	<4.0	N/A	1	No Further Action
Lead	mg/kg	1100	20	240	N/A	1	No Further Action
Mercury	mg/kg	58	20	4.4	N/A	2	No Further Action
Nickel	mg/kg	980	20	61	N/A	1	No Further Action
Selenium	mg/kg	12000	20	<1.0	N/A	1	No Further Action
Copper	mg/kg	68000	20	82	N/A	1	No Further Action
Zinc	mg/kg	730000	20	320	N/A	1	No Further Action
Cyanide - Total	mg/kg	791	20	<1.0	N/A	1	No Further Action
Phenols - Total.	mg/kg	210	13	10	N/A	1	No Further Action
Asbestos	Fibres	NFD	16	0.002% <0.001% <0.001% <0.001% 0.002%	WS101 (0.65m) WS101 (0.72m) WS104 (0.60m) TP102 (0.06m) TP110 (0.60m) TP108 (0.40m)	3	Further Action
Naphthalene	mg/kg	190	19	29	N/A	3	No Further Action
Acenaphthylene	mg/kg	83000	19	1.8	N/A	2	No Further Action
Acenaphthene	mg/kg	84000	19	67	N/A	1	No Further Action
Fluorene	mg/kg	63000	19	63	N/A	1	No Further Action
Phenanthrene	mg/kg	22000	19	250	N/A	2	No Further Action
Anthracene	mg/kg	520000	19	84	N/A	2	No Further Action
Fluoranthene	mg/kg	23000	19	260	N/A	2	No Further Action
Pyrene	mg/kg	54000	19	210	N/A	2	No Further Action
Benzo(a)Anthracene	mg/kg	170	19	110	N/A	2	No Further Action
Chrysene	mg/kg	350	19	87	N/A	2	No Further Action
Benzo(b)Fluoranthene	mg/kg	44	19	110	WS106 (0.50m)	2	Further Action
Benzo(k)Fluoranthene	mg/kg	1200	19	49	N/A	2	No Further Action
Benzo(a)Pyrene	mg/kg	35	19	97	WS106 (0.50m)	2	Further Action
Indeno(123-cd)Pyrene	mg/kg	500	19	46	N/A	2	No Further Action
Dibenzo(a,h)Anthracene	mg/kg	3.5	19	14	WS106 (0.50m)	2	Further Action
Benzo(ghi)Perylene	mg/kg	3900	19	50	N/A	2	No Further Action
TPH C5-C6 (aliphatic)	mg/kg	3200	1	<0.001	N/A	3	No Further Action
TPH C6-C8 (aliphatic)	mg/kg	7800	1	<0.001	N/A	3	No Further Action
TPH C8-C10 (aliphatic)	mg/kg	2000	1	<0.001	N/A	3	No Further Action
TPH C10-C12 (aliphatic)	mg/kg	9700	1	16	N/A	3	No Further Action
TPH C12-C16 (aliphatic)	mg/kg	59000	1	60	N/A	1	No Further Action
TPH C16-C35 (aliphatic)	mg/kg	1600000	1	340	N/A	1	No Further Action
TPH C5-C7 (aromatic)	mg/kg	26000	1	<0.001	N/A	1	No Further Action
TPH C7-C8 (aromatic)	mg/kg	56000	1	<0.001	N/A	3	No Further Action
TPH C8-C10 (aromatic)	mg/kg	3500	1	<0.001	N/A	3	No Further Action
TPH C10-C12 (aromatic)	mg/kg	16000	1	49	N/A	3	No Further Action
TPH C12-C16 (aromatic)	mg/kg	36000	1	430	N/A	3	No Further Action
TPH C16-C21 (aromatic)	mg/kg	28000	1	1500	N/A	1	No Further Action
TPH C21-C35 (aromatic)	mg/kg	28000	1	1500	N/A	1	No Further Action
TPH C5-C6 (aliphatic)*	mg/kg	3200	19	<1.0	N/A	3	No Further Action
TPH C6-C8 (aliphatic)*	mg/kg	7800	19	<0.1	N/A	3	No Further Action
TPH C8-C10 (aliphatic)*	mg/kg	2000	19	<0.1	N/A	3	No Further Action
TPH C10-C12 (aromatic)*	mg/kg	16000	19	7.2	N/A	3	No Further Action
TPH C12-C16 (aromatic)*	mg/kg	36000	19	44	N/A	3	No Further Action
TPH C16-C21 (aromatic)*	mg/kg	28000	19	180	N/A	1	No Further Action
TPH C21-C35 (aromatic)*	mg/kg	28000	19	1150	N/A	1	No Further Action



Notes

PL1 = soil ingestion, PL2 = dermal contact and ingestion, PL3 = dust inhalation; PL4 = Vapour/Gas 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.

Referring to Table 4.1, the results of this direct comparison indicates that the data exceeds the screening criteria for a commercial end use for the following contaminants:

- ✿ Asbestos;
- ✿ Benzo(b)Fluoranthene;
- ✿ Benzo(a)Pyrene; and,
- ✿ Dibenzo(a,h)Anthracene.

In addition to the above the following SVOCs have been detected above the laboratory limit of detection (LOD) within WS106 at 0.50m, where a hydrocarbon odour was noted during the site investigation:

- ✿ 2-methylnaphthalene;
- ✿ Dibenzofuran;
- ✿ Carbazole; and,
- ✿ Anthraquinone.

Made Ground deposits in WS101 were tested for PCBs due to the proximity to the former PCB landfill area bordering the south eastern sector of the site. PCBs were tested for within WS101 at 0.72m within Made Ground deposits and at 1.00m within underlying CLAY drift deposits. PCBs were detected in both samples above the LOD with total PCBs within WS101 at 0.72m equating to 0.25 mg/kg and 0.70 mg/kg.

Asbestos in the form of loose chrysotile fibres has been identified in the granular and cohesive Made Ground within WS101 (0.65m and 0.72m), WS104 (0.60m), TP108 (0.40m), and TP110 (0.60m). Amosite loose fibres have been identified within TP102 (0.60m).

The laboratory analysis confirms the assessment within the initial conceptual site model that the main constituents of concern were likely to be PAHs, PCBs, asbestos and hydrocarbon compounds.



In relation to these exceedances, the following can be determined:

- ✳ The main exposure pathways based on the Tier I exceedances are:
 - Soil ingestion;
 - Dermal contact and ingestion;
 - Vapour Inhalation; and,
 - Fibre/dust inhalation.
- ✳ The exceedances for all determinants are associated with shallow Made Ground deposits and isolated CLAY drift deposits.

HUMAN HEALTH RISK ASSESSMENT AND MITIGATION

All of the identified elevated concentrations have primary exposure pathways related to dermal contact and ingestion of soils, inhalation of particulate and vapour inhalation. The risk to chronic human health associated with the elevated concentrations on non-volatile PAH compounds can be mitigated through the installation of a suitable cover system in all, landscaping and public open space to remove any potential for direct exposure to impacted soils or for the commercial premises covered by suitable hardstanding.

The specific design and installation process for the appropriate cover systems will be clearly defined within the site remediation and enabling works strategy.

SVOCs 2-Methylnaphthalene, Dibenzofuran, Carbazole and Anthraquinone above the laboratory LOD have been identified within WS106 at 0.50m within Made Ground deposits and present a potential volatilisation to indoor air risk. Information on the identified compounds is provided herein to help inform the assessment.

2-Methylnaphthalene

2-methylnaphthalene is a white crystalline solid compound. This determinant is classified as a non-threshold substance, therefore even the smallest amount of exposure is considered to pose a theoretical risk to the critical receptor within the context of the developed CSM.

This compound was detected at a concentration of 23 mg/kg in WS106 at 0.50m.

The vapour pressure of 2-methylnaphthalene is 0.055 mm Hg @ 25°C which is slightly lower than that of naphthalene (0.085 mm Hg @ 25°C), it is therefore determined that the compound is less volatile than naphthalene. This data is obtained from Pub Chem.

The Tier 1 CIEH / LQM S4UL for naphthalene is 190 mg/kg for a commercial development scenario, however this assessment assumes dermal contact, inhalation of particulate and other direct exposure pathways. The developed CSM for the subject site will incorporate a clean cover system in landscaped areas and the majority of the site to be covered in hardstanding to ensure no direct exposure pathways.

When considering that 2-Methylnaphthalene has a notably reduced vapour pressure to that of naphthalene, the absence of the compound in the vast majority of samples tested and in due consideration of the maximum concentration of the determinant being only 23 mg/kg, the potential for this compound to enter the vapour phase from soil with temperatures ~10°C is low.

There is no justifiable or peer reviewed toxicological data for an inhalation pathway for 2-methylnaphthalene, therefore it is not possible to develop a robust site-specific risk assessment model given the absence of suitable input parameters.



In light of the above, we must consider the lines of evidence to hand and given that the compound is a non-threshold substance with no peer reviewed, robust or justifiable toxicological data the suggested method to ensure safe regeneration is the adoption of the As Low As Reasonably Possible (ALARP) approach.

In this instance, the methodology for the analytical technique is considered to be the lowest reasonably possible method of determining the presence of the non-threshold substance and mitigating risk to the lowest practicable level.

The US national library for medicine confirms:

If released to soil, 2-methylnaphthalene is expected to have slight to no mobility based upon log Koc values of 3.00-5.96. Volatilization from moist soil surfaces is expected based upon a Henry's Law constant of 5.18×10^{-4} atm-cu m/mole. However, adsorption to soil is expected to attenuate volatilization. 2-Methylnaphthalene is not expected to volatilize from dry soil surfaces based upon its vapor pressure.

This compound has a very low to no actual volatility, there is no inhalation of dust (indoor or outdoor air) or inhalation of vapour (indoor or outdoor) exposure. The total inhalation background is 1.52%.

As discussed, herein it is highly unlikely that this compound can enter the vapour phase in the soil temperatures furthermore the presence of a passively ventilated sub-floor void with a reasonable volume change potential (24hr) will ensure that in the extremely unlikely event that this compound could volatilise and migrate, the standard mitigation measure would ensure there is absolutely no potential for ingress into the habitable space.

Therefore within the context of the developed site CSM and the lines of evidence approach, it can be determined that the residual compound in this instance is highly unlikely to pose any risk in terms of vapour migration and ingress to the dwelling.

Dibenzofuran

This is a white solid compound generally derived from coal tar. The US EPA have determined a threshold value of 7.8 mg/kg. As such the concentrations of 46 mg/kg identified within WS106 at 0.50m is considered to be exceeding.

In addition to the above, the relatively low volatility of this compound within soils with a temperature of $\sim 10^{\circ}\text{C}$ all but inhibits any volatilisation potential.

The US national library for medicine confirms:

Volatilisation from moist soil surfaces is expected to be an important fate process based upon an estimated Henry's Law constant of 2.1×10^{-4} atm-cu m/mole. However, adsorption to soil is expected to attenuate volatilisation.

Dibenzofuran is not expected to volatilise from dry soil surfaces (SRC) based upon its vapour pressure

Therefore within the context of the developed site CSM and the lines of evidence approach, it can be determined that the residual compound in this instance is highly unlikely to pose any risk in terms of vapour migration and ingress to the dwelling. There is not considered to be a risk to the future end user.

Carbazole

This compound is detected at a maximum concentration of 27 mg/kg in WS106 at 0.50m.

Carbazole is a non-threshold substance, and is a white, crystalline solid. It has a characteristic odour. It is a product of incomplete combustion of organic matter and occurs in petroleum, coal, peat, crude oil and coal tar.



There is no toxicological data available to inform the preparation of a robust site-specific risk based assessment criteria that would model the potential for ingress of vapour to indoor air.

The US national library for medicine confirms:

Carbazole released to air will also be in or on particles that eventually fall to the ground. It is expected to be broken down by sunlight, depending on environmental conditions. It will not move into air from moist soil and water surfaces.

If released to soil, carbazole can have high to no mobility based upon a Koc range of 114-4980, with most values suggesting low mobility to immobility. Volatilisation from moist soil surfaces is not expected to be an important fate process based upon a Henry's Law constant of 1.16×10^{-7} atm-cu m/mole. Carbazole is not expected to volatilise from dry soil surfaces based upon its vapour pressure.

It is accepted that carbazole is a non-threshold substance, however it will be encapsulated in soils with a temperature in the region of 10°C, furthermore given that it is highly unlikely to move into the ambient air via a vapour phase migratory pathway from a soil or water there cannot be a complete pollutant linkage in this instance.

Due to the low mobility and nature of the compounds found, their marginal detectable concentrations and their limited presence on site, there is a low risk associated with the SVOC compounds.

Anthraquinone

Anthraquinone is a PAH derived from anthracene or phthalic anhydride and is used in the manufacture of dyes in the textile and pulp industries. It is also utilised as a bird repellent. The compound appears as yellow crystals or powder and is possibly carcinogenic to humans.

The US EPA determines a threshold of 4900 mg/kg for Anthraquinone, 9,10- for industrial soils. Within WS106 at 0.50m a concentration of 14 mg/kg was identified which is below the US EPA threshold. As such a phase the concentration identified are not considered to be a risk to future end users.

PCBs

PCBs above the LOD have been detected within Made Ground and CLAY soils in WS101 due to their proximity to an off-site PCB landfill cell.

The US EPA determines a threshold of 49 mg/kg for industrial soil for PCB 118. Concentrations identified within both Made Ground and CLAY deposits do not exceed this and therefore not considered a risk to future end users.

Dutch Target and Intervention Values (2000) for soil remediation expressed as a standard soil with 10% organic matter and 25% clay, have produced a target value of 0.02 mg/kg and an intervention value of 1 mg/kg. The intervention value is the total of PCB 28, 52, 101, 118, 138, 153 and 180 whilst the target value refers to the total excluding PCB 118. Given PCB 118 is not considered a risk as per the above. The target value of 0.02 mg/kg will be utilised for this assessment. With PCB 118 excluded the total PCBs for WS101 at 0.72m is 0.197 mg/kg with WS101 at 1.00m having a total PCB of 0.561 mg/kg, both of which exceed the target value of 0.02 mg/kg. As such a phase of hotspot removal should be undertaken with the area delineated and impacted materials removed, and the resulting area validated. Assessment will then be required as to whether the materials can remain on site in an area of low sensitivity or will require removal from site. It is recommended a watching brief is completed during works in this area as part of the enabling works.

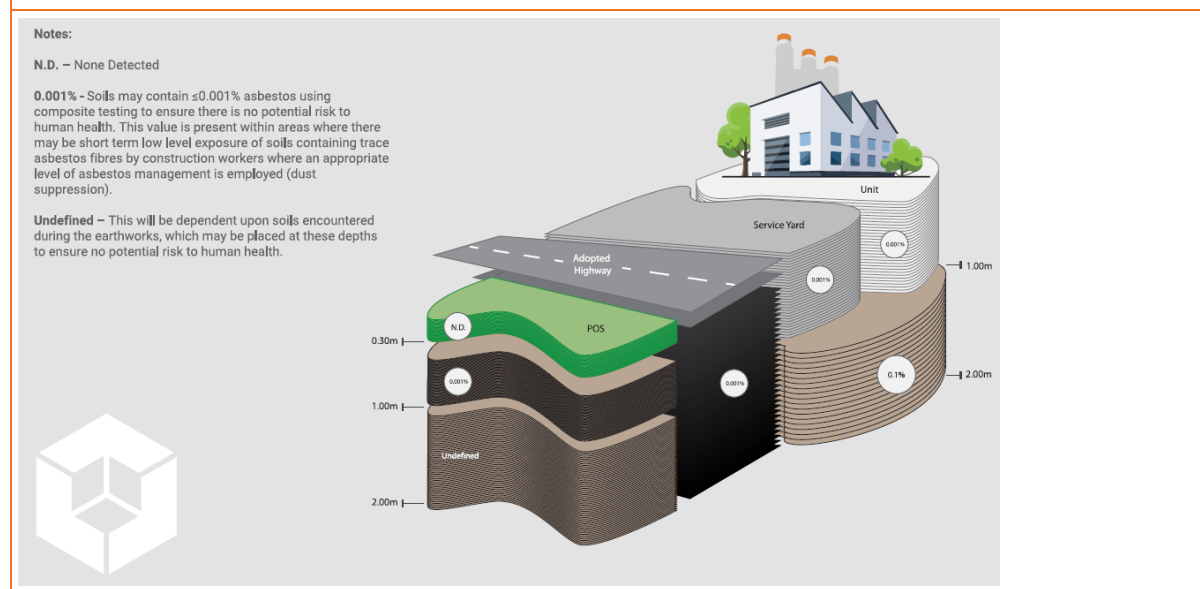


Asbestos

Asbestos in the form of chrysotile and amosite has also been identified within localised areas in shallow Made Ground deposits. Asbestos quantification has been completed with concentrations between <0.001% and 0.002%. No visual signs of ACM were encountered during the ground investigation; it is therefore likely that only trace fibres are present. It is likely that trace fibres are present within all Made Ground deposits on site. Impacted soils should be managed according to the asbestos risk mitigation conceptual site model shown in Figure 4.1.

Asbestos has been identified in WS101 and TP108 at a concentration of 0.002%. These areas should therefore be isolated and undergo a phase of delineation and hotspot removal with placement within an area of low sensitivity in line with the asbestos risk mitigation conceptual site model.

FIGURE 4.1 ASBESTOS RISK MITIGATION CONCEPTUAL SITE MODEL



Notes

ND None Detect

0.001% Soils may contain $\leq 0.001\%$ asbestos using composite testing to ensure there is no potential risk to human health. This value is present within areas where there may be a short term low level exposure of soils containing trace asbestos fibres by construction workers where an appropriate level of asbestos management is employed (dust suppression)

0.1% Soils at a depth of >1.00m bgl may contain <0.1% asbestos using composite testing where they will not be likely to be disturbed in the future and will therefore be in an area of low sensitivity. Risk assessment completed in accordance with Asbestos JIWG risk assessment tools.

Undefined- this will be dependent upon soils encountered during earthworks, which may be placed at these depths to ensure no potential risk to human health.

Chemical analysis of the natural clay drift deposits has identified these soils to be acceptable for use as subsoil within the proposed landscaping areas with the exception of CLAY soils within WS101 where PCBs have been identified; however, further chemical validation samples will be required to confirm this. There are no suitable sources of topsoil available on the site.



4.3. 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 4.2.

TABLE 4.2 CONTROLLED WATERS CONCEPTUAL MODEL AND SENSITIVITY PROFILE

DISCUSSION		SENSITIVITY RATING
Contaminant Source		
Made Ground PAHs, TPHs, SVOCs and PCBs have been identified within Made Ground deposits underlying the subject site associated with historical features on-site.		High
Pathway		
Vertical Migration Due to majority of the site being underlain by cohesive clay deposits, migration of contaminants towards the underlying aquifer is unlikely to occur as a result of the low permeability of the drift deposits. The presence of this low permeability drift will offer some protection to the underlying aquifer and inhibit vertical migration of any contaminants.		Low
Lateral migration Lateral migration of contaminants is considered unlikely due to the presence of cohesive clay deposits across the site which are of low permeability.		Low
Receptor		
Aquifer Classification in Superficial Drift Deposits	Secondary Undifferentiated Aquifer	Low
Aquifer Classification in Bedrock	Secondary A aquifer	Medium
Groundwater Source Protection Zone or Drinking Water Safeguard Zone	The site is not located within a source protection zone.	Low
Distance to the Closest Groundwater Abstraction Point	The nearest abstraction borehole is located c. 686m south of the site at Calypso Soft Drinks Ltd for process water.	Medium
Is the Site Located Within 50 m of a Surface Watercourse?	No surface watercourses have been identified within influencing distance of the site.	Low
The ICSM developed within the context of the site setting has identified a single viable pollutant pathway, which would be the downward migration of potentially mobile phase-soluble contaminants towards the underlying secondary A aquifer.		



To ensure a robust appraisal of the identified risk to controlled waters, E3P has identified the sources of potential contamination that represent a risk to controlled waters from the initial CSM, we have then assessed the availability of ground investigation data in the form of analysis of the solid phase (soil) and dissolved phase within the perched groundwater or aquifer. The results of this assessment are presented in Table 4.3.

TABLE 4.3 QUALITATIVE RISK TO CONTROLLED WATERS FROM SOIL ANALYTICAL RESULTS

CONTAMINANT	ASSESSMENT RATING	DISCUSSION
BTEX > 1 mg/kg	The soil data analysis has not identified any detectable concentrations of VOCs above 1mg/kg or TPH C5 to C6 that might otherwise be indicative of VOC impact.	None
Total VOC > 1 mg/kg		
Total SVOC > 1 mg/kg	SVOC analysis has recorded concentrations above 1 mg/kg.	Further discussion
C5-C10 > 5 mg/kg	All concentrations are below the laboratory LOD.	None
C10-C12 > 10 mg/kg	Concentrations of C10-C12 have been identified above 10 mg/kg within isolated locations.	Further discussion
C12-C16 > 50 mg/kg	Concentrations of C12-C16 have been identified above 50 mg/kg within isolated locations.	Further discussion
Phenols > 2 mg/kg	The majority of concentrations are below the laboratory LOD, with the exception of Made Ground within WS106 at 0.50m where a concentration of 10 mg/kg was identified.	Further discussion
Naphthalene > 2 mg/kg	Concentrations of Naphthalene were generally below 2 mg/kg, however concentrations above this have been detected with a maximum concentration of 29 mg/kg detected.	Further discussion
Total PAH > 10 mg/kg	Total concentrations of low-solubility PAH compounds greater than 10 mg/kg have been detected.	Further discussion
PCB > 1 mg/kg	PCB's have been detected within WS101 at levels >1 mg/kg.	Further discussion
Heavy metals > 500 mg/kg	All concentrations are below the laboratory LOD.	None

The Tier I assessment has included a comparison of leachate analysis from samples of the Made Ground and groundwater samples to drinking water standards in the first instance due to the presence of a Secondary A Aquifer within the underlying bedrock, and where absent environmental quality standards (EQS).

These are presented in Table 4.4 and Table 4.5.



TABLE 4.4 COMPARISON OF LEACHATE ANALYSIS WITH TIER 1 SCREENING LEVELS

DETERMINAND	UNIT	EQS ^{1, 2, 3}	DWS _{3,4,5}	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
		AA					
Arsenic	µg/l	50	10	4	5.1	N/A	No Further Action
Cadmium	µg/l	0.08-0.25	5	4	<0.08	N/A	No Further Action
Chromium (VI)	µg/l	3.4	–	4	22	WS104 (0.30m)	Further Action
Chromium (III)	µg/l	4.7	50	4	27	N/A	No Further Action
Copper	µg/l	1	2000	4	44	N/A	No Further Action
Total Cyanide	µg/l	1	50	4	5.8	N/A	No Further Action
Lead	µg/l	1.2	10	4	2.9	N/A	No Further Action
Mercury	µg/l	–	1.0	4	<0.5	N/A	No Further Action
Nickel	µg/l	4	20	4	4.9	N/A	No Further Action
Selenium	µg/l	–	10	4	<4.0	N/A	No Further Action
Zinc	µg/l	10.9	–	4	19	TP104 (1.38m)	Further Action
pH		6–9		4	11	WS104 (0.30m)	Further Action
Naphthalene	µg/l	2	10*	4	170	WS106 (0.50m)	Further Action
Anthracene	µg/l	0.1	10*	4	0.89	N/A	No Further Action
Benzo[b]fluoranthene	µg/l	0.00017*	10*	4	< 0.01	N/A	No Further Action
Benzo[k]fluoranthene	µg/l	0.00017*	10*	4	< 0.01	N/A	No Further Action
Benzo(a)pyrene	µg/l	0.00017*	10*	4	< 0.01	N/A	No Further Action
Indeno(123-cd)pyrene	µg/l	0.00017*	10*	4	< 0.01	N/A	No Further Action
Fluoranthene	µg/l	0.0063	10*	4	0.35	N/A	No Further Action
Benzo(ghi)perylene	µg/l	1.7–4	10*	4	< 0.01	N/A	No Further Action



DETERMINAND	UNIT	EQS 1, 2, 3	DWS 3,4,5	NO. OF LEACHATE SAMPLES	MAX CONC. IN LEACHATE	LOCATION OF EXCEEDANCE	ASSESSMENT
		AA					
TPH C5-C6 (Aromatic) (benzene)	µg/l	10	1	4	< 1.0	N/A	No Further Action
TPH C6-C8 (Aromatic) (toluene)	µg/l	74	700	4	< 1.0	N/A	No Further Action
TPH C8-C10 (Aromatic) (ethyl benzene)	µg/l	20	300	4	< 1.0	N/A	No Further Action
TPH C10-C12 (Aromatic) (xylene)	µg/l	30	500	4	170	N/A	No Further Action
TPH C12-C16 (Aromatic)	µg/l	2	90 ⁵	4	330	WS106 (0.50m)	Further Action
TPH C16-C35 (Aromatic)	µg/l	50#	90 ⁵	4	< 10	N/A	No Further Action
TPH C5-C6 (Aliphatic)	µg/l	–	15000	4	< 1.0	N/A	No Further Action
TPH C6-C8 (Aliphatic)	µg/l	–	15000	4	< 1.0	N/A	No Further Action
TPH C8-C10 (Aliphatic)	µg/l	–	300	4	< 1.0	N/A	No Further Action
TPH C10-C12 (Aliphatic)	µg/l	–	300	4	<10	N/A	No Further Action
TPH C12-C16 (Aliphatic)	µg/l	–	300	4	<10	N/A	No Further Action
TPH C16-C21 (Aliphatic)	µg/l	–	300**	4	<10	N/A	No Further Action
TPH C21-C35 (Aliphatic)	µg/l	–	300**	4	<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.

1. The Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations (2015)
2. Directive establishing a framework for Community action in the field of water policy (Water Framework Directive)
3. Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances
4. Council Directive on the quality of water intended for human consumption (Drinking Water Directive)
5. WHO Guidelines for Drinking Water Quality. Third edition (2004)



TABLE 4.5 COMPARISON OF GROUNDWATER ANALYSIS WITH TIER 1 SCREENING LEVELS

DETERMINAND	UNIT	EQS ^{1, 2, 3}	DWS _{3,4,5}	NO. OF SAMPLES	MAXIMUM CONCENTRATION IN SURFACE WATER		LOCATION OF EXCEEDANCE	ASSESSMENT
		AA			01/03/2021	25/03/2021		
Arsenic	µg/l	50	10	6	6.92	1.76	N/A	No Further Action
Cadmium	µg/l	0.08-0.25	5	6	0.04	0.03	N/A	No Further Action
Chromium (VI)	µg/l	3.4	–	6	<5.0	<5.0	N/A	No Further Action
Chromium (III)	µg/l	4.7	50	6	4.7	6.1	N/A	No Further Action
Copper	µg/l	1	2000	6	12	6.8	N/A	No Further Action
Total Cyanide	µg/l	1	50	6	1.9	<1.0	N/A	No Further Action
Lead	µg/l	1.2	10	6	0.9	0.5	N/A	No Further Action
Mercury	µg/l	–	1.0	6	<0.05	<0.05	N/A	No Further Action
Nickel	µg/l	4	20	6	5.5	8.7	N/A	No Further Action
Selenium	µg/l	–	10	6	44	3.2	WS101	Further Action
Zinc	µg/l	10.9	–	6	14 18	10	CP101 CP102	Further Action
pH		6–9		6	7.2-8.8	7.4-7.9	N/A	No Further Action
Naphthalene	µg/l	2	10*	6	<0.01	<0.01	N/A	No Further Action
Anthracene	µg/l	0.1	10*	6	<0.01	<0.01	N/A	No Further Action
Benzo[b]fluoranthene	µg/l	0.00017*	10*	6	<0.01	<0.01	N/A	No Further Action
Benzo[k]fluoranthene	µg/l	0.00017*	10*	6	<0.01	<0.01	N/A	No Further Action
Benzo(a)pyrene	µg/l	0.00017*	10*	6	<0.01	<0.01	N/A	No Further Action
Indeno(123-cd)pyrene	µg/l	0.00017*	10*	6	<0.01	<0.01	N/A	No Further Action
Fluoranthene	µg/l	0.0063	10*	6	<0.01	<0.01	N/A	No Further Action
Benzo(ghi)perylene	µg/l	1.7–4	10*	6	<0.01	<0.01	N/A	No Further Action



DETERMINAND	UNIT	EQS 1, 2, 3	DWS 3,4,5	NO. OF SAMPLES	MAXIMUM CONCENTRATION IN SURFACE WATER		LOCATION OF EXCEEDANCE	ASSESSMENT
		AA			01/03/2021	25/03/2021		
TPH C5-C6 (Aromatic) (benzene)	µg/l	10	1	6	<1.0	<1.0	N/A	No Further Action
TPH C6-C8 (Aromatic) (toluene)	µg/l	74	700	6	<1.0	<1.0	N/A	No Further Action
TPH C8-C10 (Aromatic) (ethyl benzene)	µg/l	20	300	6	<1.0	<1.0	N/A	No Further Action
TPH C10-C12 (Aromatic) (xylene)	µg/l	30	500	6	<10	<10	N/A	No Further Action
TPH C12-C16 (Aromatic)	µg/l	2	90 ⁵	6	<10	<10	N/A	No Further Action
TPH C16-C35 (Aromatic)	µg/l	50#	90 ⁵	6	<10	<10	N/A	No Further Action
TPH C5-C6 (Aliphatic)	µg/l	–	15000	6	<1.0	<1.0	N/A	No Further Action
TPH C6-C8 (Aliphatic)	µg/l	–	15000	6	<1.0	<1.0	N/A	No Further Action
TPH C8-C10 (Aliphatic)	µg/l	–	300	6	<1.0	<1.0	N/A	No Further Action
TPH C10-C12 (Aliphatic)	µg/l	–	300	6	<10	<10	N/A	No Further Action
TPH C12-C16 (Aliphatic)	µg/l	–	300	6	<10	<10	N/A	No Further Action
TPH C16-C21 (Aliphatic)	µg/l	–	300**	6	<10	<10	N/A	No Further Action
TPH C21-C35 (Aliphatic)	µg/l	–	300**	6	<10	<10	N/A	No Further Action
Tetrachloroethylene	µg/l	0.4	10	6	<1.0	<1.0	N/A	No Further Action
Trichloroethylene	µg/l	10	10	6	<1.0	<1.0	N/A	No Further Action
Trichlorobenzene	µg/l	0.4	–	6	<1.0	<1.0	N/A	No Further Action
Trichloromethane	µg/l	2.5	–	6	<1.0	<1.0	N/A	No Further Action
Dichloromethane	µg/l	20	200	6	<1.0	<1.0	N/A	No Further Action
Carbon Tetrachloride	µg/l	12	3	6	<1.0	<1.0	N/A	No Further Action



DETERMINAND	UNIT	EQS ^{1, 2, 3}	DWS _{3,4,5}	NO. OF SAMPLES	MAXIMUM CONCENTRATION IN SURFACE WATER		LOCATION OF EXCEEDANCE	ASSESSMENT
		AA			01/03/2021	25/03/2021		
Vinyl Chloride	µg/l	–	0.3	6	<1.0	<1.0	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.

1. The Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations (2015)
2. Directive establishing a framework for Community action in the field of water policy (Water Framework Directive)
3. Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances
4. Council Directive on the quality of water intended for human consumption (Drinking Water Directive)
5. WHO Guidelines for Drinking Water Quality. Third edition (2004)



4.3.1. CONTROLLED WATER RISK ASSESSMENT AND MITIGATION

This comparison indicates that the data exceeds the DWS values or where absent the EQS value for the following inorganic compounds:

-  Chromium (VI)
-  Selenium
-  Zinc
-  pH
-  Naphthalene
-  TPH C12-C16

PCBs were tested for within all groundwater samples however no concentrations above the LOD were detected.

Concentrations above EQS screening values have been identified however due to the absence of a surface water features within 50m of the subject site there is not considered to be a complete pollutant linkage and as such there is not considered a risk to surface water features.

4.3.2. DISCUSSION OF CONTROLLED WATERS RISK ASSESSMENT

In relation to the elevated chromium (VI), zinc, pH, naphthalene and TPH Aromatic C12-C16 these are associated with isolated occurrences from leachate analysis undertaken in Made Ground soils. Where leachate analysis has been undertaken, this can overstate the risk and is not wholly representative of the site characterisation. Following the completion of groundwater analysis, elevated concentrations of chromium (VI), pH, naphthalene were not identified.

Within the groundwater analysis elevated levels of selenium and zinc were identified.

Historically, the site has been subject to infilling and a number of industrial uses including railway lines crossing the site and subsequently a haulage yard in its current day use. The underlying Made Ground is considered to be the source of potential elevated determinants.

The site is underlain by cohesive CLAY drift deposits which are of low permeability and will limit lateral and vertical migration of any possible contaminants.

The site is not located within influencing distance of any surface water features. Furthermore, the closest abstraction point is located 686m south of the site and utilised for process water. Given the distance from site and presence of low permeability CLAY deposits the risk is considered to be low.

PCBs were identified within the soil analysis on site however they have not been detected within the groundwater analysis completed, and therefore are not considered to be mobile.



4.4. GROUND GAS

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). However, it is recommended that the full ground gas assessment and recommended protection measures are agreed with the local authority prior to their adoption on site. Furthermore, all protection measures adopted should be validated by a suitably qualified engineer.

4.1. INVESTIGATION RATIONALE

The ICSM has identified that the underlying Made Ground, infilled ponds and infilled land may represent a potential source of ground gas generation. Based on the identification of these sources, E3P has determined that the site represents a low ground gas source generation potential.

Within the context of the proposed residential end use and ground gas generation potential, the gas assessment requires six visits over two months, with at least two sets of readings at low or falling atmospheric pressure as set out within CIRIA 665 Tables 5.5a and 5.5b.

The spacing requirements for monitoring wells are detailed within CIRIA 665 Table 4.2, which indicates that for low gas hazard sites (Made Ground with limited degradable material, organic clay of limited thickness) and a low sensitivity development, nominal well spacing should be between 25 m and 50 m.

TABLE 4.6 GROUND GAS MONITORING LOCATION RATIONALE

LOCATION	GROUND GAS SOURCE	DEPTH OF MONITORING WELL (m)
WS101	Deeper Groundwater Well / Natural Strata	1.00–3.00
WS103	Made Ground	0.50–1.20
WS105	Deeper Groundwater Well / Natural Strata	1.00–4.00
WS106	Made Ground	0.50–1.00
CP101	Deeper Groundwater Well / Natural Strata	15.00–16.00
CP102	Deeper Groundwater Well / Natural Strata	21.00–22.00

4.2. MONITORING METHODOLOGY

Concentrations of methane (CH₄), carbon dioxide (CO₂) and oxygen (O₂) were measured using a calibrated infra-red gas analyser (GFM435) with gas flow rates were measured using an integrated flow meter.

Gas measurements were recorded for a minimum of 60 seconds at each location, at which point the maximum concentration of CH₄ and CO₂, together with the lowest concentration of O₂ were recorded. The results of the ground gas monitoring are presented in Table 4.8.



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). However, it is recommended that the full ground gas assessment and recommended protection measures are agreed with the local authority prior to their adoption on site. Furthermore, all protection measures adopted should be validated by a suitably qualified engineer.

CIRIA C665 and NHBC Report No 10627-R01 provide assessments for carbon dioxide and methane based upon gas screening values (GSVs) utilising flow rates and concentrations. The site-based GSVs for steady state methane and carbon dioxide are based upon the following equation:

$$GSV = \frac{\text{concentration (by vol)}}{100} \times \text{flowrate (l / hr)}$$

The GSVs within CIRIA C665 are based upon all buildings other than standard residential houses. The thresholds for GSVs based upon CIRIA guidance are provided within Table 4.7 (below).

TABLE 4.7 THRESHOLDS FOR GAS SCREENING VALUES (GSV) IN ACCORDANCE WITH CIRIA C665 – COMMERCIAL END USE

CIRIA – NO SUBFLOOR VOID	
CLASSIFICATION	GSV (METHANE AND CARBON DIOXIDE)
CS1	< 0.07
CS2	< 0.70
CS3	< 3.5
CS4	< 15
CS5	< 70
CS6	> 70

4.2.1. SUMMARY OF MONITORING RESULTS

Table 4.8 presents of the ground gas and groundwater monitoring results to date.



TABLE 4.8 SUMMARY OF GROUND GAS MONITORING RESULTS

WELL	DATE	CH ₄ INITIAL (%V/V)	CH ₄ STEADY (%V/V)	CH ₄ GSV (l/hr)	CO ₂ INITIAL (%V/V)	CO ₂ STEADY (%V/V)	CO ₂ GSV (l/hr)	O ₂ (%V/V)	ATMOS (mb)	ATMOS. DYNAMIC	FLOW (l/hr)	RESPONSE ZONE (m bgl)	DEPTH TO BASE (m bgl)	DEPTH TO WATER (m bgl)
WS101	25/02/21	0.10	0.10	-0.00601	0.10	0.10	-0.00601	20.20	1021	Rising	-6.01	1.00–3.00	2.86	G.L.
	10/03/21	0.10	0.10	0.00013	0.10	0.10	0.00013	20.30	1009	Falling	0.13		2.85	G.L.
	23/03/21	0.10	0.10	0.00026	0.10	0.10	0.00026	20.30	1012	Falling	0.26		2.67	0.22
	09/04/21	0.10	0.10	0.00052	0.30	0.30	0.00156	19.90	1019	Steady	0.52		2.68	0.25
	23/04/21	0.10	0.10	0.00026	0.20	0.20	0.00052	20.00	1029	Falling	0.26		2.67	0.54
WS103	Monitoring Well Destroyed											0.50–1.20	-	-
WS105	25/02/21	0.10	0.10	0.00448	0.10	0.10	0.00448	20.10	1021	Rising	4.48	1.00–4.00	3.63	0.30
	10/03/21	0.10	0.10	0.00396	0.20	0.20	0.00792	20.00	1009	Falling	3.96		3.62	0.44
	23/03/21	0.10	0.10	0.01116	0.40	0.40	0.04464	19.30	1012	Falling	11.16		3.62	0.36
	09/04/21	0.10	0.10	0.00874	0.30	0.30	0.02622	19.50	1019	Steady	8.74		3.61	0.41
	23/04/21	0.10	0.10	0.00734	0.40	0.40	0.02936	19.20	1029	Falling	7.34		3.60	0.68
WS106	25/02/21	0.10	0.10	-0.00144	1.30	1.30	-0.01872	19.20	1021	Rising	-1.44	0.50-1.00	0.77	Dry
	10/03/21	0.10	0.10	-0.00088	0.90	0.90	-0.00792	19.40	1009	Falling	-0.88		0.76	Dry
	23/03/21	0.10	0.10	0.00052	1.10	1.10	0.00572	19.30	1012	Falling	0.52		0.76	Dry
	09/04/21	0.10	0.10	0.00088	0.90	0.90	0.00792	19.50	1019	Steady	0.88		0.75	Dry
	23/04/21	0.10	0.10	0.0012	1.20	1.20	0.0144	19.20	1029	Falling	1.20		0.75	Dry
CP101	25/02/21	0.10	0.10	-0.00026	1.10	1.10	-0.00286	18.70	1021	Rising	-0.26	15.00– 16.00	14.74	1.07
	10/03/21	0.10	0.10	0.00026	1.40	1.40	0.00364	18.20	1009	Falling	26.00		14.75	1.24
	23/03/21	Unable to Access Monitoring Well.								Falling	-		-	-



WELL	DATE	CH ₄ INITIAL (%V/V)	CH ₄ STEADY (%V/V)	CH ₄ GSV (l/hr)	CO ₂ INITIAL (%V/V)	CO ₂ STEADY (%V/V)	CO ₂ GSV (l/hr)	O ₂ (%V/V)	ATMOS (mb)	ATMOS. DYNAMIC	FLOW (l/hr)	RESPONSE ZONE (m bgl)	DEPTH TO BASE (m bgl)	DEPTH TO WATER (m bgl)
CP101	09/04/21	0.10	0.10	0.00052	1.30	1.30	0.00676	18.50	1019	Steady	0.52	15.00– 16.00	14.75	1.25
	23/04/21	0.10	0.10	0.00013	1.10	1.10	0.00143	18.90	1029	Falling	0.13		14.75	2.54
CP102	25/2/21	0.10	0.10	-0.00159	0.10	0.10	-0.00159	19.90	1021	Rising	-1.59	21.00– 22.00	20.15	2.28
	10/3/21	0.10	0.10	-0.00234	0.30	0.30	-0.00702	19.60	1009	Falling	-2.34		20.20	2.49
	23/3/21	0.10	0.10	-0.01007	0.10	0.10	-0.01007	20.00	1012	Falling	-10.07		19.83	1.29
	9/4/21	0.10	0.10	-0.0097	0.20	0.20	-0.0194	19.90	1019	Steady	-9.70		19.85	1.54
	23/4/21	0.10	0.10	-0.0113	0.40	0.40	-0.0452	19.50	1029	Falling	-11.30		19.90	2.98



4.2.2. SOURCES OF GROUND GAS

The Phase I report and subsequent ground investigation has identified the following potential sources of ground gas:

- ✳ Made Ground deposits.
- ✳ Infilled Pond.
- ✳ Infilled land in close proximity to the site.

4.2.3. GROUNDWATER

Monitoring wells WS101, WS105, CP101 and CP102 have been flooded on all monitoring occasions completed to date, and therefore cannot be included within the assessment.

Within Ws106, the monitoring well was noted to be dry during all monitoring visits completed to date.

4.2.4. GAS FLOW

During the monitoring a positive flow was noted in all monitoring locations with the exception of CP102. The measure of positive flow is considered to be the result of groundwater fluctuations and flooding of the well causing compression – as opposed to gas generation – as the highest flows are recorded during periods of high groundwater levels. It should be noted that CP101 and CP102 were designed for groundwater monitoring rather than ground gas.

Negative flows are indicative of back pressure from wind being greater than the active flow from the wells. Negative flows were recorded in WS101, WS106, CP101 and CP102.

4.2.5. GAS CONCENTRATIONS

No elevated concentrations of methane above the LOD of 0.10 % v/v have been detected in monitoring completed to date.

Carbon dioxide concentrations were recorded within all the monitoring wells at concentrations ranging from 0.10% v/v (LOD) to 1.40% v/v (CP101).

4.2.6. GAS ASSESSMENT

In accordance with the methodology outlined with the CIRIA publication C665, E3P have utilised the results of the ground gas monitoring surveys to calculate a tentative gas screening value (GSV). The GSVs for the monitoring positions are summarised in Table 4.9.

TABLE 4.9 GAS RISK PROFILE AND LOCATION

LOCATION	MAX CH ₄ (% v/v)	GSV (l/hr)	MAX CO ₂ (% v/v)	GSV (l/hr)	CLASSIFICATION
WS101	0.10	-0.00601	0.30	-0.00601	CS1
WS105	0.10	0.01116	0.40	0.04464	CS1
WS106	0.10	-0.00144	1.30	-0.01872	CS1



LOCATION	MAX CH ₄ (% v/v)	GSV (l/hr)	MAX CO ₂ (% v/v)	GSV (l/hr)	CLASSIFICATION
CP101	0.10	0.00052	1.40	0.00676	CS1
CP102	0.10	-0.0113	0.40	-0.0452	CS1

The GSV has been compared to the criteria outlined with CIRIA C665 to determine the level of risk to the proposed development and to ensure the appropriate remedial options are incorporated into any future building design in this area.

Preliminary ground gas monitoring suggests that the site can be predominantly classified as CS1, and it is considered that ground gas protection measures will not be required.



4.3. POTABLE WATER SUPPLY

This section provides a summary of the site investigation data with reference to the selection of potable water supply pipework. The assessment is made with reference to the UK Water Industry Research (UKWIR) publication "Guidance on the selection of Water Supply Pipes to be used in Brownfield Sites"

TABLE 4.10 PIPELINE SELECTION PE THRESHOLD CONCENTRATIONS

Contaminant Group	PE-threshold (mg/kg)	Concentrations at <u>Current</u> pipeline depth (mg/kg)
Total VOC	0.5	<1.0
Total BTEX And MTBE	0.1	<1.0
Total SVOCs (Excluding PAH and those substances marked with an *)	2	<LOD
EC5-EC10 Aliphatic and Aromatic Hydrocarbons	2	<1.2
EC10-EC16- Aliphatic and Aromatic Hydrocarbons	10	<6.0
EC16-EC40 Aliphatic and Aromatic Hydrocarbons	500	231
Phenols (From SVOC Analysis)*	2	10
Cresols and Chlorinated Phenols (From SVOC Analysis)	2	NA
Ethers*	0.5	NA
Nitrobenzene*	0.5	NA
Ketones*	0.5	NA
Aldehydes*	0.5	NA
Amines	Fail	NA
Other Consideration		
Are there any exceedances of the PE threshold outside of the pipeline depth?	Elevated concentrations of SVOCs and TPHs have been identified within Made Ground deposits not currently at pipeline depth.	
Is free product present in soil and groundwater?	None Identified.	
Could hydrocarbon impact at greater depth than current pipeline depth be mobilised by rising groundwater levels?	Yes – heavy end hydrocarbon impact has been identified within Made Ground deposits, and groundwater has been identified at pipeline depth.	
Will soils impacted with above determinands likely be utilised elsewhere on site?	Yes – the site is likely to undergo some enabling works and movement of materials where Made Ground currently exceeding determinands may be utilised at pipeline depth.	
Will soils be imported to site as part of any future earth works	Currently unknown, however it is unlikely soils will be required to be imported to site.	

Notes - Pipe line depth normally between 0.75m–1.35m



Analysis of soils at pipeline depth currently suggests PE pipe may be required however concentrations of determinants above the PE threshold have been identified across the site. It is likely the site will undergo some enabling works where materials may be utilised in different areas of the site. Site conditions are likely to vary to current conditions following remediation and enabling works. As such, it is likely that barrier pipe will be required at the proposed development.



4.4. CONCEPTUAL SITE MODEL

Following the completion of the intrusive site investigation, chemical analysis and risk assessment, the conceptual model shown in Table 4.11 has been prepared for the site.

TABLE 4.11 CONCEPTUAL MODEL

POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL1 PL2	Non-volatile PAHs PCB's (Made Ground)	Dermal contact. Dermal contact and ingestion.	Future site users.	Likely	High	LOW
Discussion: Exceedances of non-volatile PAH's and PCB's have been identified in a number of locations throughout the subject site. The risk of PCBs can also be through inhalation and as such the elevated concentrations in the vicinity of WS101 should undergo a hotspot removal. Recommendation: In regard to the elevated PAHs, given the majority of the site will be covered in hardstanding comprising either buildings, concrete slabs or asphalt the pathway through dermal contact and soil ingestion will be broken, removing the associated risks to the end users. A 300 mm cover system will be placed in any proposed landscaped areas due to the presence of Made Ground across the site and the localised exceedance of dibenzo(a,h)anthracene. Given the depth of this exceedance, this will be below the growing medium, and therefore no further assessment is required. Construction works completed with PPE and provision of welfare. A phase of delineation, excavation and removal of PCBs in the vicinity of WS101 should be completed. With the excavated materials assessed as to whether they can remain on site in an area of low sensitivity or if they require removal from site.						



POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL3	ACM in Made Ground	Inhalation of dust.	Future site users. Off-site land users.	Likely	High	LOW
Discussion: Asbestos trace fibres have been identified throughout the Made Ground between depths of 0.40m and 0.72m bgl. However, it must be assumed that asbestos fibres are present within all the Made Ground deposits present on site. The proposed development allows for hardstanding cover across the majority of the site, which will break the main pathway and minimise future disturbance of soils. Recommendation: Materials will require management on site in line with the E3P Asbestos Conceptual Site Model. Any impacted asbestos containing soils are managed in a legislative and compliant manner on site in accordance with CIRIA 733. Asbestos Containing Materials (ACM) have been identified on-site and these should be segregated and removed from site in a compliant manner. Construction works should be completed with dust suppression, potentially HSG 84 air monitoring, PPE and provision of welfare.						
PL4	Volatile Contaminants (SVOCs, PCBs) (Made Ground)	Inhalation of vapours. Migration through permeable strata and preferential pathways.	Future site users. Off-site receptors.	Low	Low	LOW
Assessment: Elevated concentrations of SVOCs and PCBs have been identified on site. Given the properties of the SVOCs identified they are unlikely to cause a vapour risk at the site. Total PCB concentrations (excluding PCB 118) are considered to be elevated within soils at WS101 and given the potential for a vapour risk to end users a phase of delineation, removal and validation will be required with resulting materials assessed as to whether they can remain on site in an area of low sensitivity or will require removal from site.						



POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
Recommendation: During a phase of remediation and enabling works, impacted materials should undergo a hotspot validation to include the delineation and removal of volatile contamination. Excavated materials will require stockpiling on a visqueen lined bund with additional chemical analysis undertaken to determine the suitability for placement on site in an area of low sensitivity.						
PL4	Methane, carbon dioxide (infilled features on and within 250 m of the site)	Inhalation of gas. Migration through permeable strata and preferential pathways. Explosion in confined spaces.	Future site users. Buildings. Off-site land users.	Low likelihood	Moderate	To be determined
Assessment: Ground gas monitoring to date has suggested the site can be classified as CS1 and ground gas protection measures will not be required however this should be confirmed following completion of the ground gas monitoring regime.						
Recommendation: To be confirmed following completion of the ground gas monitoring regime.						



POLLUTANT LINKAGE	CONTAMINANT (SOURCE)	PATHWAY	RECEPTOR	PROBABILITY	CURRENT RISK	RESIDUAL RISK AFTER MITIGATION
PL5	Mobile contaminants such as heavy metals, PAHs, hydrocarbons, volatile compounds	Surface runoff. Migration through permeable strata and preferential pathways. Perched waters migration.	Groundwater (secondary A aquifer).	Low	Moderate	LOW
Assessment: Elevated concentrations of chromium (VI), zinc, pH, naphthalene and TPH Aromatic C12-C16 have been identified within leachate analysis. Within the groundwater analysis elevated levels of selenium and zinc were identified. The underlying Made Ground is considered to be the source of potential elevated determinants. The site is underlain by cohesive CLAY drift deposits which are of low permeability and will limit lateral and vertical migration of any possible contaminants. The site is not located within influencing distance of any surface water features. Furthermore, the closest abstraction point is located 686m south of the site and utilised for process water. Given the distance from site and presence of low permeability CLAY deposits the risk is considered to be low. Recommendation: No further assessment is required.						
PL6	Sulphate (potential ash within Made Ground)	Sulphate attack on concrete.	Building structure.	Low likelihood	Low	LOW
Assessment: Chemical analyses for pH and soluble sulphate content contained in Appendix VI (summarised in Table 3.11), shows that the soils at the site meet Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with BRE <i>Special Digest 1</i> (2005). Recommendation: No further works required.						



Main exposure pathways:

PL1 = soil ingestion, PL2 = dermal contact and ingestion, PL3 = dust inhalation; PL4 = Vapour/Gas Inhalation; PL5 = Vertical / Lateral Migration; PL6 = Corrosion of concrete; PL7=Tainting of water supply; PL8 = Uptake by plants.



5. GEOTECHNICAL ASSESSMENT

5.1. PROPOSED DEVELOPMENT

E3P understands that the proposed development will comprise of two industrial units with associated adopted estate roads and utility infrastructure. Drawing 14-255-002 (Appendix III) identifies the proposed development layout.

5.2. SUMMARY OF GROUND CONDITIONS

MADE GROUND

Made Ground deposits were encountered within all exploratory hole locations to depths of between 0.21m and 2.10m bgl (TP106), however, generally Made Ground was encountered to a depth of less than 1.60m bgl. Made Ground

Within TP101 a layer of black reworked clay (0.09-0.20m bgl) was observed overlying a layer of limestone gravel. The trial pit was terminated due to the likely presence of underlying services.

Made Ground deposits comprise a grey sandy gravel of concrete, limestone and asphalt overlying the majority of the site with the exception of TP103 where the location was overlain with a grey slightly silty, sandy gravel of limestone (MOT).

Underlying the above strata varying Made Ground deposits were encountered. Within WS101 a black sandy gravel of concrete and brick was encountered to depths of 0.61-0.70m bgl.

In locations (WS104, WS105, TP102, TP103, TP106, TP107, TP109, CP101) a reddish brown sandy gravel with gravel of brick, metal wire and plastic with large boulders of concrete and sections of brick wall encountered at depths of between 0.14-1.21m bgl.

In locations TP106 and TP108 a stiff blackish brown gravelly clay was observed overlying the reddish brown gravel at depth of between 0.60-1.00 mbgl and 0.50-1.20mbgl respectively.

In locations (WS102, WS103, TP104) a brownish black sandy gravel with pockets of clay were encountered where the gravel consisted of ash, clinker and mudstone at depths of between 0.33-1.88m bgl. In the case of TP104 a clay layer was observed overlying this layer. This strata is likely to be associated with the former railway tracks.

A layer of firm brownish black sandy gravelly clay was observed in (WS101, WS104, TP102, TP103, TP107, TP108, TP109 and CP101) at depths of between 0.48-1.60m bgl. This was observed as a layer of reworked natural stratum.

Within TP102 a layer of asphalt (0.04-0.07m bgl) was observed to be overlying a layer of concrete (0.07-0.19m bgl) which was underlain with a layer of reddish brown sandy gravel (0.19-0.72m bgl), which was in turn underlain with a layer of reworked clay (0.72-1.42m bgl).



DRIFT

Drift deposits were encountered within the majority of exploratory location with the exception of TP101 where the full depth of Made Ground could not be proven due to potential underlying services.

The drift deposits generally comprised a stiff to very stiff, high to very high strength brown slightly gravelly CLAY with gravel of sandstone and quartz.

CLAY deposits were interbedded with a brown slightly clayey medium SAND within CP101 at a depth of 15.70-15.90m bgl and in CP102 at depths of between 21.20-21.40m bgl.

SOLID GEOLOGY

The solid geology was not encountered during the ground investigation. A review of BGS borehole records in the vicinity of the site have not encountered the underlying bedrock geology, and it is assumed to be in excess of 30.00mbgl.

GROUNDWATER

Groundwater strikes were encountered as strikes, seepages and perched water between 0.60m and 21.20mbgl. True groundwater is considered to be between 15.70m and 21.20mbgl within SAND bands within the CLAY drift deposits.

5.3. SITE PREPARATION

The site should be cleared and any vegetation below areas of proposed development stripped in accordance with Series 200 of the *Manual of Contract Documents for Highway Works (MCHW)*. This should include the following:

-  Roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting void infilled with suitable compacted engineered fill.
-  Demolition of all existing buildings and removal of all concrete hardstanding.
-  Redundant services should be sealed off and grubbed out and replaced with suitable compacted engineered fill.
-  Buried structures and old foundations have been encountered on site. These should be excavated from below the proposed development footprint with the resulting void backfilled.

5.4. FOUNDATION CONDITIONS AND ASSESSMENT OF POTENTIAL BEARING CAPACITIES

In due consideration of the identified ground conditions, in-situ and laboratory geotechnical testing, E3P has undertaken an assessment of the net safe allowable bearing pressure (ABP) within the underlying natural stratum to assist in the detailed design of foundations and infrastructure and determine the target founding stratum. The results of this assessment are summarised in Table 5.1.



TABLE 5.1 SUMMARY OF ABP

COHESIVE SOILS			
Description	Depth (range m bgl)	Undrained Shear Strength (Cu) (kN/m ²)	Allowable Bearing Pressure (kN/m ²)
Stiff CLAY	1.00–2.45	50–54	103–112
Very stiff CLAY	2.00–26.00	90–217	186–447

Based on the assessment of the relative undrained shear strength, relative in-situ densities and corresponding safe net allowable bearing pressure, the suitable target founding stratum has been identified as the underlying stiff to very stiff CLAY.

However, prior to the detailed design of suitable foundations solutions, a programme of remediation and enabling works will be required to cut/fill the site to provide suitable development platform levels and remove any underlying obstructions.

Therefore, upon completion of these enabling works, the Made Ground is likely to be present at varying depths and as such it is likely that the most cost-effective option for the site would comprise either pad foundations bearing at least 500mm below the stiff to very stiff medium to very high strength cohesive soils at circa 2.00mbgl. or to re-engineer the Made Ground using vibro-stone columns (VSCs) to support a pad foundation. Relatively shallow competent stratum has been encountered on site however should a uniform 125 kN/m² be required VSC will reduce settlement and increase the ABP for shallow pad foundations to be cast in engineered Made Ground.

In the event structural loadings require increased safe ABP, it will be necessary to transfer structural loading to the deeper CLAY drift deposits by a pile foundation.

Sporadic trees surround the site periphery and as such their influence will need to be modelled to assess the requirement to deepen foundations (below current elevations) to mitigate the potential for volumetric instability attributed to fluctuations in moisture content in accordance with the requirements of LABC standards.

During development consideration of completing VSC in close proximity to sensitive infrastructure (electricity, gas main, on-site sewage system) must be taken. Consideration should be given to the structural loading and bulb of pressure that will be induced from any structure that may cause risks to below ground infrastructure, therefore foundations may be required to be taken to a depth below the adjacent infrastructure.

Where services are to be diverted the foundation should be founded on treated ground or below the feature in accordance with an approved specification.

Consideration must also be given to the varying soil matrices and differing settlement characteristics and where a foundation spans two varying matrices the sub-structure should be designed accordingly. It will be necessary to locally deepen foundations within influence of existing or proposed trees; tree influence may dictate the requirement for a piled foundation solution. The site is underlain by medium volume change potential clays and should be modelled where tree influence is present to define the requirements for mitigation from trees in cohesive soils.

E3P has prepared a ground improvement design risk matrix, summarised in Table 5.2, to ensure that the ground conditions have been proven by the intrusive site investigation are satisfactory to facilitate the appropriate stabilisation.



TABLE 5.2 GROUND IMPROVEMENT DESIGN RISK MATRIX

RISK ITEM	COMMENT	PASS/FAIL
Soft clays with an undrained shear strength less than 30 kN/m ²	CLAY soils are generally stiff to very stiff with Cu > 50kN from 1.00m bgl.	PASS
Ground with peat layers close to foundation level or the base of the stone column, or where intermediate layers of peat are thicker than 200 mm, either as a single layer or the sum of the thicknesses of individual layers throughout the length of the stone column	None Identified.	PASS
Voided filled ground, e.g. old water tanks, pottery, glass bottles, concrete rubble or brick fill of unsuitable grading	The ground investigation and site inspection has identified Made Ground deposits which will require grading to determine engineering requirements.	PASS – on completion of enabling works
Loose or non-engineered fill not previously subject to rising or fluctuating water levels saturation	None Identified.	PASS
Filled ground still settling or expected to settle under its own weight or due to the effects of surcharging/upfilling where there is a high organic content or where decay is continuing	None Identified.	PASS
Fill, containing degradable material where organic material forms more than 15% of fill by volume	None Identified.	PASS
Clays with a plasticity index greater than 40%	No CLAYs have been identified with a plasticity index of greater than 40%.	PASS
Highly sensitive soils liable to collapse or remoulding	None identified.	PASS
Cohesive soils with trees in influencing distance	Plots with tree influence will require modelling and will either be subject to a piled or mass trench-fill solution.	PASS
Overall Risk Rating and Suitability for Vibratory Ground Improvement		PASS on completion of enabling works

A summary of anticipated foundations is presented in Table 5.3 and a depth to founding plan is included as Drawing 14-255-008 in Appendix III.



TABLE 5.3 ANTICIPATED FOUNDATIONS

LOCATION	ANTICIPATED FOUNDING STRATA DEPTH (m bgl)	GROUND WATER (m bgl)	TARGET STRATUM	TREES	COAL	FOUNDATION TYPE	TYPE OF CONCRETE
CP101	2.05	15.70	Stiff CLAY	N	N	Pad / VSC	DS-1, AC-1s
CP102	1.75	21.20	Stiff CLAY	N	N	Pad / VSC	DS-1, AC-1s
WS101	1.27	1.00	Stiff CLAY	N	N	Pad / VSC	DS-1, AC-1s
WS102	1.75	N/A	Stiff CLAY	N	N	Pad / VSC	DS-1, AC-1s
WS103	1.77	N/A	Stiff CLAY	N	N	Pad / VSC	DS-1, AC-1s
WS104	1.96	N/A	Stiff CLAY	Y	N	Pad / VSC	DS-1, AC-1s
WS105	1.45	N/A	Stiff CLAY	N	N	Pad / VSC	DS-1, AC-1s
WS106	1.45	N/A	Stiff CLAY	N	N	Pad / VSC	DS-1, AC-1s
TP102	1.87	N/A	Stiff CLAY	N	N	Pad / VSC	DS-1, AC-1s
TP103	1.83	N/A	Stiff CLAY	N	N	Pad / VSC	DS-1, AC-1s
TP104	2.33	1.88	Stiff CLAY	N	N	Pad / VSC	DS-1, AC-1s
TP105	1.85	N/A	Stiff CLAY	N	N	Pad / VSC	DS-1, AC-1s
TP106	2.55	N/A	Stiff CLAY	N	N	VSC	DS-1, AC-1s
TP107	1.85	N/A	Stiff CLAY	N	N	Pad / VSC	DS-1, AC-1s
TP108	1.80	N/A	Stiff CLAY	Y	N	Pad / VSC	DS-1, AC-1s
TP109	1.68	N/A	Stiff CLAY	Y	N	Pad / VSC	DS-1, AC-1s
TP110	1.85	N/A	Stiff CLAY	N	N	Pad / VSC	DS-1, AC-1s
TP111	1.75	N/A	Stiff CLAY	N	N	Pad / VSC	DS-1, AC-1s

It is recommended that, at working drawing stage, a foundation schedule is prepared for the development taking account of the physical change of natural clay soils and the current/proposed locations of trees.

5.5. GROUND FLOOR SLABS

Following enabling works, the site will likely have a variable thickness of Made Ground, that may extend to significant depth in places. Given the structures that are proposed, it is considered that ground-bearing floor slabs will require settlement analysis and detailed design in order to accommodate variability of the formation and account for differential settlement.

A ground-bearing slab will be viable for the commercial structures; however, it will need to be constructed utilising a sub-base with the thickness designed by a structural engineer to ensure that settlement tolerances are taken into consideration. Consideration should be given at design stage with respect to settlements and loadings where the floor slab spans varying soil types and isolated areas of increased Made Ground, therefore a requirement for a detailed earthworks specification is recommended.



Where a ground-bearing floor slab is to be constructed within the conjectured zone of tree influence, the clay will need to be removed to ensure that any desiccated soil cannot swell and induce heave to the structure. Alternatively, it may be possible to design the structure to resist the influence of clay heave using exaggerated sub-base and additional reinforcement within the slab to be designed by the structural engineer.

Where it is necessary to undertake cut-and-fill works utilising site-derived cohesive soils, careful consideration must be given to seasonal climatic conditions, which will have a significant impact of moisture conditions and the ability to compact clay soils in the wetter winter months. It may be necessary to undertake an element of stabilisation works through the addition of lime to ensure the soils can be engineered to the required performance standards.

It would be possible to utilise soil stabilisation techniques that incorporate the addition of lime and OPC to construct a stiffened soil horizon with a CBR > 15% to constitute a sub-base replacement layer that could then be capped with Type 1 MOT. The use of soil stabilisation could be extended within the conjectured zone of tree influence to modify the structure of clay soils and negate the potential for volumetric instability.

5.6. HEAVE PRECAUTIONS

The site has been proven to be underlain by clay soils, which are susceptible to volumetric instability due to fluctuations in moisture content, particularly within influencing distance of trees as per the NHBC/LABC conjectured zones of influence.

As the clay is deemed to be moderate plasticity, heave precautions are required to the internal face of the external load-bearing walls (outside or within tree influence).

If a ground beam is to be constructed within the zone of tree influence, heave precautions are required to the underside of this and edge beams.

If the ground floor slab is to be constructed with a beam and block floor, a minimum subfloor void of 250 mm is required within any structures located in the zone of conjectured tree influence.

If the ground floor slab is constructed with a cast in-situ suspended floor slab, then heave precautions that can tolerate 50 mm of clay swelling are required within any part of the floor slab to be located within the zone of influence of a tree.

A summary of heave precautions is presented in Table 5.4.



TABLE 5.4 SUMMARY OF HEAVE PRECAUTIONS

		MINIMUM VOID DIMENSION FOR FOUNDATIONS, GROUND BEAMS AND SUSPENDED IN-SITU CONCRETE GROUND FLOORS		MINIMUM VOID DIMENSIONS UNDER PRECAST CONCRETE AND SUSPENDED TIMBER FLOORS
Plasticity Index of Soil	Required Foundation Depth (m)	Thickness of Void Former Against Side of Foundation or Ground Beam (mm)	Thickness of Void Former on Underside of Edge Beam and Floor Slab (mm)	Void Dimension (mm)
High Plasticity (> 40)	> 2.5	Engineer Design		Engineer Design
	2.0–2.5	35	150	300
	1.5–2.0	25	75	
Moderate Plasticity (20–40)	> 2.5	Engineer Design		Engineer Design
	2.0–2.5	25	100	250
	1.5–2.0	25	50	
Low Plasticity (< 20)	2.0–2.5	N/A	50	200
	> 2.0	No Special Precautions		

5.7. HIGHWAYS CONSTRUCTION

A programme of remediation and enabling works will be required to remediate the proposed road subgrade in accordance with the requirements of the Manual of Contract Documents for Highway Works Volume 1 Specification For Highway Works (Series 600-Earthworks) for a method compaction.

It is considered that the material can be re-engineered using method compaction to achieve a CBR in excess of 5% if works are completed in favourable climatic conditions.

5.8. DRAINAGE

The presence of substantial depths of Made Ground across some areas of the site may result in settlement. It is therefore recommended that drain runs are designed using steeper gradients and flexible joints to allow for some differential settlement.

Furthermore, the site is predominantly underlain by in excess of 5.00 m of likely low-permeability gravelly CLAY. Falling head permeability tests have been completed, and a poor soakaway potential was calculated. As such, it is not recommended that soakaways are utilised for disposal of surface water runoff.



5.9. CONCRETE DURABILITY

Based upon the results of the chemical analyses it is considered that subsurface concrete can be designed in accordance with Design Sulphate Class DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-1s in accordance with the recommendations provided in BRE *Special Digest 1* (2005).

5.10. EXCAVATIONS

Trial pits were generally stable in both granular Made Ground and natural strata; as such, it is considered that near-surface excavations will be feasible. In areas where Made Ground exceeded 2 m, excavations were generally less stable. Stability decreased where concrete boulders and brick wall sections were encountered.

Site observations indicated that excavations should be feasible in the near surface with normal plant.

However, due to the depth and variability of the Made Ground and likelihood of trench collapse, it is considered that all excavations are supported or battered back in accordance with guidance contained in CIRIA R97.

If local pumping of groundwater is required during the advancement of excavations for the proposed foundations then consideration should be given to the potential for dewatering gravels in the surrounding areas that may cause structural damage to building substructures in close proximity to the site.

TABLE 5.5 CIVIL ENGINEERING EXCAVATION RISK MATRIX

RISK ITEM	PRESENT	COMMENT
Running Sands	No	No running sand has been identified.
Minor Water Ingress	Yes	Ingress of water into foundation excavation will potentially flood foundation excavations, limiting the viability of spread foundations to be constructed.
Shallow Bedrock	No	Bedrock has not been encountered on site.



5.11. CONSTRUCTION ACTIVITY AND INSPECTION

The following activities and inspections should be incorporated into the site works:

- ✿ Due to the variability of the soils at the site, it is recommended that sufficient allowance is made for the inspection of formations and sub-formations to foundations and pavement construction.
- ✿ Due to the presence of service infrastructure on-site and high pressure gas main in close proximity to the site, consideration should be given to the structural loading and bulb of pressure that will be induced from any structure that may cause risks to below ground infrastructure, therefore foundations may be required to be taken to a depth below the adjacent infrastructure.
- ✿ Excavations where access is required should be subject to a risk assessment from a competent person and, where appropriate, mitigation measures such as benching back the sides or use of support systems in accordance with CIRIA R97 should be utilised.
- ✿ It is considered that dewatering may be required, especially following periods of heavy rainfall. Removal of surface water and water within trenches should be possible with conventional sump pumping. Discharge of any water should be agreed with the relevant regulatory body and be undertaken under a trade effluent discharge, where required. Measures to remove silt and suspended solids may be required and consideration should be given to provision of space for settling tanks or an attenuation pond.
- ✿ Where access to confined spaces is required, appropriate mitigation measures should be addressed within the construction stage health and safety plan. Particular account should be taken of the gas results.
- ✿ The presence of potential contamination and mitigation measures should be addressed as part of the construction stage health and safety plan and should include measures to design out the risks, reduce their impact and, finally, to include the use of personnel protective equipment (PPE).



5.12. GEOTECHNICAL RISK REGISTER

POTENTIAL CONSTRAINT	ABNORMAL	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Remediation of contaminated soils		On site	20	Asbestos in the form of chrysotile trace fibres have been encountered within localised areas of Made Ground on site (<0.001%-0.002%). These soils will require suitable management during future works on site to ensure there is no risk to construction workers, third parties (off-site) or future end users. Elevated concentrations of PCBs have been identified which will require delineation and removal, with an assessment of the materials for their suitability to remain on site.
Bedrock		NA	0	Shallow bedrock has not been identified on site.
Obstructions		All	0	Concrete and brick boulders have been identified on site which will require removal.
Artificially levelled and filled platforms		All	100	The site appears to have been levelled and artificially backfilled.
Retaining walls		NA	0	No retaining walls were identified on the subject site,
Trench collapse		All	100	Trial pits were generally stable during the site investigation, however large boulders of brick wall and concrete were encountered which may reduce the stability of excavations during enabling works and may cause locations to be prone to collapse.
Mature trees		On site	TBC	Arboriculture survey required to determine areas of potential tree influence. The site is predominantly surfaced by hardstanding; however a number of semi mature trees are present on the site's periphery.
Volume change potential clay		On site	100	The site is underlain by cohesive soils which have been determined to be of moderate plasticity and as such heave precautions will be required.
Peat		NA	0	No peat has been identified on site.
Running sands		N/A	N/A	Data searches indicate no hazard to very low risk.



Pacific Park Wrexham

Phase II Geoenvironmental Site Assessment
May 2021

POTENTIAL CONSTRAINT	ABNORMAL	LOCATION ON SITE	ESTIMATED AREA OF SITE AT RISK (%)	ASSESSMENT AND MITIGATION
Ground dissolution		N/A	N/A	Data searches indicate no hazard.
Concrete design		On site	100	The subject site meets DS-1, AC-1s concrete classification.
Low-permeability ground		On site	100	Soakaways unlikely to be effective on site due to the presence of low permeability cohesive deposits underlying the site.
Services/sensitive structures		On site	20	A review of online services has identified a number of services within the site boundary. Piling may not be possible within close proximity to any sensitive infrastructure.
Abnormal foundation solutions		On site	100	Significant Made Ground deposits are present on the subject site; it is likely either a pad foundation or re-engineering of the Made Ground with VSC to support a pad foundation is most likely the most effective foundation solution for the subject site.
Areas not investigated		On site	10	The area of historic infilled water feature was not investigated due to the close proximity of underlying services within this area.
Surface water features		NA	0	No surface water features located on site.
Current ponds to be filled		NA	0	No ponds currently present on site.
Historically infilled pond		On site	10	A historic infilled pond is located in the west of the subject site which requires further works and analysis when access is available. Access was restricted during the site investigation due to the presence of service infrastructure.
Quarry high wall		NA	0	Not present on site.
Mining		NA	0	Not present on site.
Slope		NA	0	The site is relatively level in topography. The northern portion of the site is roughly 1.5m higher than the surrounding offsite land to the west, along Bridge Road North. Care should be taken to ensure no instability is created during enabling works.



5.13. FURTHER WORKS

Based on the findings of the intrusive site investigation, the following additional works are recommended to be completed in due course:

-  Further investigation of inaccessible areas in the vicinity of the former pond.
-  Plot-specific foundation schedule (upon receipt of the final development levels).
-  Arboricultural survey.
-  Geotechnical earthworks strategy (infrastructure).
-  Remediation and enabling works strategy.
-  Construction phase Surface Water Management Plan.



6. CONCLUSIONS AND RECOMMENDATIONS

6.1. CONTAMINATED LAND ASSESSMENT

Human Health	A Tier I human health risk assessment has been undertaken using the chemical analysis results of the soils and comparing to the relevant Tier I criteria for a commercial development. This assessment has identified the presence of elevated levels of asbestos, non-volatile PAHs, PCBs and detectable SVOC presence. All of the identified elevated concentrations have primary exposure pathways related to dermal contact and ingestion of soils, inhalation of particulate and inhalation of vapours. The risk to chronic human health associated with the elevated concentrations on non-volatile PAH compounds can be mitigated through the installation of a suitable cover system in all, landscaping and public open space to remove any potential for direct exposure to impacted soils or for the commercial premises covered by suitable hardstanding. Asbestos in the form of chrysotile and amosite has also been identified within localised areas in shallow Made Ground deposits. Asbestos quantification has been completed with concentrations between <0.001% and 0.002%. No visual signs of ACM were encountered during the ground investigation; it is therefore likely that only trace fibres are present. It is likely that trace fibres are present within all Made Ground deposits on site. Impacted soils should be managed according to the asbestos risk mitigation conceptual site model. Asbestos has been identified in WS101 and TP108 at a concentration of 0.002%. These areas should therefore be isolated and undergo a phase of delineation and hotspot removal with placement within an area of low sensitivity in line with the asbestos risk mitigation conceptual site model. PCBs have been identified within Made Ground and CLAY drift deposits within WS101 and are considered to be elevated. As such a phase of hotspot removal should be undertaken with the area delineated and impacted materials removed, and the resulting area validated. Assessment will then be required as to whether the materials can remain on site in an area of low sensitivity or will require removal from site. It is recommended a watching brief is completed during works in this area as part of the enabling works. Concentrations of SVOCs above the laboratory limit if detection have been identified however given the properties of the SVOCs identified they are unlikely to cause a vapour risk at the site.
Controlled Waters	Elevated concentrations of chromium (VI), zinc, pH, naphthalene and TPH Aromatic C12-C16 have been identified within leachate analysis. Within the groundwater analysis elevated levels of selenium and zinc were identified. The underlying Made Ground is considered to be the source of potential elevated determinants. The site is underlain by cohesive CLAY drift deposits which are of low permeability and will limit lateral and vertical migration of any possible contaminants.



Controlled Waters Cont.	The site is not located within influencing distance of any surface water features. Furthermore, the closest abstraction point is located 686m south of the site and utilised for process water. Given the distance from site and presence of low permeability CLAY deposits the risk is considered to be low.
Ground Gas	Characteristic Situation 1 (pending completion of gas monitoring).
Potable Water	This will need to be confirmed following the completion of a UKWIR risk assessment. Post-remediation and enabling works ground conditions may be different from those identified during this site investigation, however an allowance for barrier pipe should be considered.

6.2. GEOTECHNICAL ASSESSMENT

A number of concrete and brick obstructions have been encountered within the Made Ground indicative of fill material used to raise levels for the subject site. These were encountered as large boulders of brick and concrete. These will require removal during enabling works to prepare a development platform.

The underlying natural clay drift deposits have been assessed as being stiff to very stiff, medium strength to very high strength with a net ABP in the order of 103-112 kN/m² at circa 1.00-2.45 m bgl increasing to 186-447 kN/m² at circa 2.00-26.00 m bgl.

Upon completion of enabling works, the Made Ground is likely to be present at varying depths and as such it is likely that the most cost-effective option for the site would comprise either pad foundations bearing at least 500mm below the stiff to very stiff medium to very high strength cohesive soils at circa 2.00mbgl. or to re-engineer the Made Ground using vibro-stone columns (VSCs) to support a pad foundation. In the event structural loadings require increased safe ABP, it will be necessary to transfer structural loading to the deeper CLAY drift deposits by a pile foundation.

During development consideration of completing VSC in close proximity to sensitive infrastructure must be taken. Furthermore, consideration of the structural loadings that will induce a bulb of pressure should be taken into account.

END OF REPORT



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



Pacific Park

Phase II Geoenvironmental Site Assessment

May 2021

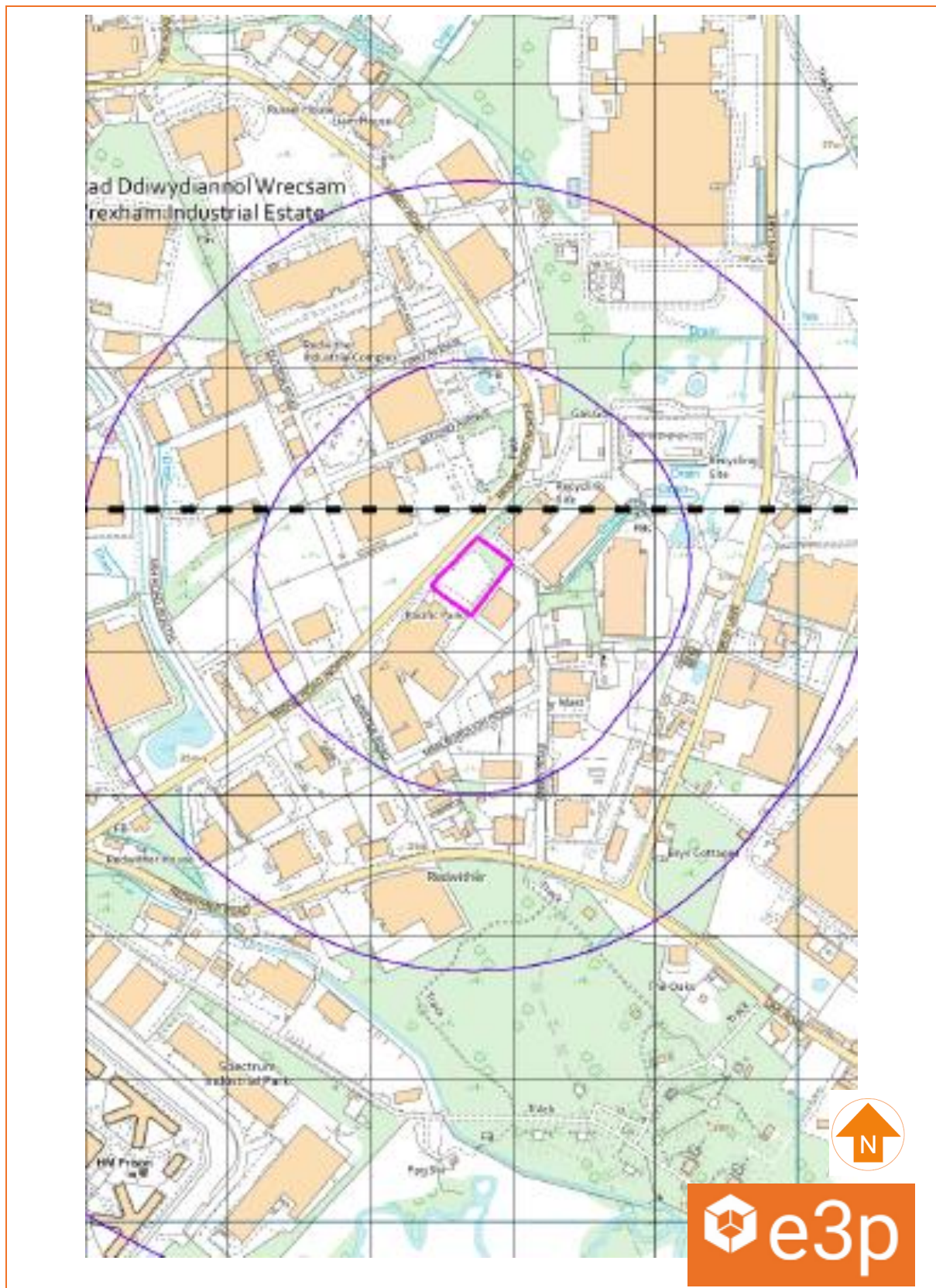
MIBK	Methyl isobutyl ketone	WTE	Water table elevation
m	Metres	ppm	Parts per million
km	Kilometres	mg/m³	Milligram per metre cubed
% v/v	Percent volume in air	m bgl bgl	Metres below ground level
mb	Millibars (atmospheric pressure)	m bcl	Metre below cover level
l/hr	Litres per hour	mAOD	Metres above ordnance 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

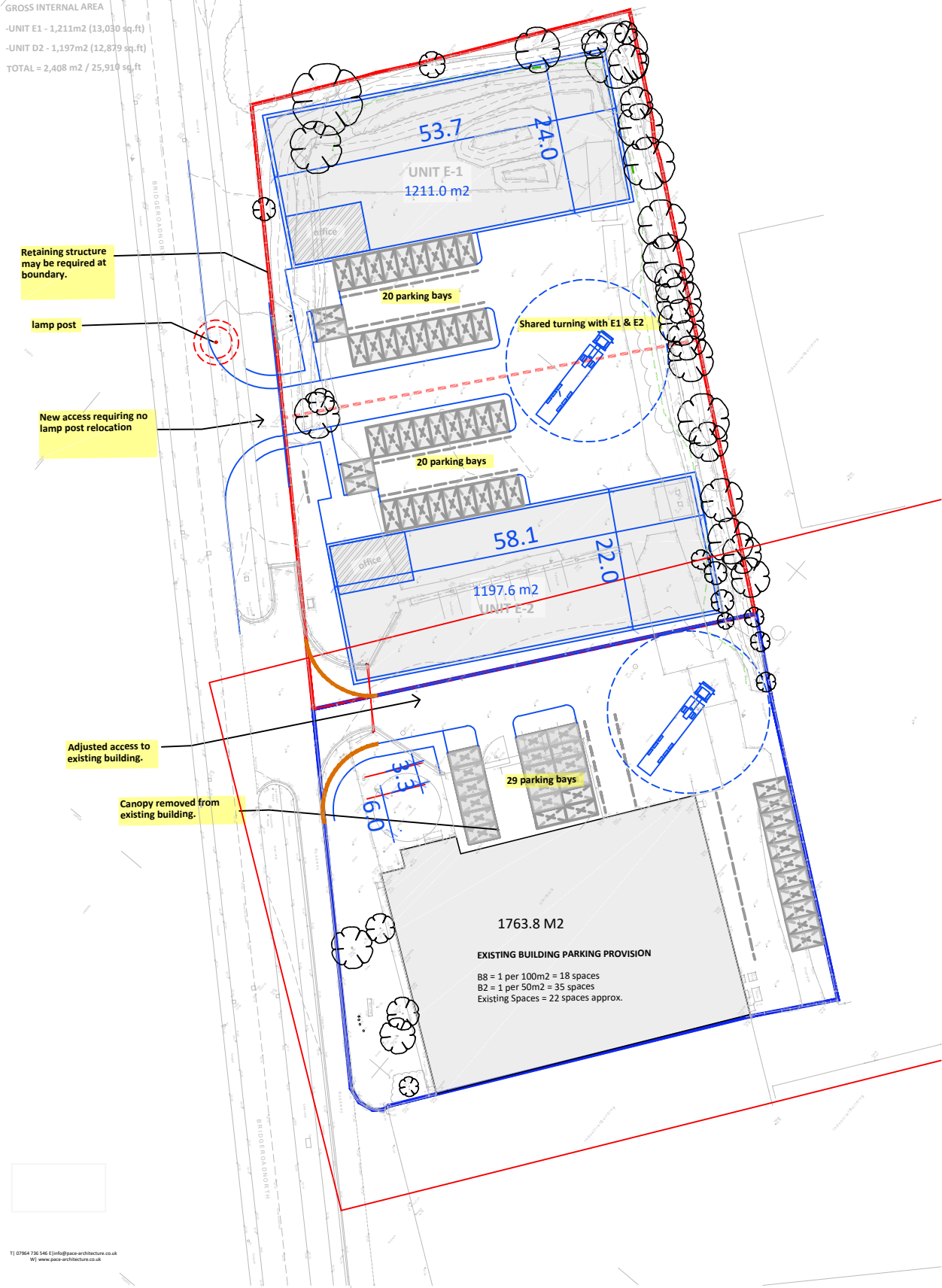
DRAWINGS

DRAWING 14-255-001 – SITE LOCATION PLAN



OPTION E Rev A

GROSS INTERNAL AREA
-UNIT E1 - 1,211m2 (13,030 sq.ft)
-UNIT D2 - 1,197m2 (12,879 sq.ft)
TOTAL = 2,408 m2 / 25,910 sq.ft



T: 0161 738 546 E: info@e3p.co.uk
W: www.e3p.co.uk

Notes:				
P1	REVA	06.07.2020	LM	BH
Phase	Issue	Date	Drawn	Checked

Client:	
Multimaq Ltd	
Job Title:	
Pacific Park, Wrexham	

Job No:
14-255
Drawing No:
002

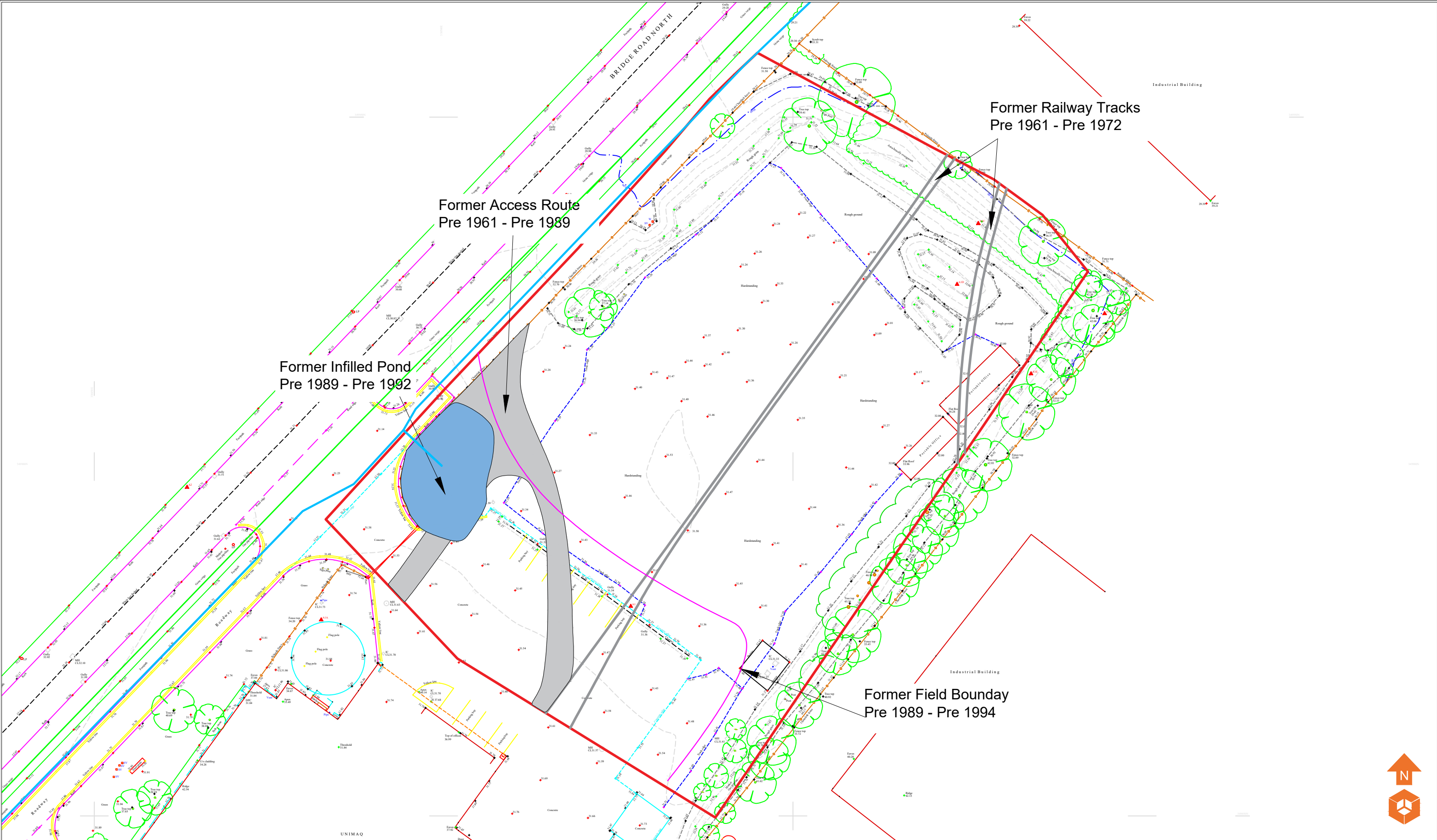
Date:
06.07.2020
Scale:
NTS@ A3

Drawing Title:
Proposed Development Plan



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

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- Historical Features
- Former Pond
 - Former Access Route
 - Former Railway Tracks
 - Former Field Boundary

Notes:				
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P1	REVA	06.07.2020	LM	MJ
Phase	Issue	Date	Drawn	Checked

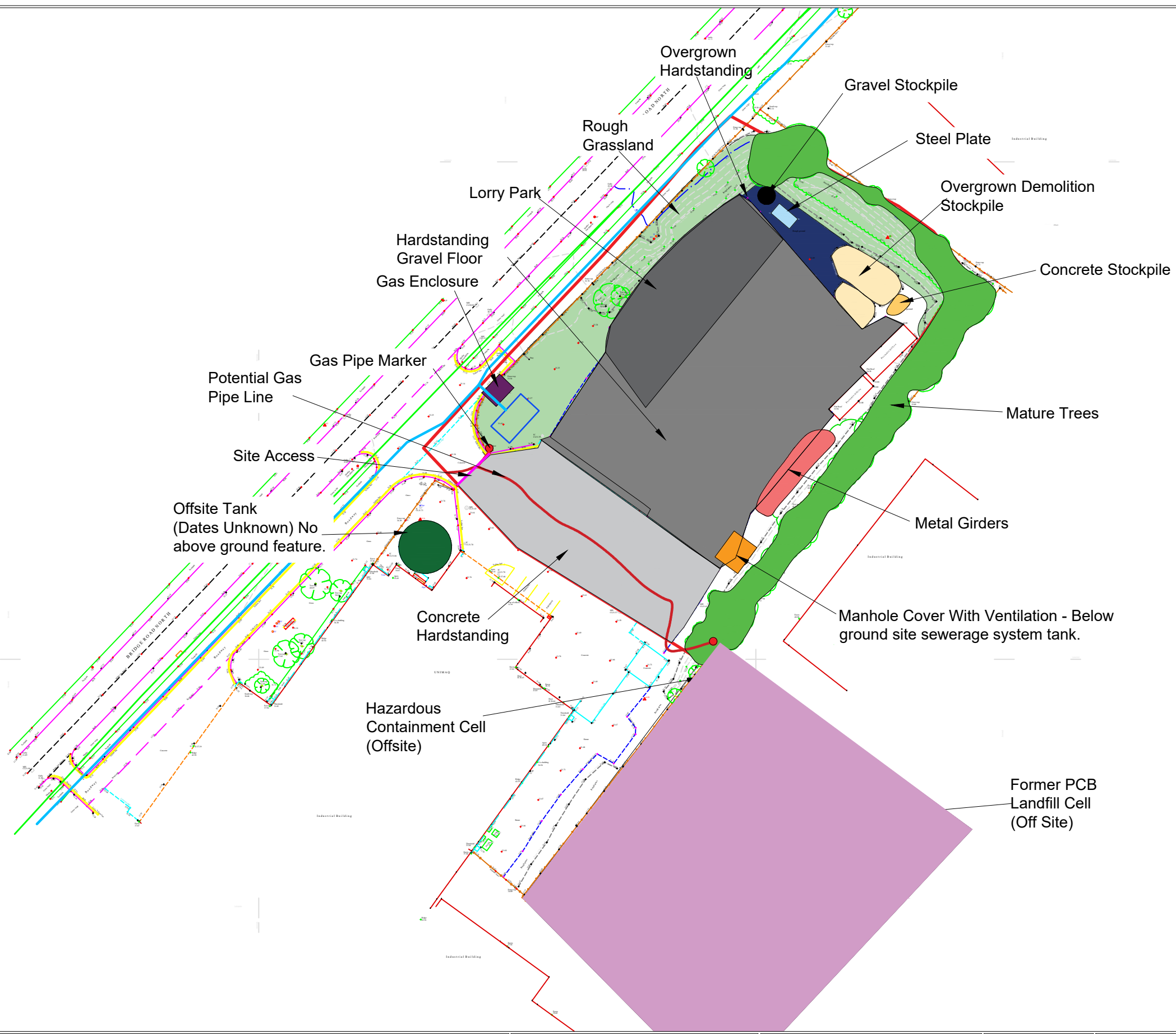
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Job Title:	Pacific Park, Wrexham

Job No:	14-255	Date:	12.05.2021
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Environmental Engineering Partnerships Ltd
City Heliport & Business Centre
Eccles, Manchester, M30 7RU
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

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Site Features

Gravel Stockpile

Lorry Parking

Hardstanding Rubble

Concrete Hardstanding

Overgrown Demolition StockPiles

Concrete Stockpile

Manhole Cover

Metal Girders

Gas Pipe Marker

Potential Gas Pipe

Site Access

Steel plate

Former PCB Landfill Cell

Tank

Overgrown Hardstanding

Rough Grassland

Gas Enclosure

Offsite Containment Cell

Notes:

P1	REVE	12.05.2021	EB	BH
P1	REVD	21.04.2021	EB	BH
P1	REVC	31.07.2020	HM	BH
P1	REVB	30.07.2020	LM	BH
P1	REVA	06.07.2020	LM	MJ
Phase	Issue	Date	Drawn	Checked

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Multimaq Ltd

Job Title:

Pacific Park, Wrexham

Job No:

14-255

Drawing No:

004

Job Title:

Pacific Park, Wrexham

Date:

12.05.2021

Scale:

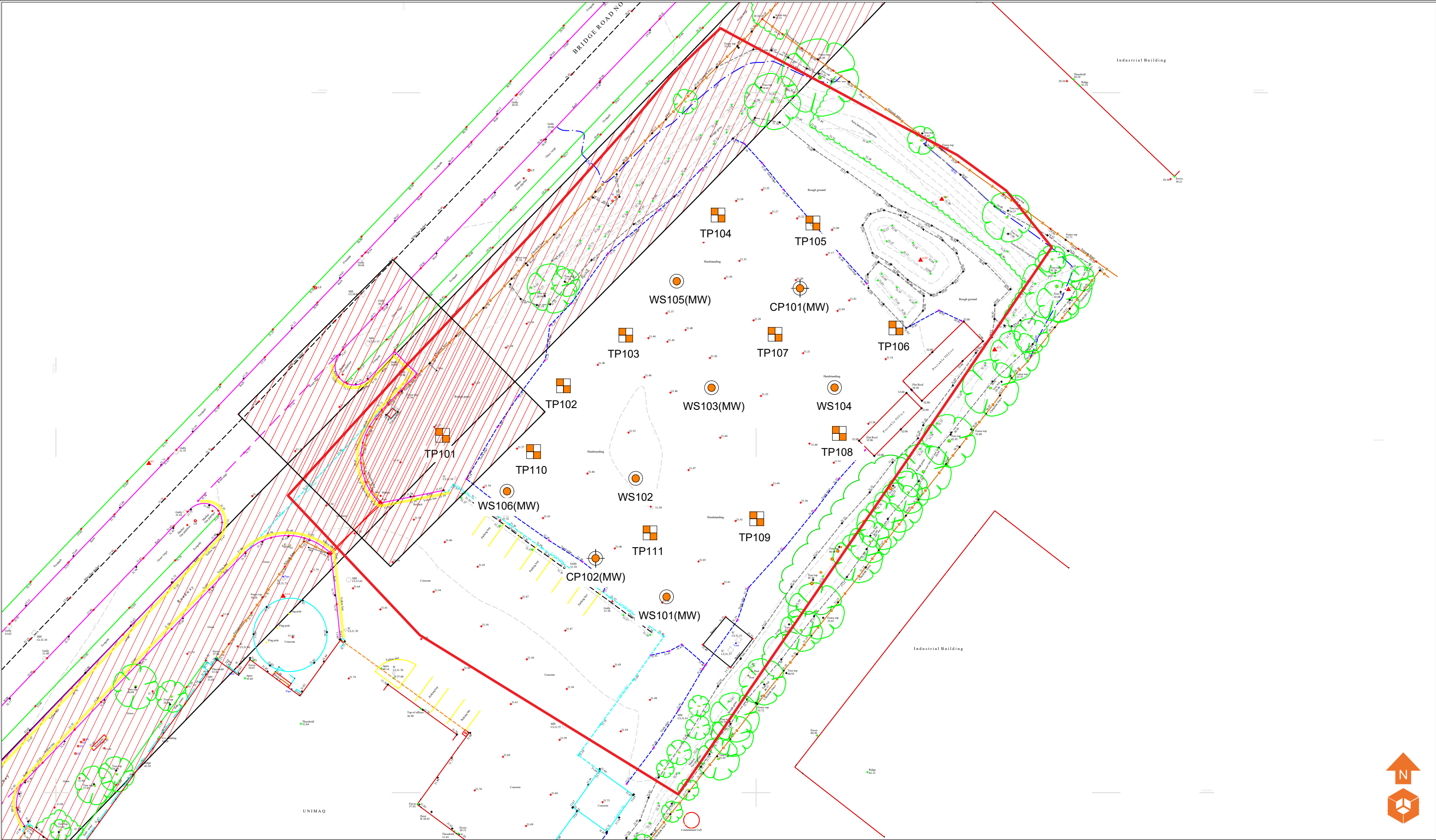
NTS@ A3

Drawing Title:

Site Features Plan

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Urmston, Manchester, M41 7JQ
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

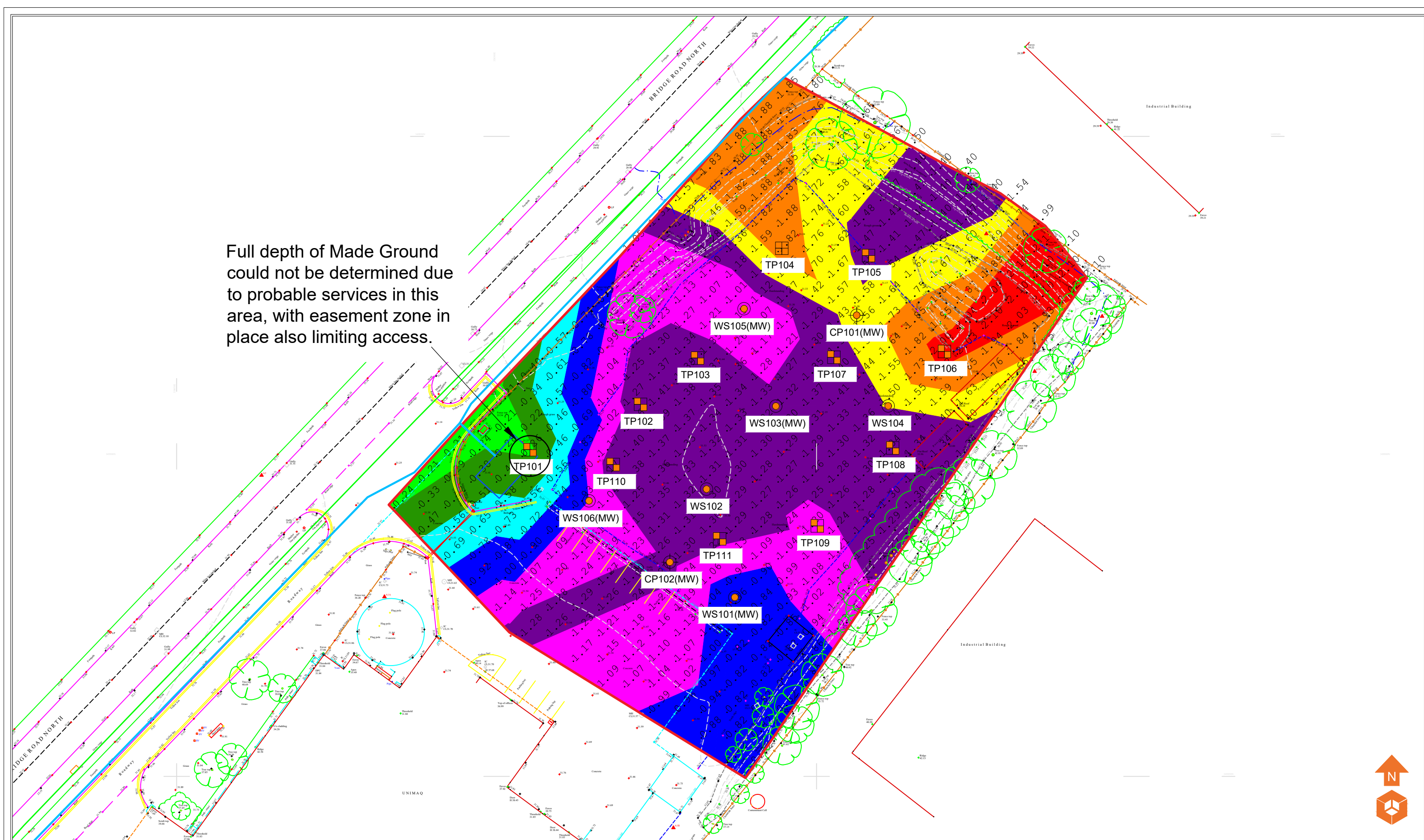
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Location Symbols Approximate Window Sample Probehole Location Approximate Window Sample Probehole Location with Install Approximate Trial Pit Location Approximate Cable Percussive Borehole Location Approximate Cable Percussive Borehole Location with Install Gas Main Easement / Gas Governor Box	Notes:	Client: Multimaq Ltd	Job No: 14-255	Date: 12.05.2021	Environmental Engineering Partnerships Ltd City Heliport & Business Centre Eccles, Manchester, M30 7RU Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk
P1 REV B 12.05.2021 EB BH P1 REV A 26.02.2021 EB MJ Phase Issue Date Drawn Checked	Job Title: Pacific Park, Wrexham	Drawing No: 005	Scale: NTS	Drawing Title: Exploratory Hole Location Plan	

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Full depth of Made Ground could not be determined due to probable services in this area, with easement zone in place also limiting access.



Location Symbols

- Approximate Window Sample Probehole Location
- Approximate Window Sample Probehole Location with Install
- Approximate Trial Pit Location
- Approximate Cable Percussive Borehole Location

Made Ground Depth (m)

- Depth of Made Ground 0.00 - 0.24m
- Depth of Made Ground 0.25 - 0.49m
- Depth of Made Ground 0.50 - 0.74m
- Depth of Made Ground 0.75 - 0.99m
- Depth of Made Ground 1.00 - 1.24m
- Depth of Made Ground 1.25 - 1.49m
- Depth of Made Ground 1.50 - 1.74m
- Depth of Made Ground 1.75 - 1.99m
- Depth of Made Ground >2.00m

Full Depth of Made Ground Not Proven

Notes:

P1	REVC	12.05.2021	EB	BH
P1	REVB	21.04.2021	EB	BH
P1	REVA	26.02.2021	EB	MJ
Phase	Issue	Date	Drawn	Checked

Client:

Multimaq Ltd

Job Title:

Pacific Park, Wrexham

Job No:

14-255

Drawing No:

006

Date:

12.05.2021

Scale:

NTS@ A3

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

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Services and easement
restricted access however
founding depth likely circa
1.75mbgl into natural CLAY
stratum.

Former Pond



Location Symbols

- Approximate Window Sample Probehole Location
- Approximate Window Sample Probehole Location with Install
- Approximate Trial Pit Location
- Approximate Cable Percussive Borehole Location

Shallow Spread Footings

- Depth to Founding Strata 0.00 - 1.24m
- Depth to Founding Strata 1.25 - 1.49m

Mass Trench Fill Footings

- Depth to Founding Strata 1.50 - 1.74m
- Depth to Founding Strata 1.75 - 1.99m
- Depth to Founding Strata 2.00 - 2.24m

Engineered Footings

- Depth to Founding Strata 2.25 - 2.49m
- Depth to Founding Strata >2.50m

Full Depth of Founding Strata Not Identified

Notes:				
P1	REVc	12.05.2021	EB	BH
P1	REVB	21.04.2021	EB	BH
P1	REVA	06.04.2021	EB	MJ
Phase	Issue	Date	Drawn	Checked

Client:

Multimaq Ltd

Job Title:

Pacific Park,
Wrexham

Job No:

14-255

Drawing No:

008

Date:

21.05.2021

Scale:

NTS

Drawing Title:

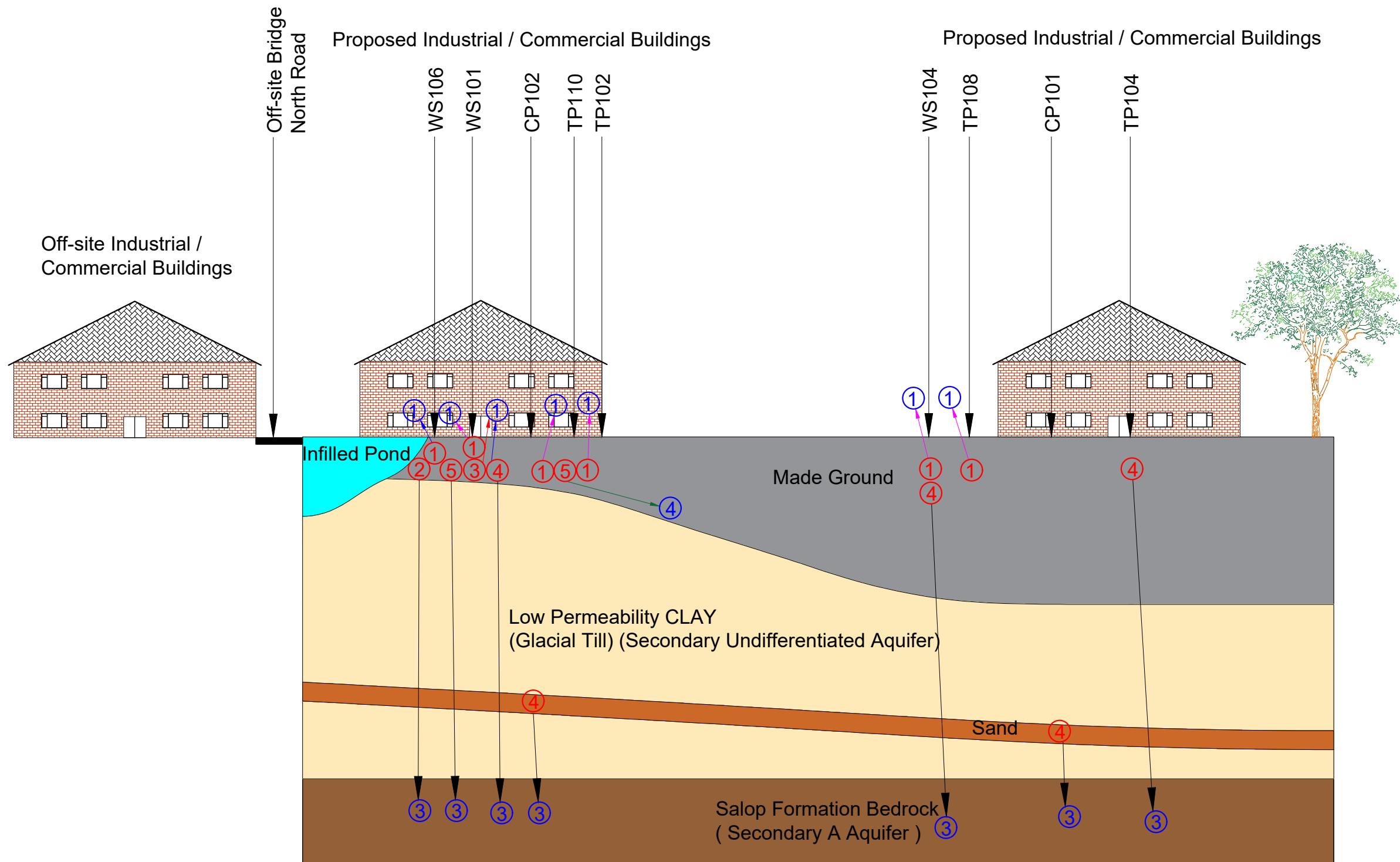
Depth Of Founding
Strata Plan

Environmental Engineering
Partnerships Ltd
City Heliport & Business Centre
Eccles, Manchester, M30 7RU
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

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SW

NE



Geology Key

- Made Ground
- Clay
- Bedrock
- Infilled Pond
- Off-site Bridge
- Sand

Sources

- 1 Asbestos
- 2 PAH's
- 3 PCB's
- 4 Heavy Metals
- 5 TPH's

Receptors

- 1 Construction Workers & End Users
- 2 Off Site Land User
- 3 Secondary A aquifer
- 4 Potable Water Supply

Pathways

- Dermal Contact / Ingestion
- Vapour Inhalation
- Inhalation / Accumulation
- Tainting of Water Supplies
- Dust Inhalation
- Vertical Migration
- Lateral Migration

Notes:

P1	REVB	12.05.2021	EB	BH
P1	REVA	19.04.2021	EB	BH
Phase	Issue	Date	Drawn	Checked

Client:

Multimaq Ltd

Job Title:

Pacific Park,
Wrexham

Job No:

14-255

Drawing No:

010

Date:

12.05.2021

Scale:

NTS@ A3

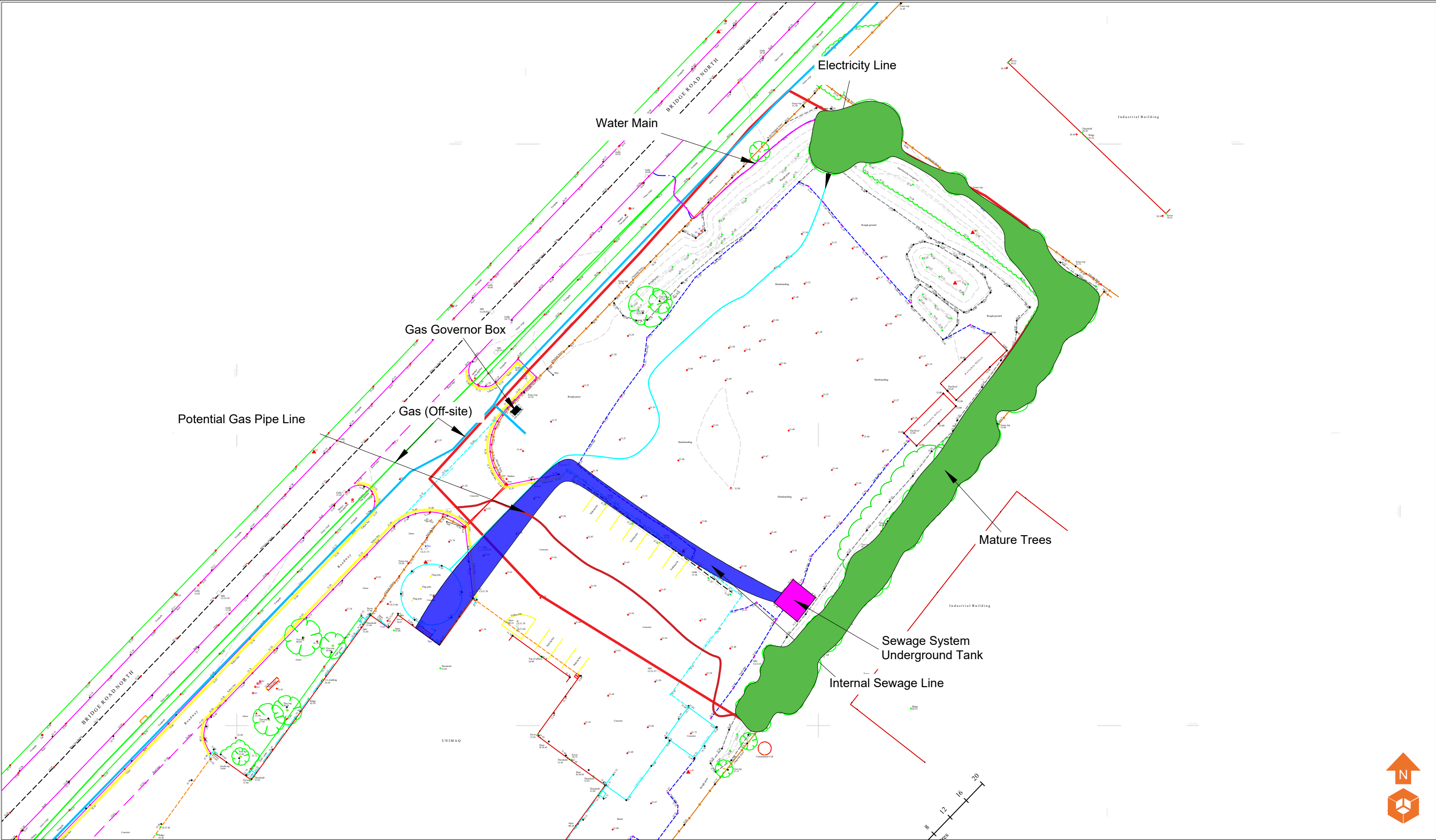
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Conceptual Site
Model

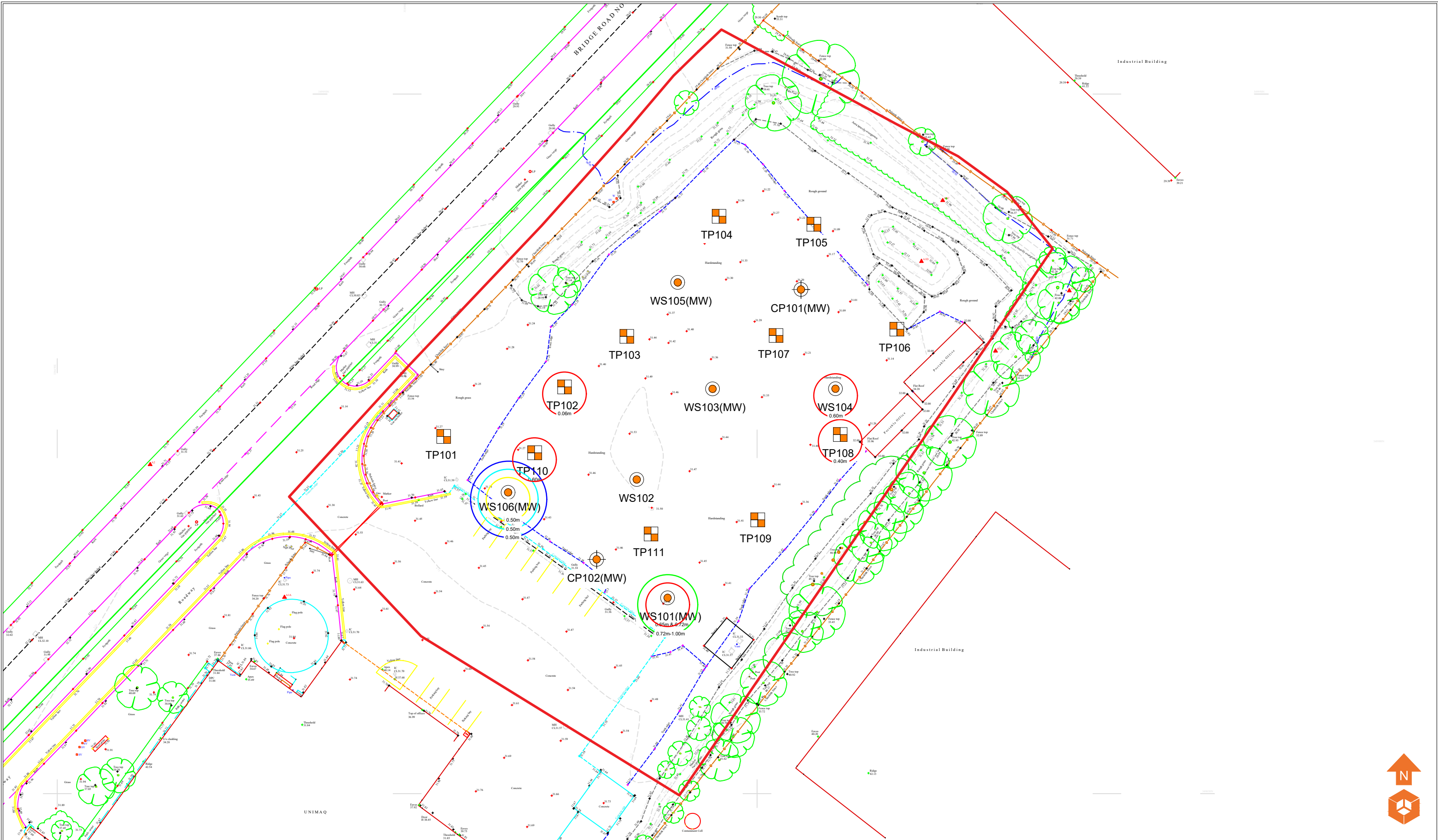


Environmental Engineering
Partnership Ltd
Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

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Development Constraints Internal Sewerage Line Sewage System Underground Tank Gas Governor Box Mature Trees Water Main Electricity Line Potential Gas Pipe Line	Notes:					Client: Multimaq Ltd		Job No: 14-255	Date: 12.05.2021	e3p Environmental Engineering Partnerships Ltd City Heliport & Business Centre Eccles, Manchester, M30 7RU Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk
	P1 REVB 12.05.2021 EB BH P1 REVA 06.04.2021 EB BH					Job Title: Pacific Park, Wrexham		Drawing No: 015	Scale: NTS	
	Phase Issue Date Drawn Checked							Drawing Title: Development Constraints Plan		



- Location Symbols**

 - Approximate Window Sample Probehole Location
 - Approximate Window Sample Probehole Location with install
 - Approximate Trial Pit Location
 - Approximate Cable Percussive Borehole Location
 - Approximate Cable Percussive Borehole Location with install
- Elevated Concentrations of Contaminants of Concern**

 - Asbestos
 - PCB's
 - Benzo(b) Fluoranthene
 - Benzo(a) Pyrene
 - Dibenzo(a,h) Anthracene

Notes:				
P1	REVB	12.05.2021	EB	MJ
P1	REVA	06.04.2021	EB	MJ
Phase	Issue	Date	Drawn	Checked

Client:
Multimaq Ltd
Job Title:
Pacific Park, Wrexham

Job No:
14-255
Drawing No:
018

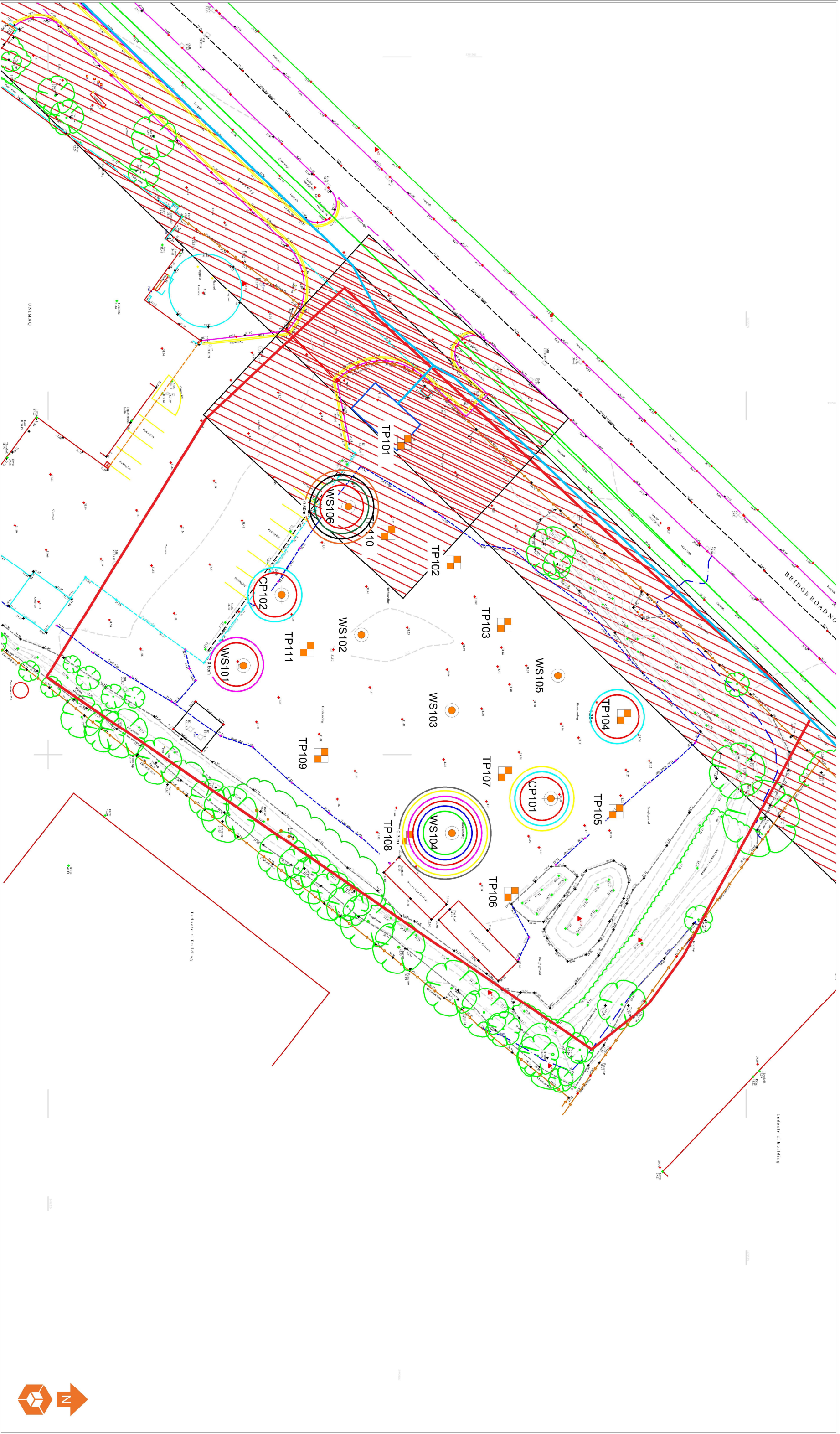
Date:
12.05.2021
Scale:
NTS



Environmental Engineering Partnerships Ltd
City Heliport & Business Centre
Eccles, Manchester, M30 7RU
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

Drawing Title:
Contamination Issues Plan - Soils

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APPENDIX IV PHOTOGRAPHS

PLATE 1 VIEW OF TP104 EXCAVATION



PLATE 2 VIEW OF TP106 EXCAVATION



PLATE 3 VIEW OF TP108 EXCAVATION



PLATE 4 VIEW OF TP110 EXCAVATION



APPENDIX V

E3P EXPLORATORY HOLE LOGS

Project Name: Pacific Park

Project No.
14255

Co-ords: 338507.00 - 349904.00
Level:

Date
16/02/2021

Location: Wrexham

Dimensions (m): 2.00

Scale
1:30

Client: Multimaq Limited

Depth
0.21

1.00

2.00

Logged
J Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.17	ES		0.09 0.20 0.21		 	MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to subangular of concrete and limestone. MADE GROUND: Stiff brownish black, sandy gravelly clay. Gravel is fine to coarse angular to subangular, of brick and concrete. MADE GROUND: Grey slightly silty sandy gravel. Gravel is fine to coarse angular to subangular of limestone. (MOT) End of Pit at 0.21m

Trial Pit Photographs



Trial Pit 101



Trial Pit 101

Remarks: 1. Trial pit terminated at 0.21m bgl due to potential underlying services.

Stability: Stable

Project Name: Pacific Park	Project No. 14255	Co-ords: 338528.00 - 349914.00 Level:	Date 16/02/2021
Location: Wrexham		Dimensions (m): 2.00 1.00	Scale 1:30
Client: Multimaq Limited		Depth 2.10	Logged J Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.03 0.06	ES ES		0.04 0.07 0.19			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to subangular of concrete, limestone and asphalt. MADE GROUND: Black slightly sandy gravel. Gravel is fine to coarse angular to subangular of asphalt. MADE GROUND: Concrete.	
	0.60	ES		0.72			MADE GROUND: Reddish brown sandy gravel with cobbles and boulders. Gravel is fine to coarse angular to subangular to subrounded of concrete, brick, limestone, metal wire and plastic. Cobbles are angular to subangular of concrete and brick. Boulders are angular to subangular of concrete and brick (wall sections).	1
	1.00 1.00	ES HVP	138				MADE GROUND: Blackish brown gravelly clay. Gravel is fine to coarse angular to sub-angular of brick and concrete.	
	1.50 1.50	ES HVP	127	1.42			Stiff high strength brown, slightly gravelly CLAY. Gravel is fine to coarse rounded to subangular, of sandstone and quartz. (Becoming very stiff, very high strength at circa 2.00m bgl)	2
	2.00	HVP	153	2.10			End of Pit at 2.10m	3
								4

Trial Pit Photographs



Trial Pit 102

Remarks: 1. Complete.

Stability: Stable

Project Name: Pacific Park

Project No.
14255

Co-ords: 338538.00 - 349925.00
Level:

Date
16/02/2021

Location: Wrexham

Dimensions (m): 2.00

Scale
1:30

Client: Multimaq Limited

Depth
2.00

1.00

Logged
J Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.30	B		0.28			MADE GROUND: Grey slightly silty sandy gravel. Gravel is fine to coarse angular to sub-angular of limestone and asphalt (MOT).	
				0.52			MADE GROUND: Reddish brown sandy gravel with cobbles and boulders. Gravel is fine to coarse angular to subangular to subrounded of concrete, brick, limestone, metal wire and plastic. Cobbles are angular to subangular of concrete and brick. Boulders are angular to subangular of concrete and brick (wall sections).	
	0.80	ES					MADE GROUND: Blackish brown gravelly clay. Gravel is fine to coarse angular to sub-angular of brick and concrete.	1
	1.00	HVP	64					
	1.40	HVP	122	1.38				
	1.70	ES					Stiff high strength brown, slightly gravelly CLAY. Gravel is fine to coarse rounded to sub-angular of sandstone and quartz.	
	1.90	HVP	139	2.00				2
							End of Pit at 2.00m	
								3
								4

Trial Pit Photographs



Trial Pit 103



Trial Pit 103

Remarks: 1. Complete.

Stability: Stable

Project Name: Pacific Park	Project No. 14255	Co-ords: 338553.00 - 349940.00 Level:	Date 16/02/2021
Location: Wrexham	Dimensions (m): Depth 2.40		Scale 1:30
Client: Multimaq Limited			Logged J Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
▼ 1.88	0.60	HVP	28	0.50			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to sub-angular of concrete, brick, asphalt and limestone.	
							MADE GROUND: Blackish brown gravelly clay. Gravel is fine to coarse angular to sub-angular of brick and concrete.	1
	1.38	ES		1.32			MADE GROUND: Black slightly sandy clayey gravel with pockets of clay. Gravel is fine to coarse angular to sub-angular of clinker and ash.	
	1.90 1.90	ES HVP	117	1.88			Stiff high strength brown, slightly gravelly CLAY. Gravel is fine to coarse rounded to sub-angular of sandstone and quartz.	2
				2.40			End of Pit at 2.40m	3
								4

Trial Pit Photographs



Trial Pit 104



Trial Pit 104

Remarks: 1.Complete. 2. Perched water encountered at 1.88m bgl

Stability: Stable

Project Name: Pacific Park

Project No.
14255

Co-ords: 338566.00 - 349935.00
Level:

Date
16/02/2021

Location: Wrexham

Dimensions (m): 2.00

Scale
1:30

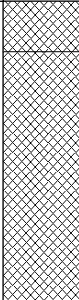
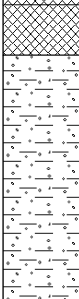
Client: Multimag Limited

Depth
2.40

1.00

2.00

Logged
J Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.20			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to sub-angular of concrete, brick and asphalt.	1 -
	0.40	HVP	28		MADE GROUND: Blackish brown gravelly clay. Gravel is fine to coarse angular to sub-angular of brick and concrete.			
	0.70	HVP	27					
	0.90 1.00	HVP ES	27					
	1.30 1.40	ES HVP	113	1.20 1.40		MADE GROUND: Reddish brown sandy gravel. Gravel is fine to coarse angular to sub-angular of brick.	2 -	
						Stiff high strength brown, slightly gravelly CLAY. Gravel is fine to coarse rounded to sub-angular of sandstone and quartz.		
	2.00	HVP	112	2.40		End of Pit at 2.40m	3 -	
								4 -
							5 -	
							6 -	
							7 -	
							8 -	
							9 -	
							10 -	

Trial Pit Photographs



Trial Pit 105



Trial Pit 105

Remarks: 1. Complete.

Stability:	Stable
------------	--------

Project Name: Pacific Park	Project No. 14255	Co-ords: 338582.00 - 349923.00 Level:	Date 16/02/2021
Location: Wrexham	Dimensions (m): 2.00 1.00		Scale 1:30
Client: Multimaq Limited	Depth 3.00		Logged J Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.30	ES		0.20			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to sub-angular of concrete and asphalt.	
				0.60			MADE GROUND: Reddish brown sandy gravel. Gravel fine to coarse angular to sub-angular of brick.	
				1.00			MADE GROUND: Blackish brown gravelly clay. Gravel is fine to coarse angular to sub-angular of brick and concrete.	1
	1.50	ES					MADE GROUND: Reddish brown sandy gravel. Gravel is fine to coarse angular to sub-angular of brick.	
				2.10			Very stiff very high strength brown mottled greyish blue sandy CLAY.	2
	2.30 2.30	B HVP	186					
				3.00			End of Pit at 3.00m	3
								4

Trial Pit Photographs



Trial Pit 106



Trial Pit 106

Remarks: 1. Complete.

Stability: Stable

Project Name: Pacific Park	Project No. 14255	Co-ords: 338560.00 - 349920.00 Level:	Date 16/02/2021
Location: Wrexham	Dimensions (m): 2.00 1.00		Scale 1:30
Client: Multimaq Limited	Depth 2.40		Logged J Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.40	ES		0.20			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to sub-angular of concrete and asphalt.	
							MADE GROUND: Greyish red sandy gravel with cobbles. Gravel is fine to coarse angular to sub-angular of concrete, brick, ceramics and plastic. Cobbles are angular to sub-angular of concrete and brick (wall sections).	1
	1.30	ES		1.21			MADE GROUND: Blackish brown gravelly clay. Gravel is fine to coarse angular to sub-angular of brick and concrete.	
	1.30	HVP	63	1.40			Very stiff very high strength brown, slightly gravelly CLAY. Gravel is fine to coarse sub-angular to rounded of sandstone and quartz.	2
	1.50	HVP	167					
	2.30	HVP	169	2.40			End of Pit at 2.40m	3
								4

Trial Pit Photographs



Trial Pit 107



Trial Pit 107

Remarks: 1.Complete.

Stability: Stable

Project Name: Pacific Park	Project No. 14255	Co-ords: 338573.00 - 349906.00 Level:	Date 16/02/2021
Location: Wrexham		Dimensions (m): 2.00 1.00	Scale 1:30
Client: Multimaq Limited		Depth 2.20	Logged J Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.20			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to sub-angular of concrete and asphalt.	
	0.40	ES		0.50			MADE GROUND: Reddish brown sandy gravel. Gravel is fine to coarse angular to sub-angular of brick.	
	0.90	ES		1.20			MADE GROUND: Blackish brown gravelly clay. Gravel is fine to coarse angular to sub-angular of brick and concrete.	
	0.90	HVP	28	1.30				
	1.25	ES		1.35			MADE GROUND: Reddish brown sandy gravel. Gravel angular to subangular, fine to coarse of brick fragments.	
	1.40	HVP	144				MADE GROUND: Stiff blackish brown gravelly clay. Gravel is angular to subangular, fine to coarse of brick and concrete.	
							Stiff high strength brown, slightly gravelly CLAY. Gravel is fine to coarse sub-angular to rounded of sandstone and quartz. (Becoming very stiff, very high strength at circa 2.00m bgl)	
	2.00	HVP	153	2.20			End of Pit at 2.20m	

Trial Pit Photographs



Trial Pit 108



Trial Pit 108

Remarks: 1. Complete.

Stability: Stable

Project Name: Pacific Park	Project No. 14255	Co-ords: 338560.00 - 349894.00 Level:	Date 16/02/2021
Location: Wrexham		Dimensions (m): 2.00 1.00	Scale 1:30
Client: Multimaq Limited		Depth 1.90	Logged J Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.30	ES		0.20			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to sub-angular of concrete and asphalt.	
	0.50	ES		0.48			MADE GROUND: Reddish brown sandy gravel. Gravel is fine to coarse angular to sub-angular of brick.	
	1.00	HVP	118				MADE GROUND: Blackish brown gravelly clay. Gravel is fine to coarse angular to sub-angular of brick and concrete.	1
	1.30 1.40	B HVP	161	1.23			Very stiff very high strength brown, slightly gravelly CLAY. Gravel is fine to coarse angular to sub-rounded of sandstone and quartz.	
	1.80	HVP	167	1.90			End of Pit at 1.90m	2
								3
								4

Trial Pit Photographs



Trial Pit 109



Trial Pit 109

Remarks: 1. Complete.

Stability: Stable

Project Name: Pacific Park	Project No. 14255	Co-ords: 338519.00 - 349902.00 Level:	Date 16/02/2021
Location: Wrexham	Dimensions (m): 2.00 1.00		Scale 1:30
Client: Multimaq Limited	Depth 2.30		Logged J Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.30			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to sub-angular of concrete and asphalt.	
				0.47			MADE GROUND: Grey slightly silty sandy gravel. Gravel is fine to coarse angular to sub-angular of limestone. (MOT)	
	0.60	ES	29				MADE GROUND: Black gravelly clay. Gravel is fine to coarse angular to sub-angular of brick, concrete and clinker.	
	0.60	HVP						
				1.00			MADE GROUND: Reddish brown sandy gravel. Gravel is fine to coarse angular to sub-angular of brick.	1
	1.30	ES						
	1.50	HVP	169	1.40			Very stiff very high strength brown, slightly gravelly CLAY. Gravel is fine to coarse sub-angular to rounded of sandstone and quartz.	
	2.00	HVP	195					2
				2.30			End of Pit at 2.30m	
								3
								4

Trial Pit Photographs



Trial Pit 110



Trial Pit 110

Remarks: 1. Complete.

Stability: Stable

Project Name: Pacific Park	Project No. 14255	Co-ords: 338535.00 - 349888.00 Level:	Date 16/02/2021
Location: Wrexham	Dimensions (m): 2.00 1.00		Scale 1:30
Client: Multimaq Limited	Depth 2.00		Logged J Craig

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
 0.60				0.50			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to sub-angular of concrete, asphalt and ash.	
				0.60			MADE GROUND: Grey slightly silty sandy gravel. Gravel is fine to coarse angular to sub-angular of limestone. (MOT)	
	1.00	ES					MADE GROUND: Red sandy gravel. Gravel is fine to coarse angular to sub-angular of wood, mudstone and concrete.	1
	1.40 1.40	ES HVP	175	1.30			Very stiff very high strength brown, slightly gravelly CLAY. Gravel is fine to coarse sub-angular to rounded of sandstone and quartz.	
	1.90	HVP	190	2.00			End of Pit at 2.00m	2
								3
								4

Trial Pit Photographs



Trial Pit 111



Trial Pit 111

Remarks: 1. Complete. 2. Former land drain encountered at 0.60m bgl.

Stability: Stable

Borehole Log

Borehole No.

WS101

Sheet 1 of 1

Project Name: Pacific Park

Project No.
14255

Co-ords: 338544E - 349879N

Hole Type
WS

Location: Wrexham

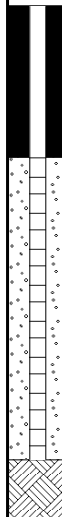
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Scale
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Client: Multimaq Limited

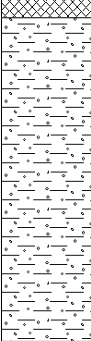
Dates: 10/02/2021

Logged By
J Craig

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.50	ES					MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to sub-angular of concrete, asphalt and limestone.	
		0.65	ES		0.61				
		0.72	ES		0.70				
		0.80	PP	59.35	0.82				
		1.00	ES						
		1.00	SPT	N=10 (2,2/2,3,2,3)				MADE GROUND: Black sandy gravel. Gravel is fine to coarse angular to sub-angular of concrete and brick.	1
		1.20	PP	95.16				MADE GROUND: Brownish black, sandy gravelly clay. Gravel is fine to coarse angular to sub-angular of brick and concrete.	
		1.50	U					Stiff medium strength brown, slightly gravelly CLAY. Gravel is fine to coarse sub-angular to rounded of sandstone and quartz. (Becoming very stiff, very high strength at circa 2.00m bgl)	
		1.80	PP	104.97					2
		2.00	SPT	N=33 (5,6/8,8,8,9)					
		2.20	PP	120.66					
		2.80	PP	122.62					3
		3.00	SPT	50 (9,11/50 for 265mm)					
					3.42			End of Borehole at 3.42m	4
									5
									6
									7
									8
									9
									10

Remarks

1. Complete. 2. Refusal within clay deposits. 3. Monitoring well installed with response zone between 1.00m and 3.00m bgl. 4 Perched water encountered at 1.00m bgl.

				Borehole Log				Borehole No. WS102 Sheet 1 of 1	
Project Name: Pacific Park				Project No. 14255		Co-ords: 338536E - 349898N		Hole Type WS	
Location: Wrexham				Level:		Scale 1:50			
Client: Multimaq Limited				Dates: 10/02/2021		Logged By J Craig			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15	ES		0.62		 MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to sub-angular of concrete, limestone and asphalt.	1	
		0.70	ES						
		1.00	SPT	N=11 (7,4/2,3,3,3)	1.30		 MADE GROUND: Brownish black, sandy gravel. Gravel is fine to coarse angular to sub-angular of brick, concrete, clinker, ash and mudstone.		
		1.40	ES						
		1.40	PP	97.61		 Very stiff high strength brown, slightly gravelly CLAY. Gravel is fine to coarse sub-angular to rounded of sandstone and quartz. (Becoming very stiff very high strength at circa 3.00m bgl)	2		
		1.80	PP	109.38					
		2.00	SPT	N=26 (5,5/6,6,7,7)					
		2.20	PP	112.82					
		2.70	PP	122.62					
		3.00	SPT	50 (7,9/50 for 290mm)					
				3.44		End of Borehole at 3.44m	3		
							4		
							5		
							6		
							7		
							8		
							9		
							10		
Remarks 1. Complete. 2. Refusal within clay deposits.									



Borehole Log

Borehole No.

WS104

Sheet 1 of 1

Project Name: Pacific Park

Project No.
14255

Co-ords: 338570E - 349913N

Hole Type
WS

Location: Wrexham

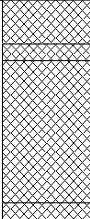
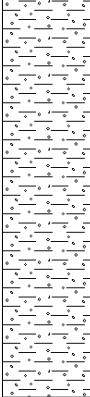
Level:

Scale
1:50

Client: Multimaq Limited

Dates: 10/02/2021

Logged By
J Craig

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
		0.15	ES		0.29 0.40			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to sub-angular of concrete, limestone and asphalt.	1	
		0.30	ES							MADE GROUND: Brown sandy gravel with cobbles. Gravel is fine to coarse angular to sub-angular of brick, concrete and metal. Cobbles are angular to sub-angular of brick and concrete.
		0.60	ES	49.54				MADE GROUND: Blackish brown, sandy gravelly clay. Gravel is fine to coarse angular to sub-angular of brick, concrete, sandstone, ash and clinker.		
		0.60	PP							
		1.00	SPT	N=10 (2,2/2,2,3,3)	1.34 1.51			Very stiff high strength brown, slightly gravelly CLAY. Gravel is fine to coarse sub-angular to rounded of sandstone and quartz. (circa 3.00m bgl becomes very stiff very high strength).		2
		1.20	PP	45.13						
		1.40	ES	41.20						
		1.40	PP							
		1.50	U	94.18						
		1.52	ES							
		1.60	PP	N=25 (5,5/4,6,7,8)						
		2.00	SPT							
		2.10	PP	118.70						
				2.70	PP		122.62			
				3.00	SPT		N=45 (9,8/10,11,12,12)			
				3.10	PP		122.62			
		3.70	PP	122.62						
		4.00	SPT	N=50 (9,12/14,14,16,6)						
					4.45		End of Borehole at 4.45m	5		
								6		
								7		
								8		
								9		
								10		

Remarks

1. Complete. 2. Refusal within CLAY.

Borehole Log

Borehole No.

WS105

Sheet 1 of 1

Project Name: Pacific Park

Project No.
14255

Co-ords: 338550E - 349933N

Hole Type
WS

Location: Wrexham

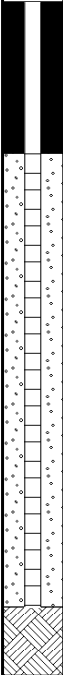
Level:

Scale
1:50

Client: Multimaq Limited

Dates: 10/02/2021

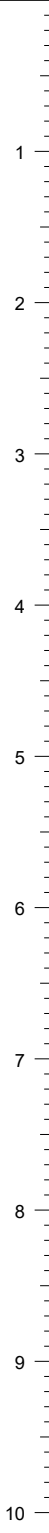
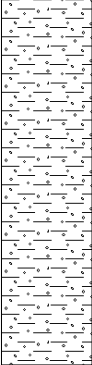
Logged By
J Craig

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.15	ES		0.14			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to sub-angular of concrete, limestone and asphalt.	1
		0.40	ES		0.39				
		1.00	SPT	N=18 (2,3/4,4,5,5)	1.00			MADE GROUND: Blackish brown, sandy gravelly clay. Gravel is fine to coarse angular to sub-angular of brick, concrete, sandstone, ash and clinker.	2
		1.20	PP	60.33					
		1.40	ES					Very stiff high strength brown, slightly gravelly CLAY. Gravel is fine to coarse sub-angular to rounded of sandstone and quartz.(Becoming stiff medium strength at circa 2.00m bgl, then becoming very stiff high strength at circa 3.00m bgl, then becoming very stiff very high strength at circa 4.00m bgl).	3
		1.80	PP	74.07					
		2.00	SPT	N=12 (2,2/3,3,3,3)				4	
		2.10	PP	74.07					
		2.60	PP	109.87				5	
		3.00	SPT	N=27 (3,3/5,7,7,8)					
		3.10	PP	122.62				6	
		3.70	PP	204.38					
		4.00	SPT	N=50 (12,12/13,15,16,6)				7	
					4.45				
End of Borehole at 4.45m									8
									9
									10

Remarks

1. Complete. 2. Refusal within CLAY. 3. Monitoring well installed with response zone from 1.00m to 4.00m bgl.

				Borehole Log			Borehole No. WS106 Sheet 1 of 1		
Project Name: Pacific Park				Project No. 14255		Co-ords: 338519E - 349898N		Hole Type WS	
Location: Wrexham				Level:		Scale 1:50			
Client: Multimaq Limited				Dates: 10/02/2021		Logged By J Craig			

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	ES		0.34		MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to sub-angular of concrete, limestone and asphalt.		
		0.50	ES				MADE GROUND: Black slightly sandy gravel. Gravel is fine to coarse angular to sub-angular of brick, asphalt and concrete. (Hydrocarbon odour).		
		1.00	SPT	N=10 (4,5/2,2,3,3)	1.00		Stiff medium strength brown, slightly gravelly CLAY. Gravel is fine to coarse sub-angular to rounded of sandstone and quartz. (Becoming very stiff, high strength at circa 2.00m bgl, then becoming very stiff very high strength at circa 3.00m bgl).		
		1.20	ES						
		1.20	PP	136.52					
		1.80	PP	197.02					
		2.00	U						
		2.00	SPT	N=18 (5,3/4,4,5,5)					
		2.20	PP	204.38					
		2.70	PP	204.38					
	3.00	SPT	N=50 (6,8/11,14,12,13)						
				3.45		End of Borehole at 3.45m			

Remarks

1. Complete 2. Refusal in CLAY. 3. Monitoring well installed with response zone between 0.50m and 1.00m bgl. 4. Water seepage encountered at 1.30m bgl. 5. Hydrocarbon odour encountered with strata at 0.34m to 1.00m bgl.



				Borehole Log				Borehole No. CP101 Sheet 1 of 2	
Project Name: Pacific Park				Project No. 14255		Co-ords: 338565E - 349923N		Hole Type CP	
Location: Wrexham				Level:				Scale 1:50	
Client: Multimaq Limited				Dates: 16/02/2021				Logged By J Craig	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.30			MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to sub-angular of concrete, limestone and asphalt.	
					0.70			MADE GROUND: Reddish brown sandy gravel. Gravel fine to coarse angular to sub-angular of brick.	
		1.00	SPT	N=9 (2,2/2,3,2,2)				MADE GROUND: Blackish brown gravelly clay. Gravel is fine to coarse angular to sub-angular of brick and concrete.	1
					1.60				
		2.00 2.00	B SPT	N=24 (3,4/5,6,6,7)				Very stiff high strength brown, slightly gravelly CLAY. Gravel is fine to coarse sub-angular to rounded of sandstone and quartz.	2
		3.00	U	Ublow=67	3.00				
		4.00	SPT	N=38 (7,8/8,9,10,11)					
		5.00 5.00	B SPT	N=42 (7,8/8,10,12,12)					
		6.50	SPT	N=45 (9,10/11,11,12,11)					
		8.00	SPT	N=38 (8,10/10,9,10,9)					
			9.50 9.50	B SPT	N=49 (9,9/11,12,13,13)				

Remarks

1. Complete. 2. Water strike encountered at 15.70m bgl. 3. Monitoring well installed with response zone between 15.00m and 16.00m bgl.



Project Name: Pacific Park

Project No.
14255

Co-ords: 338565E - 349923N

Hole Type
CP

Location: Wrexham

Level:

Scale
1:50

Client: Multimaq Limited

Dates: 16/02/2021

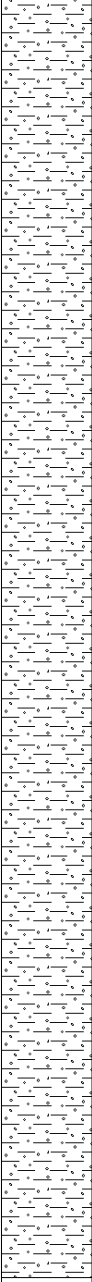
Logged By
J Craig

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		11.00	SPT	N=41 (9,10/10,11,10,10)				Very stiff very high strength brown sandy CLAY. (Circa 14.00m bgl becomes very stiff high strength).	11
		12.50	U	Ublow=83					12
		14.00	SPT	N=36 (9,9/8,9,10,9)					13
									14
									15
					15.70				
					15.90				
		16.50	B SPT	N=40 (10,11/10,10,9,11)				Brown slightly clayey medium SAND.	16
		16.50						Very stiff high strength brown sandy CLAY.	17
		18.00	SPT	N=43 (10,9/9,11,12,11)					18
									19
		19.50	SPT	N=40 (10,10/9,9,10,12)					20
					20.00			End of Borehole at 20.00m	20

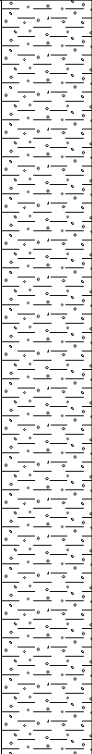
Remarks

1. Complete. 2. Water strike encountered at 15.70m bgl. 3. Monitoring well installed with response zone between 15.00m and 16.00m bgl.

				Borehole Log				Borehole No. CP102 Sheet 1 of 3	
Project Name: Pacific Park				Project No. 14255		Co-ords: 338533E - 349888N		Hole Type CP	
Location: Wrexham				Level:		Scale 1:50			
Client: Multimaq Limited				Dates: 17/02/2021		Logged By J Craig			

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description		
		Depth (m)	Type	Results						
1					0.50		 MADE GROUND: Grey sandy gravel. Gravel is fine to coarse angular to sub-angular of concrete, limestone and asphalt.	1		
					0.60				 MADE GROUND: Grey slightly silty sandy gravel. Gravel is fine to coarse angular to sub-angular of limestone. (MOT)	
					1.30					 MADE GROUND: Red sandy gravel. Gravel is fine to coarse angular to sub-angular of wood, mudstone and concrete.
							 Very stiff very high strength brown sandy CLAY. (Circa 11.00m bgl becomes very stiff very high strength) (Circa 14.00m bgl becomes very stiff high strength).	2		
										3
										4
								5		
								6		
								7		
								8		
								9		
								10		

Remarks 1. Complete 2. Water strike encountered at 21.20m bgl 3. Monitoring well installed with response zone between 21.00m and 22.00m bgl.									
---	--	--	--	--	--	--	--	---	--

				Borehole Log				Borehole No. CP102 Sheet 2 of 3	
Project Name: Pacific Park				Project No. 14255		Co-ords: 338533E - 349888N		Hole Type CP	
Location: Wrexham				Level:		Scale 1:50			
Client: Multimaq Limited				Dates: 17/02/2021		Logged By J Craig			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		11.00	SPT	N=46 (10,9/11,12,12,11)	15.00			Very stiff very high strength brown sandy CLAY. (Circa 11.00m bgl becomes very stiff very high strength) (Circa 14.00m bgl becomes very stiff high strength).	11
		12.50	U	Ublow=84					12
		14.00 14.00	B SPT	N=36 (10,9/9,9,10,8)				13	
		15.50	SPT	N=37 (9,10/10,9,9,9)				14	
		17.00	SPT	N=36 (9,8/9,9,9,9)				15	
		18.50	SPT	N=35 (9,10/8,8,9,10)				16	
									17
									18
									19
									20
Remarks 1. Complete 2. Water strike encountered at 21.20m bgl 3. Monitoring well installed with response zone between 21.00m and 22.00m bgl.									

Project Name: Pacific Park

Project No.
14255

Co-ords: 338533E - 349888N

Hole Type
CP

Location: Wrexham

Level:

Scale
1:50

Client: Multimaq Limited

Dates: 17/02/2021

Logged By
J Craig

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		20.00	SPT	N=40 (11,11/10,10,10,10)				Very stiff high strength brown sandy CLAY.	
					21.20				21
		21.50	U	Ublow=93	21.40			Brown slightly clayey medium SAND. Very stiff high strength brown sandy CLAY.	
									22
		23.00	SPT	N=45 (11,10/11,11,12,11)					23
									24
		24.50	B						25
		24.50	SPT	50 (11,12/50 for 270mm)					
		26.00	SPT	50 (10,12/50 for 265mm)	26.00			End of Borehole at 26.00m	26
									27
									28
									29
									30

Remarks

1. Complete 2. Water strike encountered at 21.20m bgl 3. Monitoring well installed with response zone between 21.00m and 22.00m bgl.

APPENDIX VI

CHEMICAL TESTING

RESULTS



Rebecca Hodnett

e3p
Taylor Road
Urmston
Manchester
M41 7JQ

e: rhodnett@e3p.co.uk

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

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

Analytical Report Number : 21-58832

Project / Site name:	Pacific Park Wrexham	Samples received on:	18/02/2021
Your job number:	14 255	Samples instructed on/ Analysis started on:	25/02/2021
Your order number:	14255-JC-J	Analysis completed by:	03/03/2021
Report Issue Number:	1	Report issued on:	03/03/2021
Samples Analysed:	1 soil sample		

Signed: 

Zina Abdul Razzak
Senior Quality 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: 21-58832
Project / Site name: Pacific Park Wrexham
Your Order No: 14255-JC-J

Lab Sample Number				1782112
Sample Reference				TP108
Sample Number				None Supplied
Depth (m)				0.40
Date Sampled				16/02/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
Stone Content	%	0.1	NONE	< 0.1
Moisture Content	%	0.01	NONE	10
Total mass of sample received	kg	0.001	NONE	1.2

				Chrysotile
Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	
Asbestos in Soil	Type	N/A	ISO 17025	Detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	0.002
Asbestos Quantification Total	%	0.001	ISO 17025	0.002

General Inorganics

Total Cyanide	mg/kg	1	MCERTS	< 1
Total Organic Carbon (TOC)	%	0.1	MCERTS	1.2

Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.58
Anthracene	mg/kg	0.05	MCERTS	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.8
Pyrene	mg/kg	0.05	MCERTS	0.67
Benzo(a)anthracene	mg/kg	0.05	MCERTS	1.2
Chrysene	mg/kg	0.05	MCERTS	0.73
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	1.5
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.63
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.99
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.81
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	0.34
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.88

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	9.12
-----------------------------	-------	-----	--------	------

Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	16
Barium (aqua regia extractable)	mg/kg	1	MCERTS	700
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	0.71
Boron (water soluble)	mg/kg	0.2	MCERTS	0.5
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.7
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0
Copper (aqua regia extractable)	mg/kg	1	MCERTS	63
Lead (aqua regia extractable)	mg/kg	1	MCERTS	76
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	2.4
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	18
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	28
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	320

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0
---------------	-------	---	------	-------

Analytical Report Number: 21-58832
Project / Site name: Pacific Park Wrexham
Your Order No: 14255-JC-J

Lab Sample Number				1782112
Sample Reference				TP108
Sample Number				None Supplied
Depth (m)				0.40
Date Sampled				16/02/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	7.2
TPH (C12 - C16)	mg/kg	4	MCERTS	19
TPH (C16 - C21)	mg/kg	1	MCERTS	43
TPH (C21 - C35)	mg/kg	1	MCERTS	820
TPH (C35 - C40)	mg/kg	10	MCERTS	330
TPH Total C5 - C40	mg/kg	10	MCERTS	1200

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



Analytical Report Number: 21-58832
Project / Site name: Pacific Park Wrexham
Your Order No: 14255-JC-J

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

The samples were analysed qualitatively for asbestos by polarising light and dispersion staining as described by the Health and Safety Executive in HSG 248.

Quantitative Analysis

The analysis was carried out using our documented in-house method A006-PL based on HSE Contract Research Report No: 83/1996: Development and Validation of an analytical method to determine the amount of asbestos in soils and loose aggregates (Davies et al, 1996) and HSG 248. Our method includes initial examination of the entire representative sample, then fractionation and detailed analysis of each fraction, with quantification by hand picking and weighing.

The limit of detection (reporting limit) of this method is 0.001 %.

The method has been validated using samples of at least 100 g, results for samples smaller than this should be interpreted with caution.

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
1782112	TP108	0.40	120	Loose Fibres	Chrysotile	0.002	0.002

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.



Analytical Report Number : 21-58832
Project / Site name: Pacific Park Wrexham

* 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 *
1782112	TP108	None Supplied	0.4	Brown gravelly clay with brick.

Analytical Report Number : 21-58832
Project / Site name: Pacific Park Wrexham

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

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
Asbestos identification in soil	Asbestos Identification with the use of polarised light microscopy in conjunction with disperion staining techniques.	In house method based on HSG 248	A001-PL	D	ISO 17025
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total 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
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	MCERTS
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in house method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
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

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' 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.

Sample Deviation Report



Analytical Report Number : 21-58832

Project / Site name: Pacific Park Wrexham

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
TP108	None Supplied	S	1782112	c	Total cyanide in soil	L080-PL	c



Rebecca Hodnett

e3p
Taylor Road
Urmston
Manchester
M41 7JQ

e: rhodnett@e3p.co.uk

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

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

Analytical Report Number : 21-56525

Project / Site name:	Pacific Park Wrexham	Samples received on:	11/02/2021
Your job number:	14-255	Samples instructed on/ Analysis started on:	12/02/2021
Your order number:	14-255-JC-F	Analysis completed by:	18/02/2021
Report Issue Number:	1	Report issued on:	18/02/2021
Samples Analysed:	3 leachate samples - 11 soil samples		

Signed:

Rachel Bradley
Deputy Quality Manager
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: 21-56525
 Project / Site name: Pacific Park Wrexham
 Your Order No: 14-255-JC-F

Lab Sample Number	1768468	1768469	1768470	1768471	1768472
Sample Reference	WS101	WS101	WS101	WS102	WS103
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.65	0.72	1.00	0.70	1.00
Date Sampled	10/02/2021	10/02/2021	10/02/2021	10/02/2021	10/02/2021
Time Taken	None Supplied	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
Moisture Content	%	0.01	NONE	6.5	16
Total mass of sample received	kg	0.001	NONE	0.5	0.5

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	Chrysotile	Chrysotile	-	-	-
Asbestos in Soil	Type	N/A	ISO 17025	Detected	Detected	-	Not-detected	Not-detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	0.002	< 0.001	-	-	-
Asbestos Quantification Total	%	0.001	ISO 17025	0.002	< 0.001	-	-	-

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	9.1	-	8.3	8.1	8.5
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Total Sulphate as SO ₄	mg/kg	50	MCERTS	2200	-	710	15000	870
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.056	-	0.04	0.072	0.047
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	110	-	79	140	95
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	56.3	-	39.5	72.3	47.4
Sulphide	mg/kg	1	MCERTS	9.8	-	200	170	110
Total Sulphur	mg/kg	50	MCERTS	3300	-	630	7100	1200

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	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	0.51	< 0.05	0.3	< 0.05	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.49	< 0.05	0.23	< 0.05	0.35
Pyrene	mg/kg	0.05	MCERTS	0.61	< 0.05	0.21	< 0.05	0.37
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.31	< 0.05	< 0.05	< 0.05	0.28
Chrysene	mg/kg	0.05	MCERTS	0.36	< 0.05	< 0.05	< 0.05	0.2
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	0.43	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.29	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.38	< 0.05	< 0.05	< 0.05	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.3	< 0.05	< 0.05	< 0.05	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.36	< 0.05	< 0.05	< 0.05	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	4.04	< 0.80	< 0.80	< 0.80	1.2
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 Your Order No: 14-255-JC-F

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Date Sampled	10/02/2021	10/02/2021	10/02/2021	10/02/2021	10/02/2021
Time Taken	None Supplied	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	9.5	12	9.1	24	11
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-	130	-	-	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	1.1	-	-	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	1.5	-	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.5	0.5	< 0.2	< 0.2	0.6
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	20	-	32	27	35
Copper (aqua regia extractable)	mg/kg	1	MCERTS	43	34	34	43	30
Lead (aqua regia extractable)	mg/kg	1	MCERTS	44	58	43	35	35
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	4.4	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	20	34	30	26	35
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	42	-	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	110	220	140	41	130

Monoaromatics & Oxygenates

Benzene	µg/kg	1	MCERTS	-	-	-	-	-
Toluene	µg/kg	1	MCERTS	-	-	-	-	-
Ethylbenzene	µg/kg	1	MCERTS	-	-	-	-	-
p & m-xylene	µg/kg	1	MCERTS	-	-	-	-	-
o-xylene	µg/kg	1	MCERTS	-	-	-	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-	-	-	-

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Time Taken	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status		

Petroleum Hydrocarbons

TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-	-	-	-	-
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-	-	-

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-	-	-	-	-
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-	-	-

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
TPH (C16 - C21)	mg/kg	1	MCERTS	12	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C21 - C35)	mg/kg	1	MCERTS	170	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C35 - C40)	mg/kg	10	MCERTS	49	< 10	< 10	< 10	< 10
TPH Total C5 - C40	mg/kg	10	MCERTS	230	< 10	< 10	< 10	< 10

VOCs

Chloromethane	µg/kg	1	ISO 17025	-	-	-	-	-
Chloroethane	µg/kg	1	NONE	-	-	-	-	-
Bromomethane	µg/kg	1	ISO 17025	-	-	-	-	-
Vinyl Chloride	µg/kg	1	NONE	-	-	-	-	-
Trichlorofluoromethane	µg/kg	1	NONE	-	-	-	-	-
1,1-Dichloroethene	µg/kg	1	NONE	-	-	-	-	-
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	-	-	-	-	-
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	-	-	-	-	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-	-	-	-
1,1-Dichloroethane	µg/kg	1	MCERTS	-	-	-	-	-
2,2-Dichloropropane	µg/kg	1	MCERTS	-	-	-	-	-
Trichloromethane	µg/kg	1	MCERTS	-	-	-	-	-
1,1,1-Trichloroethane	µg/kg	1	MCERTS	-	-	-	-	-
1,2-Dichloroethane	µg/kg	1	MCERTS	-	-	-	-	-
1,1-Dichloropropene	µg/kg	1	MCERTS	-	-	-	-	-
Trans-1,2-dichloroethene	µg/kg	1	NONE	-	-	-	-	-
Benzene	µg/kg	1	MCERTS	-	-	-	-	-
Tetrachloromethane	µg/kg	1	MCERTS	-	-	-	-	-
1,2-Dichloropropane	µg/kg	1	MCERTS	-	-	-	-	-
Trichloroethene	µg/kg	1	MCERTS	-	-	-	-	-
Dibromomethane	µg/kg	1	MCERTS	-	-	-	-	-
Bromodichloromethane	µg/kg	1	MCERTS	-	-	-	-	-
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	-	-	-	-	-

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Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.65	0.72	1.00	0.70	1.00
Date Sampled				10/02/2021	10/02/2021	10/02/2021	10/02/2021	10/02/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	-	-	-	-	-
Toluene	µg/kg	1	MCERTS	-	-	-	-	-
1,1,2-Trichloroethane	µg/kg	1	MCERTS	-	-	-	-	-
1,3-Dichloropropane	µg/kg	1	ISO 17025	-	-	-	-	-
Dibromochloromethane	µg/kg	1	ISO 17025	-	-	-	-	-
Tetrachloroethene	µg/kg	1	NONE	-	-	-	-	-
1,2-Dibromoethane	µg/kg	1	ISO 17025	-	-	-	-	-
Chlorobenzene	µg/kg	1	MCERTS	-	-	-	-	-
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	-	-	-	-	-
Ethylbenzene	µg/kg	1	MCERTS	-	-	-	-	-
p & m-Xylene	µg/kg	1	MCERTS	-	-	-	-	-
Styrene	µg/kg	1	MCERTS	-	-	-	-	-
Tribromomethane	µg/kg	1	NONE	-	-	-	-	-
o-Xylene	µg/kg	1	MCERTS	-	-	-	-	-
1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	-	-	-	-	-
Isopropylbenzene	µg/kg	1	MCERTS	-	-	-	-	-
Bromobenzene	µg/kg	1	MCERTS	-	-	-	-	-
n-Propylbenzene	µg/kg	1	ISO 17025	-	-	-	-	-
2-Chlorotoluene	µg/kg	1	MCERTS	-	-	-	-	-
4-Chlorotoluene	µg/kg	1	MCERTS	-	-	-	-	-
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	-	-	-	-	-
tert-Butylbenzene	µg/kg	1	MCERTS	-	-	-	-	-
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	-	-	-	-	-
sec-Butylbenzene	µg/kg	1	MCERTS	-	-	-	-	-
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	-	-	-	-	-
p-Isopropyltoluene	µg/kg	1	ISO 17025	-	-	-	-	-
1,2-Dichlorobenzene	µg/kg	1	MCERTS	-	-	-	-	-
1,4-Dichlorobenzene	µg/kg	1	MCERTS	-	-	-	-	-
Butylbenzene	µg/kg	1	MCERTS	-	-	-	-	-
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	-	-	-	-	-
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	-	-	-	-	-
Hexachlorobutadiene	µg/kg	1	MCERTS	-	-	-	-	-
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	-	-	-	-	-

SVOCs

Aniline	mg/kg	0.1	NONE	-	-	-	-	-
Phenol	mg/kg	0.2	ISO 17025	-	-	-	-	-
2-Chlorophenol	mg/kg	0.1	MCERTS	-	-	-	-	-
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	-	-	-	-	-
1,3-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	-	-	-
1,2-Dichlorobenzene	mg/kg	0.1	MCERTS	-	-	-	-	-
1,4-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	-	-	-
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	-	-	-	-	-
2-Methylphenol	mg/kg	0.3	MCERTS	-	-	-	-	-
Hexachloroethane	mg/kg	0.05	MCERTS	-	-	-	-	-
Nitrobenzene	mg/kg	0.3	MCERTS	-	-	-	-	-
4-Methylphenol	mg/kg	0.2	NONE	-	-	-	-	-
Isophorone	mg/kg	0.2	MCERTS	-	-	-	-	-
2-Nitrophenol	mg/kg	0.3	MCERTS	-	-	-	-	-
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	-	-	-	-	-
Bis(2-chloroethoxy)methane	mg/kg	0.3	MCERTS	-	-	-	-	-
1,2,4-Trichlorobenzene	mg/kg	0.3	MCERTS	-	-	-	-	-
Naphthalene	mg/kg	0.05	MCERTS	-	-	-	-	-

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Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	-	-	-	-	-
4-Chloroaniline	mg/kg	0.1	NONE	-	-	-	-	-
Hexachlorobutadiene	mg/kg	0.1	MCERTS	-	-	-	-	-
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	-	-	-	-	-
2,4,6-Trichlorophenol	mg/kg	0.1	MCERTS	-	-	-	-	-
2,4,5-Trichlorophenol	mg/kg	0.2	MCERTS	-	-	-	-	-
2-Methylnaphthalene	mg/kg	0.1	NONE	-	-	-	-	-
2-Chloronaphthalene	mg/kg	0.1	MCERTS	-	-	-	-	-
Dimethylphthalate	mg/kg	0.1	MCERTS	-	-	-	-	-
2,6-Dinitrotoluene	mg/kg	0.1	MCERTS	-	-	-	-	-
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	-	-	-
Acenaphthene	mg/kg	0.05	MCERTS	-	-	-	-	-
2,4-Dinitrotoluene	mg/kg	0.2	MCERTS	-	-	-	-	-
Dibenzofuran	mg/kg	0.2	MCERTS	-	-	-	-	-
4-Chlorophenyl phenyl ether	mg/kg	0.3	ISO 17025	-	-	-	-	-
Diethyl phthalate	mg/kg	0.2	MCERTS	-	-	-	-	-
4-Nitroaniline	mg/kg	0.2	MCERTS	-	-	-	-	-
Fluorene	mg/kg	0.05	MCERTS	-	-	-	-	-
Azobenzene	mg/kg	0.3	MCERTS	-	-	-	-	-
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	-	-	-	-	-
Hexachlorobenzene	mg/kg	0.3	MCERTS	-	-	-	-	-
Phenanthrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Anthracene	mg/kg	0.05	MCERTS	-	-	-	-	-
Carbazole	mg/kg	0.3	MCERTS	-	-	-	-	-
Dibutyl phthalate	mg/kg	0.2	MCERTS	-	-	-	-	-
Anthraquinone	mg/kg	0.3	MCERTS	-	-	-	-	-
Fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	-
Pyrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Butyl benzyl phthalate	mg/kg	0.3	ISO 17025	-	-	-	-	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	-
Chrysene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	-	-	-

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PCBs by GC-MS

PCB Congener 28	mg/kg	0.001	MCERTS	-	0.002	0.01	-	-
PCB Congener 52	mg/kg	0.001	MCERTS	-	0.025	0.077	-	-
PCB Congener 101	mg/kg	0.001	MCERTS	-	0.062	0.2	-	-
PCB Congener 118	mg/kg	0.001	MCERTS	-	0.05	0.15	-	-
PCB Congener 138	mg/kg	0.001	MCERTS	-	0.058	0.15	-	-
PCB Congener 153	mg/kg	0.001	MCERTS	-	0.04	0.1	-	-
PCB Congener 180	mg/kg	0.001	MCERTS	-	0.01	0.024	-	-

Total PCBs by GC-MS

Total PCBs	mg/kg	0.007	MCERTS	-	0.25	0.7	-	-
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U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number: 21-56525
 Project / Site name: Pacific Park Wrexham
 Your Order No: 14-255-JC-F

Lab Sample Number	1768473	1768474	1768475	1768476	1768477
Sample Reference	WS103	WS104	WS105	WS106	WS106
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	1.40	0.60	0.15	0.30	0.50
Date Sampled	10/02/2021	10/02/2021	10/02/2021	10/02/2021	10/02/2021
Time Taken	None Supplied	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
Moisture Content	%	0.01	NONE	14	16
Total mass of sample received	kg	0.001	NONE	0.5	0.5

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	Chrysotile	-	-	-
Asbestos in Soil	Type	N/A	ISO 17025	-	Detected	Not-detected	Not-detected	Not-detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	< 0.001	-	-	-
Asbestos Quantification Total	%	0.001	ISO 17025	-	< 0.001	-	-	-

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	-	-	10.1	8.8	8.3
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	-	1100	620	2300
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	-	-	0.075	0.04	0.12
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	-	-	150	80	250
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	-	-	75.4	40.1	125
Sulphide	mg/kg	1	MCERTS	-	-	1.3	580	270
Total Sulphur	mg/kg	50	MCERTS	-	-	720	790	2400

Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	-	-	< 1.0	< 1.0	10
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Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	-
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	-
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	-
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	-
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	0.54	< 0.05	0.31	-
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	-
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.86	< 0.05	1.2	-
Pyrene	mg/kg	0.05	MCERTS	< 0.05	0.61	< 0.05	1.5	-
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	1.1	< 0.05	0.93	-
Chrysene	mg/kg	0.05	MCERTS	< 0.05	0.87	< 0.05	0.79	-
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	1.5	< 0.05	1.7	-
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.48	< 0.05	0.86	-
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	1	< 0.05	2	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.61	< 0.05	1.2	-
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	-
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	0.65	< 0.05	1.6	-

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	8.29	< 0.80	12	-
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Analytical Report Number: 21-56525
 Project / Site name: Pacific Park Wrexham
 Your Order No: 14-255-JC-F

Lab Sample Number				1768473	1768474	1768475	1768476	1768477
Sample Reference				WS103	WS104	WS105	WS106	WS106
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.40	0.60	0.15	0.30	0.50
Date Sampled				10/02/2021	10/02/2021	10/02/2021	10/02/2021	10/02/2021
Time Taken				None Supplied	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	14	9.1	9.1	4.6	12
Barium (aqua regia extractable)	mg/kg	1	MCERTS	320	140	-	-	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	1.4	0.89	-	-	-
Boron (water soluble)	mg/kg	0.2	MCERTS	0.5	2	-	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.8	0.5	0.5
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	18	17	16
Copper (aqua regia extractable)	mg/kg	1	MCERTS	35	30	19	18	22
Lead (aqua regia extractable)	mg/kg	1	MCERTS	17	49	14	240	31
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	47	29	14	13	15
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	52	35	-	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	73	100	85	53	55
Monoaromatics & Oxygenates								
Benzene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Toluene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
p & m-xylene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
o-xylene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-	-	-	< 1.0

Analytical Report Number: 21-56525
 Project / Site name: Pacific Park Wrexham
 Your Order No: 14-255-JC-F

Lab Sample Number				1768473	1768474	1768475	1768476	1768477
Sample Reference				WS103	WS104	WS105	WS106	WS106
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.40	0.60	0.15	0.30	0.50
Date Sampled				10/02/2021	10/02/2021	10/02/2021	10/02/2021	10/02/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Petroleum Hydrocarbons								
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-	-	16
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-	-	60
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-	-	-	-	110
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-	-	-	-	230
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-	-	410

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-	-	-	-	< 0.001
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-	-	-	-	49
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-	-	-	-	430
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-	-	-	-	1500
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-	-	-	-	1500
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-	-	-	-	3500

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	-
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	-
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	-
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	-
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	-
TPH (C16 - C21)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	8.5	-
TPH (C21 - C35)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	160	-
TPH (C35 - C40)	mg/kg	10	MCERTS	< 10	< 10	< 10	46	-
TPH Total C5 - C40	mg/kg	10	MCERTS	< 10	< 10	< 10	210	-

VOCs

Chloromethane	µg/kg	1	ISO 17025	-	-	-	-	< 1.0
Chloroethane	µg/kg	1	NONE	-	-	-	-	< 1.0
Bromomethane	µg/kg	1	ISO 17025	-	-	-	-	< 1.0
Vinyl Chloride	µg/kg	1	NONE	-	-	-	-	< 1.0
Trichlorofluoromethane	µg/kg	1	NONE	-	-	-	-	< 1.0
1,1-Dichloroethene	µg/kg	1	NONE	-	-	-	-	< 1.0
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	-	-	-	-	< 1.0
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-	-	-	-	< 1.0
1,1-Dichloroethane	µg/kg	1	MCERTS	-	-	-	-	< 1.0
2,2-Dichloropropane	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Trichloromethane	µg/kg	1	MCERTS	-	-	-	-	< 1.0
1,1,1-Trichloroethane	µg/kg	1	MCERTS	-	-	-	-	< 1.0
1,2-Dichloroethane	µg/kg	1	MCERTS	-	-	-	-	< 1.0
1,1-Dichloropropene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Trans-1,2-dichloroethene	µg/kg	1	NONE	-	-	-	-	< 1.0
Benzene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Tetrachloromethane	µg/kg	1	MCERTS	-	-	-	-	< 1.0
1,2-Dichloropropane	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Trichloroethene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Dibromomethane	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Bromodichloromethane	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	-	-	-	-	< 1.0

Analytical Report Number: 21-56525
Project / Site name: Pacific Park Wrexham
Your Order No: 14-255-JC-F

Lab Sample Number				1768473	1768474	1768475	1768476	1768477
Sample Reference				WS103	WS104	WS105	WS106	WS106
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.40	0.60	0.15	0.30	0.50
Date Sampled				10/02/2021	10/02/2021	10/02/2021	10/02/2021	10/02/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	-	-	-	-	< 1.0
Toluene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
1,1,2-Trichloroethane	µg/kg	1	MCERTS	-	-	-	-	< 1.0
1,3-Dichloropropane	µg/kg	1	ISO 17025	-	-	-	-	< 1.0
Dibromochloromethane	µg/kg	1	ISO 17025	-	-	-	-	< 1.0
Tetrachloroethene	µg/kg	1	NONE	-	-	-	-	< 1.0
1,2-Dibromoethane	µg/kg	1	ISO 17025	-	-	-	-	< 1.0
Chlorobenzene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
p & m-Xylene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Styrene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Tribromomethane	µg/kg	1	NONE	-	-	-	-	< 1.0
o-Xylene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Isopropylbenzene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Bromobenzene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
n-Propylbenzene	µg/kg	1	ISO 17025	-	-	-	-	< 1.0
2-Chlorotoluene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
4-Chlorotoluene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	-	-	-	-	< 1.0
tert-Butylbenzene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	-	-	-	-	< 1.0
sec-Butylbenzene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	-	-	-	-	< 1.0
p-Isopropyltoluene	µg/kg	1	ISO 17025	-	-	-	-	< 1.0
1,2-Dichlorobenzene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
1,4-Dichlorobenzene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Butylbenzene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	-	-	-	-	< 1.0
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
Hexachlorobutadiene	µg/kg	1	MCERTS	-	-	-	-	< 1.0
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	-	-	-	-	< 1.0

SVOCs

Aniline	mg/kg	0.1	NONE	-	-	-	-	< 0.1
Phenol	mg/kg	0.2	ISO 17025	-	-	-	-	< 0.2
2-Chlorophenol	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
1,3-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
1,2-Dichlorobenzene	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
1,4-Dichlorobenzene	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
2-Methylphenol	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
Hexachloroethane	mg/kg	0.05	MCERTS	-	-	-	-	< 0.05
Nitrobenzene	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
4-Methylphenol	mg/kg	0.2	NONE	-	-	-	-	< 0.2
Isophorone	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
2-Nitrophenol	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
Bis(2-chloroethoxy)methane	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
1,2,4-Trichlorobenzene	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
Naphthalene	mg/kg	0.05	MCERTS	-	-	-	-	29

Analytical Report Number: 21-56525
 Project / Site name: Pacific Park Wrexham
 Your Order No: 14-255-JC-F

Lab Sample Number				1768473	1768474	1768475	1768476	1768477
Sample Reference				WS103	WS104	WS105	WS106	WS106
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.40	0.60	0.15	0.30	0.50
Date Sampled				10/02/2021	10/02/2021	10/02/2021	10/02/2021	10/02/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
4-Chloroaniline	mg/kg	0.1	NONE	-	-	-	-	< 0.1
Hexachlorobutadiene	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	-	-	-	-	< 0.1
2,4,6-Trichlorophenol	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
2,4,5-Trichlorophenol	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
2-Methylnaphthalene	mg/kg	0.1	NONE	-	-	-	-	23
2-Chloronaphthalene	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
Dimethylphthalate	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
2,6-Dinitrotoluene	mg/kg	0.1	MCERTS	-	-	-	-	< 0.1
Acenaphthylene	mg/kg	0.05	MCERTS	-	-	-	-	1.8
Acenaphthene	mg/kg	0.05	MCERTS	-	-	-	-	67
2,4-Dinitrotoluene	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
Dibenzofuran	mg/kg	0.2	MCERTS	-	-	-	-	46
4-Chlorophenyl phenyl ether	mg/kg	0.3	ISO 17025	-	-	-	-	< 0.3
Diethyl phthalate	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
4-Nitroaniline	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
Fluorene	mg/kg	0.05	MCERTS	-	-	-	-	63
Azobenzene	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
Hexachlorobenzene	mg/kg	0.3	MCERTS	-	-	-	-	< 0.3
Phenanthrene	mg/kg	0.05	MCERTS	-	-	-	-	250
Anthracene	mg/kg	0.05	MCERTS	-	-	-	-	84
Carbazole	mg/kg	0.3	MCERTS	-	-	-	-	27
Dibutyl phthalate	mg/kg	0.2	MCERTS	-	-	-	-	< 0.2
Anthraquinone	mg/kg	0.3	MCERTS	-	-	-	-	14
Fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	260
Pyrene	mg/kg	0.05	MCERTS	-	-	-	-	210
Butyl benzyl phthalate	mg/kg	0.3	ISO 17025	-	-	-	-	< 0.3
Benzo(a)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	110
Chrysene	mg/kg	0.05	MCERTS	-	-	-	-	87
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	110
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	-	-	-	-	49
Benzo(a)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	97
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	-	-	-	-	46
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	-	-	-	-	14
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	-	-	-	-	50

Analytical Report Number: 21-56525
 Project / Site name: Pacific Park Wrexham
 Your Order No: 14-255-JC-F

Lab Sample Number				1768473	1768474	1768475	1768476	1768477
Sample Reference				WS103	WS104	WS105	WS106	WS106
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				1.40	0.60	0.15	0.30	0.50
Date Sampled				10/02/2021	10/02/2021	10/02/2021	10/02/2021	10/02/2021
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
PCBs by GC-MS								
PCB Congener 28	mg/kg	0.001	MCERTS	-	-	-	-	-
PCB Congener 52	mg/kg	0.001	MCERTS	-	-	-	-	-
PCB Congener 101	mg/kg	0.001	MCERTS	-	-	-	-	-
PCB Congener 118	mg/kg	0.001	MCERTS	-	-	-	-	-
PCB Congener 138	mg/kg	0.001	MCERTS	-	-	-	-	-
PCB Congener 153	mg/kg	0.001	MCERTS	-	-	-	-	-
PCB Congener 180	mg/kg	0.001	MCERTS	-	-	-	-	-
Total PCBs by GC-MS								
Total PCBs	mg/kg	0.007	MCERTS	-	-	-	-	-

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

Analytical Report Number: 21-56525
Project / Site name: Pacific Park Wrexham
Your Order No: 14-255-JC-F

Lab Sample Number				1768478
Sample Reference				WS106
Sample Number				None Supplied
Depth (m)				1.20
Date Sampled				10/02/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
Stone Content	%	0.1	NONE	< 0.1
Moisture Content	%	0.01	NONE	15
Total mass of sample received	kg	0.001	NONE	0.5

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-
Asbestos in Soil	Type	N/A	ISO 17025	-
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-
Asbestos Quantification Total	%	0.001	ISO 17025	-

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.2
Total Cyanide	mg/kg	1	MCERTS	< 1
Total Sulphate as SO ₄	mg/kg	50	MCERTS	440
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.11
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	230
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	114
Sulphide	mg/kg	1	MCERTS	16
Total Sulphur	mg/kg	50	MCERTS	170

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80
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Analytical Report Number: 21-56525
 Project / Site name: Pacific Park Wrexham
 Your Order No: 14-255-JC-F

Lab Sample Number				1768478
Sample Reference				WS106
Sample Number				None Supplied
Depth (m)				1.20
Date Sampled				10/02/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
Heavy Metals / Metalloids				
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	11
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	45
Copper (aqua regia extractable)	mg/kg	1	MCERTS	34
Lead (aqua regia extractable)	mg/kg	1	MCERTS	15
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	43
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	71

Monoaromatics & Oxygenates

Benzene	µg/kg	1	MCERTS	-
Toluene	µg/kg	1	MCERTS	-
Ethylbenzene	µg/kg	1	MCERTS	-
p & m-xylene	µg/kg	1	MCERTS	-
o-xylene	µg/kg	1	MCERTS	-
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	-

Analytical Report Number: 21-56525
 Project / Site name: Pacific Park Wrexham
 Your Order No: 14-255-JC-F

Lab Sample Number				1768478
Sample Reference				WS106
Sample Number				None Supplied
Depth (m)				1.20
Date Sampled				10/02/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
Petroleum Hydrocarbons				
TPH-CWG - Aliphatic >EC5 - EC6	mg/kg	0.001	MCERTS	-
TPH-CWG - Aliphatic >EC6 - EC8	mg/kg	0.001	MCERTS	-
TPH-CWG - Aliphatic >EC8 - EC10	mg/kg	0.001	MCERTS	-
TPH-CWG - Aliphatic >EC10 - EC12	mg/kg	1	MCERTS	-
TPH-CWG - Aliphatic >EC12 - EC16	mg/kg	2	MCERTS	-
TPH-CWG - Aliphatic >EC16 - EC21	mg/kg	8	MCERTS	-
TPH-CWG - Aliphatic >EC21 - EC35	mg/kg	8	MCERTS	-
TPH-CWG - Aliphatic (EC5 - EC35)	mg/kg	10	MCERTS	-

TPH-CWG - Aromatic >EC5 - EC7	mg/kg	0.001	MCERTS	-
TPH-CWG - Aromatic >EC7 - EC8	mg/kg	0.001	MCERTS	-
TPH-CWG - Aromatic >EC8 - EC10	mg/kg	0.001	MCERTS	-
TPH-CWG - Aromatic >EC10 - EC12	mg/kg	1	MCERTS	-
TPH-CWG - Aromatic >EC12 - EC16	mg/kg	2	MCERTS	-
TPH-CWG - Aromatic >EC16 - EC21	mg/kg	10	MCERTS	-
TPH-CWG - Aromatic >EC21 - EC35	mg/kg	10	MCERTS	-
TPH-CWG - Aromatic (EC5 - EC35)	mg/kg	10	MCERTS	-

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0
TPH (C16 - C21)	mg/kg	1	MCERTS	< 1.0
TPH (C21 - C35)	mg/kg	1	MCERTS	< 1.0
TPH (C35 - C40)	mg/kg	10	MCERTS	< 10
TPH Total C5 - C40	mg/kg	10	MCERTS	< 10

VOCs

Chloromethane	µg/kg	1	ISO 17025	< 1.0
Chloroethane	µg/kg	1	NONE	< 1.0
Bromomethane	µg/kg	1	ISO 17025	< 1.0
Vinyl Chloride	µg/kg	1	NONE	< 1.0
Trichlorofluoromethane	µg/kg	1	NONE	< 1.0
1,1-Dichloroethene	µg/kg	1	NONE	< 1.0
1,1,2-Trichloro 1,2,2-Trifluoroethane	µg/kg	1	ISO 17025	< 1.0
Cis-1,2-dichloroethene	µg/kg	1	MCERTS	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0
1,1-Dichloroethane	µg/kg	1	MCERTS	< 1.0
2,2-Dichloropropane	µg/kg	1	MCERTS	< 1.0
Trichloromethane	µg/kg	1	MCERTS	< 1.0
1,1,1-Trichloroethane	µg/kg	1	MCERTS	< 1.0
1,2-Dichloroethane	µg/kg	1	MCERTS	< 1.0
1,1-Dichloropropene	µg/kg	1	MCERTS	< 1.0
Trans-1,2-dichloroethene	µg/kg	1	NONE	< 1.0
Benzene	µg/kg	1	MCERTS	< 1.0
Tetrachloromethane	µg/kg	1	MCERTS	< 1.0
1,2-Dichloropropane	µg/kg	1	MCERTS	< 1.0
Trichloroethene	µg/kg	1	MCERTS	< 1.0
Dibromomethane	µg/kg	1	MCERTS	< 1.0
Bromodichloromethane	µg/kg	1	MCERTS	< 1.0
Cis-1,3-dichloropropene	µg/kg	1	ISO 17025	< 1.0

Analytical Report Number: 21-56525
Project / Site name: Pacific Park Wrexham
Your Order No: 14-255-JC-F

Lab Sample Number				1768478
Sample Reference				WS106
Sample Number				None Supplied
Depth (m)				1.20
Date Sampled				10/02/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
Trans-1,3-dichloropropene	µg/kg	1	ISO 17025	< 1.0
Toluene	µg/kg	1	MCERTS	< 1.0
1,1,2-Trichloroethane	µg/kg	1	MCERTS	< 1.0
1,3-Dichloropropane	µg/kg	1	ISO 17025	< 1.0
Dibromochloromethane	µg/kg	1	ISO 17025	< 1.0
Tetrachloroethene	µg/kg	1	NONE	< 1.0
1,2-Dibromoethane	µg/kg	1	ISO 17025	< 1.0
Chlorobenzene	µg/kg	1	MCERTS	< 1.0
1,1,1,2-Tetrachloroethane	µg/kg	1	MCERTS	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	< 1.0
p & m-Xylene	µg/kg	1	MCERTS	< 1.0
Styrene	µg/kg	1	MCERTS	< 1.0
Tribromomethane	µg/kg	1	NONE	< 1.0
o-Xylene	µg/kg	1	MCERTS	< 1.0
1,1,2,2-Tetrachloroethane	µg/kg	1	MCERTS	< 1.0
Isopropylbenzene	µg/kg	1	MCERTS	< 1.0
Bromobenzene	µg/kg	1	MCERTS	< 1.0
n-Propylbenzene	µg/kg	1	ISO 17025	< 1.0
2-Chlorotoluene	µg/kg	1	MCERTS	< 1.0
4-Chlorotoluene	µg/kg	1	MCERTS	< 1.0
1,3,5-Trimethylbenzene	µg/kg	1	ISO 17025	< 1.0
tert-Butylbenzene	µg/kg	1	MCERTS	< 1.0
1,2,4-Trimethylbenzene	µg/kg	1	ISO 17025	< 1.0
sec-Butylbenzene	µg/kg	1	MCERTS	< 1.0
1,3-Dichlorobenzene	µg/kg	1	ISO 17025	< 1.0
p-Isopropyltoluene	µg/kg	1	ISO 17025	< 1.0
1,2-Dichlorobenzene	µg/kg	1	MCERTS	< 1.0
1,4-Dichlorobenzene	µg/kg	1	MCERTS	< 1.0
Butylbenzene	µg/kg	1	MCERTS	< 1.0
1,2-Dibromo-3-chloropropane	µg/kg	1	ISO 17025	< 1.0
1,2,4-Trichlorobenzene	µg/kg	1	MCERTS	< 1.0
Hexachlorobutadiene	µg/kg	1	MCERTS	< 1.0
1,2,3-Trichlorobenzene	µg/kg	1	ISO 17025	< 1.0

SVOCs

Aniline	mg/kg	0.1	NONE	< 0.1
Phenol	mg/kg	0.2	ISO 17025	< 0.2
2-Chlorophenol	mg/kg	0.1	MCERTS	< 0.1
Bis(2-chloroethyl)ether	mg/kg	0.2	MCERTS	< 0.2
1,3-Dichlorobenzene	mg/kg	0.2	MCERTS	< 0.2
1,2-Dichlorobenzene	mg/kg	0.1	MCERTS	< 0.1
1,4-Dichlorobenzene	mg/kg	0.2	MCERTS	< 0.2
Bis(2-chloroisopropyl)ether	mg/kg	0.1	MCERTS	< 0.1
2-Methylphenol	mg/kg	0.3	MCERTS	< 0.3
Hexachloroethane	mg/kg	0.05	MCERTS	< 0.05
Nitrobenzene	mg/kg	0.3	MCERTS	< 0.3
4-Methylphenol	mg/kg	0.2	NONE	< 0.2
Isophorone	mg/kg	0.2	MCERTS	< 0.2
2-Nitrophenol	mg/kg	0.3	MCERTS	< 0.3
2,4-Dimethylphenol	mg/kg	0.3	MCERTS	< 0.3
Bis(2-chloroethoxy)methane	mg/kg	0.3	MCERTS	< 0.3
1,2,4-Trichlorobenzene	mg/kg	0.3	MCERTS	< 0.3
Naphthalene	mg/kg	0.05	MCERTS	< 0.05

Analytical Report Number: 21-56525
Project / Site name: Pacific Park Wrexham
Your Order No: 14-255-JC-F

Lab Sample Number				1768478
Sample Reference				WS106
Sample Number				None Supplied
Depth (m)				1.20
Date Sampled				10/02/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
2,4-Dichlorophenol	mg/kg	0.3	MCERTS	< 0.3
4-Chloroaniline	mg/kg	0.1	NONE	< 0.1
Hexachlorobutadiene	mg/kg	0.1	MCERTS	< 0.1
4-Chloro-3-methylphenol	mg/kg	0.1	NONE	< 0.1
2,4,6-Trichlorophenol	mg/kg	0.1	MCERTS	< 0.1
2,4,5-Trichlorophenol	mg/kg	0.2	MCERTS	< 0.2
2-Methylnaphthalene	mg/kg	0.1	NONE	< 0.1
2-Chloronaphthalene	mg/kg	0.1	MCERTS	< 0.1
Dimethylphthalate	mg/kg	0.1	MCERTS	< 0.1
2,6-Dinitrotoluene	mg/kg	0.1	MCERTS	< 0.1
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05
2,4-Dinitrotoluene	mg/kg	0.2	MCERTS	< 0.2
Dibenzofuran	mg/kg	0.2	MCERTS	< 0.2
4-Chlorophenyl phenyl ether	mg/kg	0.3	ISO 17025	< 0.3
Diethyl phthalate	mg/kg	0.2	MCERTS	< 0.2
4-Nitroaniline	mg/kg	0.2	MCERTS	< 0.2
Fluorene	mg/kg	0.05	MCERTS	< 0.05
Azobenzene	mg/kg	0.3	MCERTS	< 0.3
Bromophenyl phenyl ether	mg/kg	0.2	MCERTS	< 0.2
Hexachlorobenzene	mg/kg	0.3	MCERTS	< 0.3
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05
Carbazole	mg/kg	0.3	MCERTS	< 0.3
Dibutyl phthalate	mg/kg	0.2	MCERTS	< 0.2
Anthraquinone	mg/kg	0.3	MCERTS	< 0.3
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05
Pyrene	mg/kg	0.05	MCERTS	< 0.05
Butyl benzyl phthalate	mg/kg	0.3	ISO 17025	< 0.3
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05
Chrysene	mg/kg	0.05	MCERTS	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05

Analytical Report Number: 21-56525
 Project / Site name: Pacific Park Wrexham
 Your Order No: 14-255-JC-F

Lab Sample Number				1768478
Sample Reference				WS106
Sample Number				None Supplied
Depth (m)				1.20
Date Sampled				10/02/2021
Time Taken				None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status	
PCBs by GC-MS				
PCB Congener 28	mg/kg	0.001	MCERTS	-
PCB Congener 52	mg/kg	0.001	MCERTS	-
PCB Congener 101	mg/kg	0.001	MCERTS	-
PCB Congener 118	mg/kg	0.001	MCERTS	-
PCB Congener 138	mg/kg	0.001	MCERTS	-
PCB Congener 153	mg/kg	0.001	MCERTS	-
PCB Congener 180	mg/kg	0.001	MCERTS	-
Total PCBs by GC-MS				
Total PCBs	mg/kg	0.007	MCERTS	-

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



Analytical Report Number: 21-56525
Project / Site name: Pacific Park Wrexham
Your Order No: 14-255-JC-F

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

The samples were analysed qualitatively for asbestos by polarising light and dispersion staining as described by the Health and Safety Executive in HSG 248.

Quantitative Analysis

The analysis was carried out using our documented in-house method A006-PL based on HSE Contract Research Report No: 83/1996: Development and Validation of an analytical method to determine the amount of asbestos in soils and loose aggregates (Davies et al, 1996) and HSG 248. Our method includes initial examination of the entire representative sample, then fractionation and detailed analysis of each fraction, with quantification by hand picking and weighing.

The limit of detection (reporting limit) of this method is 0.001 %.

The method has been validated using samples of at least 100 g, results for samples smaller than this should be interpreted with caution.

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
1768468	WS101	0.65	117	Loose Fibres	Chrysotile	0.002	0.002
1768469	WS101	0.72	129	Loose Fibres	Chrysotile	< 0.001	< 0.001
1768474	WS104	0.60	100	Loose Fibres	Chrysotile	< 0.001	< 0.001

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.



Analytical Report Number: 21-56525
Project / Site name: Pacific Park Wrexham

Your Order No: 14-255-JC-F

Lab Sample Number	1768479	1768480	1768481
Sample Reference	WS101	WS104	WS106
Sample Number	None Supplied	None Supplied	None Supplied
Depth (m)	0.65	0.30	0.50
Date Sampled	10/02/2021	10/02/2021	10/02/2021
Time Taken	None Supplied	None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status

General Inorganics

pH	pH Units	N/A	ISO 17025	8	11	8
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	< 1.0	5.8	< 1.0

Total Phenols

Total Phenols (monohydric)	µg/l	1	ISO 17025	< 1.0	8.8	11000
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Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	170
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	0.4
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	11
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	5.1
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	4.4
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	0.89
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	0.35
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	0.22
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	0.17
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	NONE	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	NONE	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	NONE	< 0.01	< 0.01	< 0.01

Total PAH

Total EPA-16 PAHs	µg/l	0.2	NONE	< 0.2	< 0.2	200
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Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	1	ISO 17025	4.4	2.8	5.1
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08	< 0.08	< 0.08
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	22	< 5.0
Chromium (dissolved)	µg/l	0.4	ISO 17025	1.5	27	1.6
Copper (dissolved)	µg/l	0.7	ISO 17025	9	44	8.9
Lead (dissolved)	µg/l	1	ISO 17025	2.9	2.4	< 1.0
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5	< 0.5	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	2.7	4.9	3.9
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0	< 4.0	< 4.0
Zinc (dissolved)	µg/l	0.4	ISO 17025	9.9	8.1	7.7

Monoaromatics & Oxygenates

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

Petroleum Hydrocarbons

TPH1 (C10 - C40)	µg/l	10	NONE	< 10	< 10	500
TPH-CWG - Aliphatic >C5 - C6	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0



Analytical Report Number: 21-56525
Project / Site name: Pacific Park Wrexham

Your Order No: 14-255-JC-F

Lab Sample Number				1768479	1768480	1768481
Sample Reference				WS101	WS104	WS106
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				0.65	0.30	0.50
Date Sampled				10/02/2021	10/02/2021	10/02/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status			
TPH-CWG - Aliphatic >C6 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10

TPH-CWG - Aromatic >C5 - C7	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C7 - C8	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C8 - C10	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	170
TPH-CWG - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	330
TPH-CWG - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10
TPH-CWG - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	500

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

Analytical Report Number : 21-56525

Project / Site name: Pacific Park Wrexham

* 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 *
1768468	WS101	None Supplied	0.65	Brown sandy clay with gravel.
1768469	WS101	None Supplied	0.72	Brown clay with gravel.
1768470	WS101	None Supplied	1	Brown clay with gravel.
1768471	WS102	None Supplied	0.7	Brown sandy clay with gravel.
1768472	WS103	None Supplied	1	Brown sandy clay with gravel.
1768473	WS103	None Supplied	1.4	Brown clay.
1768474	WS104	None Supplied	0.6	Brown clay.
1768475	WS105	None Supplied	0.15	Brown sandy clay with gravel.
1768476	WS106	None Supplied	0.3	Brown sandy clay with gravel.
1768477	WS106	None Supplied	0.5	Brown sandy clay with gravel.
1768478	WS106	None Supplied	1.2	Brown clay.

Analytical Report Number : 21-56525
Project / Site name: Pacific Park Wrexham

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

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 disperion 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
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
Hexavalent chromium in leachate	Determination of hexavalent chromium in leachate by acidification, addition of 1,5 diphenylcarbazine followed by colorimetry.	In-house method	L080-PL	W	ISO 17025
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazine followed by colorimetry.	In-house method	L080-PL	W	MCERTS
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	NONE
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
PCB's By GC-MS in soil	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L027-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
pH at 20oC in leachate	Determination of pH in leachate by electrometric measurement.	In house method.	L005-PL	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	MCERTS

Analytical Report Number : 21-56525
Project / Site name: Pacific Park Wrexham

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Total sulphate (as SO ₄ in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
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	MCERTS
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	NONE
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
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	MCERTS
BTEX and MTBE in soil (Monoaromatics)	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073B-PL	W	MCERTS
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	MCERTS
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	MCERTS
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
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in house method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
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



Analytical Report Number : 21-56525
Project / Site name: Pacific Park Wrexham

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' 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.

Rebecca Hodnett

e3p
Taylor Road
Urmston
Manchester
M41 7JQ

e: rhodnett@e3p.co.uk

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

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

Analytical Report Number : 21-58166-2

Replaces Analytical Report Number: 21-58166-2, issue no. 1
Client references/information amended.

Project / Site name:	Pacific Park	Samples received on:	18/02/2021
Your job number:	14-255	Samples instructed on/ Analysis started on:	22/02/2021
Your order number:		Analysis completed by:	10/05/2021
Report Issue Number:	2	Report issued on:	10/05/2021
Samples Analysed:	1 leachate sample - 8 soil samples		

Signed: 

Agnieszka Czerwińska
Technical Reviewer (Reporting Team)
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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

Analytical Report Number: 21-58166-2
Project / Site name: Pacific Park

Lab Sample Number	1777798	1777799	1777800	1777801	1777802
Sample Reference	TP101	TP102	TP104	TP104	TP105
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.17	0.06	1.38	1.90	1.00
Date Sampled	16/02/2021	16/02/2021	16/02/2021	16/02/2021	16/02/2021
Time Taken	None Supplied	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
Moisture Content	%	0.01	NONE	15	9.2
Total mass of sample received	kg	0.001	NONE	0.40	0.40

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	Amosite	-	-	-
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Detected	Not-detected	-	Not-detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	< 0.001	-	-	-
Asbestos Quantification Total	%	0.001	ISO 17025	-	< 0.001	-	-	-

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.3	-	7.8	8.0	8.2
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1	< 1	< 1
Total Sulphate as SO ₄	mg/kg	50	MCERTS	620	-	1300	410	270
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	0.012	-	0.16	0.020	0.016
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	23	-	330	40	31
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	11.6	-	165	20.1	15.6
Sulphide	mg/kg	1	MCERTS	< 1.0	-	15	1.6	1.3
Total Sulphur	mg/kg	50	MCERTS	310	-	980	210	120
Total Organic Carbon (TOC)	%	0.1	MCERTS	-	-	1.9	-	-

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	MCERTS	< 0.05	0.38	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	0.51	0.29	0.28	< 0.05
Anthracene	mg/kg	0.05	MCERTS	< 0.05	0.16	< 0.05	< 0.05	< 0.05
Fluoranthene	mg/kg	0.05	MCERTS	0.47	1.4	0.41	0.60	< 0.05
Pyrene	mg/kg	0.05	MCERTS	0.54	1.6	0.43	0.73	< 0.05
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.52	0.85	0.46	0.72	< 0.05
Chrysene	mg/kg	0.05	MCERTS	0.34	0.80	0.30	0.49	< 0.05
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	0.81	1.1	0.60	0.71	< 0.05
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	0.26	0.65	0.20	0.46	< 0.05
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.57	1.3	0.38	0.69	< 0.05
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.35	0.61	0.33	0.47	< 0.05
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.45	0.90	0.36	0.57	< 0.05

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	4.31	10.2	3.76	5.72	< 0.80
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Analytical Report Number: 21-58166-2
Project / Site name: Pacific Park

Lab Sample Number	1777798	1777799	1777800	1777801	1777802
Sample Reference	TP101	TP102	TP104	TP104	TP105
Sample Number	None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)	0.17	0.06	1.38	1.90	1.00
Date Sampled	16/02/2021	16/02/2021	16/02/2021	16/02/2021	16/02/2021
Time Taken	None Supplied	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	11	3.7	17	15	10
Barium (aqua regia extractable)	mg/kg	1	MCERTS	-	29	-	-	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	-	0.22	-	-	-
Boron (water soluble)	mg/kg	0.2	MCERTS	-	0.6	-	-	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	37	-	41	45	31
Copper (aqua regia extractable)	mg/kg	1	MCERTS	30	8.3	82	53	28
Lead (aqua regia extractable)	mg/kg	1	MCERTS	36	21	60	34	22
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	34	8.0	61	44	30
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	-	18	-	-	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	84	24	160	140	55

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
TPH (C12 - C16)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
TPH (C16 - C21)	mg/kg	1	MCERTS	6.6	14	5.5	< 1.0	< 1.0
TPH (C21 - C35)	mg/kg	1	MCERTS	31	470	18	< 1.0	< 1.0
TPH (C35 - C40)	mg/kg	10	MCERTS	< 10	650	< 10	< 10	< 10
TPH Total C5 - C40	mg/kg	10	MCERTS	39	1100	26	< 10	< 10

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

Analytical Report Number: 21-58166-2
Project / Site name: Pacific Park

Lab Sample Number				1777803	1777804	1777805
Sample Reference				TP106	TP108	TP110
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				1.50	1.25	0.60
Date Sampled				16/02/2021	16/02/2021	16/02/2021
Time Taken				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	< 0.1
Moisture Content	%	0.01	NONE	8.8	11	12
Total mass of sample received	kg	0.001	NONE	0.40	0.50	0.40

Asbestos in Soil Screen / Identification Name	Type	N/A	ISO 17025	-	-	Chrysotile
Asbestos in Soil	Type	N/A	ISO 17025	Not-detected	Not-detected	Detected
Asbestos Quantification (Stage 2)	%	0.001	ISO 17025	-	-	< 0.001
Asbestos Quantification Total	%	0.001	ISO 17025	-	-	< 0.001

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	-	-	7.5
Total Cyanide	mg/kg	1	MCERTS	< 1	< 1	< 1
Total Sulphate as SO ₄	mg/kg	50	MCERTS	-	-	2100
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	g/l	0.00125	MCERTS	-	-	0.17
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/kg	2.5	MCERTS	-	-	330
Water Soluble SO ₄ (2:1 Leach. Equiv.) 1hr extraction	mg/l	1.25	MCERTS	-	-	167
Sulphide	mg/kg	1	MCERTS	-	-	7.8
Total Sulphur	mg/kg	50	MCERTS	-	-	1900
Total Organic Carbon (TOC)	%	0.1	MCERTS	-	1.7	-

Total Phenols

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

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.28
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.7
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	1.2
Phenanthrene	mg/kg	0.05	MCERTS	< 0.05	0.70	11
Anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	3.3
Fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.90	25
Pyrene	mg/kg	0.05	MCERTS	< 0.05	0.94	22
Benzo(a)anthracene	mg/kg	0.05	MCERTS	< 0.05	0.74	16
Chrysene	mg/kg	0.05	MCERTS	< 0.05	0.44	11
Benzo(b)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.72	18
Benzo(k)fluoranthene	mg/kg	0.05	MCERTS	< 0.05	0.43	7.5
Benzo(a)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.59	15
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	< 0.05	0.33	6.9
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	2.7
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	0.46	7.6

Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	MCERTS	< 0.80	6.25	149
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Analytical Report Number: 21-58166-2
Project / Site name: Pacific Park

Lab Sample Number				1777803	1777804	1777805
Sample Reference				TP106	TP108	TP110
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				1.50	1.25	0.60
Date Sampled				16/02/2021	16/02/2021	16/02/2021
Time Taken				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	35	24	15
Barium (aqua regia extractable)	mg/kg	1	MCERTS	220	210	-
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	2.4	1.1	-
Boron (water soluble)	mg/kg	0.2	MCERTS	0.6	2.2	-
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	1.1
Chromium (hexavalent)	mg/kg	4	MCERTS	< 4.0	< 4.0	< 4.0
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	-	-	32
Copper (aqua regia extractable)	mg/kg	1	MCERTS	58	32	45
Lead (aqua regia extractable)	mg/kg	1	MCERTS	32	51	120
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	48	31	36
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	62	39	-
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	41	95	250

Petroleum Hydrocarbons

TPH (C5 - C6)	mg/kg	1	NONE	< 1.0	< 1.0	< 1.0
TPH (C6 - C8)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1
TPH (C8 - C10)	mg/kg	0.1	MCERTS	< 0.1	< 0.1	< 0.1
TPH (C10 - C12)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0
TPH (C12 - C16)	mg/kg	4	MCERTS	13	< 4.0	44
TPH (C16 - C21)	mg/kg	1	MCERTS	12	24	180
TPH (C21 - C35)	mg/kg	1	MCERTS	5.8	80	430
TPH (C35 - C40)	mg/kg	10	MCERTS	< 10	< 10	93
TPH Total C5 - C40	mg/kg	10	MCERTS	33	110	750

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



Analytical Report Number: 21-58166-2
Project / Site name: Pacific Park

Lab Sample Number				1777806
Sample Reference				TP104
Sample Number				None Supplied
Depth (m)				1.38
Date Sampled				16/02/2021
Time Taken				None Supplied
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status	

General Inorganics

pH	pH Units	N/A	ISO 17025	7.7
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	< 1.0

Total Phenols

Total Phenols (monohydric)	µg/l	1	ISO 17025	< 1.0
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Speciated PAHs

Naphthalene	µg/l	0.01	ISO 17025	< 0.01
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01
Fluorene	µg/l	0.01	ISO 17025	< 0.01
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01
Anthracene	µg/l	0.01	ISO 17025	< 0.01
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01
Pyrene	µg/l	0.01	ISO 17025	< 0.01
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	NONE	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	NONE	< 0.01
Benzo(ghi)perylene	µg/l	0.01	NONE	< 0.01

Total PAH

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

Arsenic (dissolved)	µg/l	1	ISO 17025	< 1.0
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0
Chromium (dissolved)	µg/l	0.4	ISO 17025	0.7
Copper (dissolved)	µg/l	0.7	ISO 17025	14
Lead (dissolved)	µg/l	1	ISO 17025	< 1.0
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	3.3
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0
Zinc (dissolved)	µg/l	0.4	ISO 17025	19



Analytical Report Number: 21-58166-2
Project / Site name: Pacific Park

Lab Sample Number				1777806
Sample Reference				TP104
Sample Number				None Supplied
Depth (m)				1.38
Date Sampled				16/02/2021
Time Taken				None Supplied
Analytical Parameter (Leachate Analysis)	Units	Limit of detection	Accreditation Status	

Monoaromatics & Oxygenates

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

Petroleum Hydrocarbons

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

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

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

Analytical Report Number: **21-58166**
Project / Site name: **Pacific Park**
Your Order No:

Certificate of Analysis - Asbestos Quantification

Methods:

Qualitative Analysis

The samples were analysed qualitatively for asbestos by polarising light and dispersion staining as described by the Health and Safety Executive in HSG 248.

Quantitative Analysis

The analysis was carried out using our documented in-house method A006-PL based on HSE Contract Research Report No: 83/1996: Development and Validation of an analytical method to determine the amount of asbestos in soils and loose aggregates (Davies et al, 1996) and HSG 248. Our method includes initial examination of the entire representative sample, then fractionation and detailed analysis of each fraction, with quantification by hand picking and weighing.

The limit of detection (reporting limit) of this method is 0.001 %.

The method has been validated using samples of at least 100 g, results for samples smaller than this should be interpreted with caution.

Both Qualitative and Quantitative Analyses are UKAS accredited.

Sample Number	Sample ID	Sample Depth (m)	Sample Weight (g)	Asbestos Containing Material Types Detected (ACM)	PLM Results	Asbestos by hand picking/weighing (%)	Total % Asbestos in Sample
1777799	TP102	0.06	211	Loose Fibres	Amosite	< 0.001	< 0.001
1777805	TP110	0.60	186	Loose Fibres	Chrysotile	< 0.001	< 0.001

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

Analytical Report Number : 21-58166-2

Project / Site name: Pacific Park

* 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 *
1777798	TP101	None Supplied	0.17	Brown loam and clay with gravel.
1777799	TP102	None Supplied	0.06	Black gravel with tar.**
1777800	TP104	None Supplied	1.38	Brown loam and clay with gravel.
1777801	TP104	None Supplied	1.9	Brown clay and sand with gravel.
1777802	TP105	None Supplied	1	Brown clay and sand with gravel and vegetation.
1777803	TP106	None Supplied	1.5	Red clay and sand with gravel and rubble.
1777804	TP108	None Supplied	1.25	Brown clay and sand with gravel.
1777805	TP110	None Supplied	0.6	Brown loam and clay with gravel.

** Non MCERTS Matrix

Analytical Report Number : 21-58166-2
Project / Site name: Pacific Park

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

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 disperion 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
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
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
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L080-PL	W	MCERTS
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	NONE
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
pH at 20oC in leachate	Determination of pH in leachate by electrometric measurement.	In house method.	L005-PL	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	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS

Analytical Report Number : 21-58166-2
Project / Site name: Pacific Park

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Total Sulphur in soil	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
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	NONE
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
BTEX and MTBE in leachates (Monoaromatics)	Determination of BTEX and MTBE in leachates by headspace GC-MS.	In-house method based on USEPA8260	L0738-PL	W	ISO 17025
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	MCERTS
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
Asbestos Quantification - Gravimetric	Asbestos quantification by gravimetric method - in house method based on references.	HSE Report No: 83/1996, HSG 248, HSG 264 & SCA Blue Book (draft).	A006-PL	D	ISO 17025
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' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' 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.

**Rebecca Hodnett**

e3p
Taylor Road
Urmston
Manchester
M41 7JQ

e: rhodnett@e3p.co.uk

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

t: 01923 225404

f: 01923 237404

e: reception@i2analytical.com

Analytical Report Number : 21-65364

Project / Site name:	Pacific Park Wrexham	Samples received on:	26/03/2021
Your job number:	14-255	Samples instructed on/ Analysis started on:	26/03/2021
Your order number:	14255-BH-M	Analysis completed by:	06/04/2021
Report Issue Number:	1	Report issued on:	06/04/2021
Samples Analysed:	3 water samples		

Signed: *Karolina Marek*

Karolina Marek
PL Head of Reporting Team
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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



Analytical Report Number: 21-65364
Project / Site name: Pacific Park Wrexham

Your Order No: 14255-BH-M

Lab Sample Number	1818622	1818623	1818624
Sample Reference	CP102	WS105	WS101
Sample Number	None Supplied	None Supplied	None Supplied
Depth (m)	None Supplied	None Supplied	None Supplied
Date Sampled	25/03/2021	25/03/2021	25/03/2021
Time Taken	None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status

General Inorganics

pH	pH Units	N/A	ISO 17025	7.4	7.4	7.9
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	3.61	10.6	8.09

Total Phenols

Total Phenols (monohydric)	µg/l	1	ISO 17025	1.8	< 1.0	< 1.0
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Heavy Metals / Metalloids

Calcium (dissolved)	mg/l	0.012	ISO 17025	75	92	47
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0

Arsenic (dissolved)	µg/l	0.15	ISO 17025	1.76	1.19	1.43
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02	0.03	< 0.02
Chromium (dissolved)	µg/l	0.2	ISO 17025	6.1	3.5	1.8
Copper (dissolved)	µg/l	0.5	ISO 17025	6.8	4.0	6.8
Lead (dissolved)	µg/l	0.2	ISO 17025	0.5	< 0.2	0.5
Manganese (dissolved)	µg/l	0.05	ISO 17025	230	640	45
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	8.7	6.0	3.0
Selenium (dissolved)	µg/l	0.6	ISO 17025	1.9	3.2	1.9
Zinc (dissolved)	µg/l	0.5	ISO 17025	9.3	10	6.1

Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0

Petroleum Hydrocarbons

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

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



Analytical Report Number: 21-65364
Project / Site name: Pacific Park Wrexham

Your Order No: 14255-BH-M

Lab Sample Number				1818622	1818623	1818624
Sample Reference				CP102	WS105	WS101
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				25/03/2021	25/03/2021	25/03/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status			

VOCs

Chloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Chloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Bromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Vinyl Chloride	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Trichlorofluoromethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Cis-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
2,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Trichloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Trans-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Tetrachloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Trichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Dibromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Bromodichloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Cis-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Trans-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1,2-Trichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Dibromochloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Tetrachloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dibromoethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Chlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1,1,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
p & m-Xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Styrene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Tribromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
o-Xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1,2,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Isopropylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Bromobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
n-Propylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
2-Chlorotoluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
4-Chlorotoluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
tert-Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
sec-Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
p-Isopropyltoluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0



Analytical Report Number: 21-65364
Project / Site name: Pacific Park Wrexham

Your Order No: 14255-BH-M

Lab Sample Number				1818622	1818623	1818624
Sample Reference				CP102	WS105	WS101
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				25/03/2021	25/03/2021	25/03/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status			
Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-chloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2,4-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0

SVOCs

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



Analytical Report Number: 21-65364
Project / Site name: Pacific Park Wrexham

Your Order No: 14255-BH-M

Lab Sample Number				1818622	1818623	1818624
Sample Reference				CP102	WS105	WS101
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				25/03/2021	25/03/2021	25/03/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status			
Butyl benzyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
3&4-Methylphenol	µg/l	0.1	NONE	< 0.10	< 0.10	< 0.10

PCBs by GC-MS

PCB Congener 28	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02
PCB Congener 52	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02
PCB Congener 101	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02
PCB Congener 118	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02
PCB Congener 138	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02
PCB Congener 153	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02
PCB Congener 180	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02

PCBs by GC-MS

Total PCBs	µg/l	0.14	NONE	< 0.14	< 0.14	< 0.14
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U/S = Unsuitable Sample I/S = Insufficient Sample



Analytical Report Number : 21-65364
Project / Site name: Pacific Park Wrexham

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

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
PCB's By GC-MS in water	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L028-PL	W	NONE
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	NONE
TPH1 (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS.	In-house method	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE
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	ISO 17025
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	NONE
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	ISO 17025
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

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

For method numbers ending in 'PL' 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.

Sample Deviation Report



Analytical Report Number : 21-65364

Project / Site name: Pacific Park Wrexham

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
CP102	None Supplied	W	1818622	c	pH at 20oC in water (automated)	L099-PL	c
WS101	None Supplied	W	1818624	c	pH at 20oC in water (automated)	L099-PL	c
WS105	None Supplied	W	1818623	c	pH at 20oC in water (automated)	L099-PL	c



Rebecca Hodnett
e3p
Heliport Business Centre
Manchester
M30 7RU

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: rhodnett@e3p.co.uk

Analytical Report Number : 21-60171

Project / Site name:	Pacific PArk Wrexham	Samples received on:	03/03/2021
Your job number:	14-255	Samples instructed on/ Analysis started on:	03/03/2021
Your order number:	14255-JC-L	Analysis completed by:	10/03/2021
Report Issue Number:	1	Report issued on:	10/03/2021
Samples Analysed:	3 water samples		

Signed:

Joanna Wawrzeczko
Technical Reviewer (Reporting Team)
For & on behalf of i2 Analytical Ltd.

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

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

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

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

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



Analytical Report Number: 21-60171
Project / Site name: Pacific Park Wrexham

Your Order No: 14255-JC-L

Lab Sample Number				1790410	1790411	1790412
Sample Reference				CP101	CP102	WS101
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				01/03/2021	01/03/2021	01/03/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status			

General Inorganics

pH	pH Units	N/A	ISO 17025	7.2	7.5	8.8
Total Cyanide (Low Level 1 µg/l)	µg/l	1	ISO 17025	< 1.0	< 1.0	1.9
Dissolved Organic Carbon (DOC)	mg/l	0.1	NONE	8.43	3.25	11.2

Total Phenols

Total Phenols (monohydric)	µg/l	1	ISO 17025	3	2.9	5.9
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Heavy Metals / Metalloids

Calcium (dissolved)	mg/l	0.012	ISO 17025	110	77	14
Chromium (hexavalent)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0

Arsenic (dissolved)	µg/l	0.15	ISO 17025	1.14	1.53	6.92
Cadmium (dissolved)	µg/l	0.02	ISO 17025	< 0.02	0.04	0.02
Chromium (dissolved)	µg/l	0.2	ISO 17025	3.9	4.6	4.7
Copper (dissolved)	µg/l	0.5	ISO 17025	5.2	11	12
Lead (dissolved)	µg/l	0.2	ISO 17025	< 0.2	0.9	0.3
Manganese (dissolved)	µg/l	0.05	ISO 17025	1600	140	20
Mercury (dissolved)	µg/l	0.05	ISO 17025	< 0.05	< 0.05	< 0.05
Nickel (dissolved)	µg/l	0.5	ISO 17025	5.5	2.8	4.1
Selenium (dissolved)	µg/l	0.6	ISO 17025	1.5	3.6	44
Zinc (dissolved)	µg/l	0.5	ISO 17025	14	18	< 0.5

Monoaromatics & Oxygenates

Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0

Petroleum Hydrocarbons

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

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



Analytical Report Number: 21-60171
Project / Site name: Pacific Park Wrexham

Your Order No: 14255-JC-L

Lab Sample Number				1790410	1790411	1790412
Sample Reference				CP101	CP102	WS101
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				01/03/2021	01/03/2021	01/03/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status			

VOCs

Chloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Chloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Bromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Vinyl Chloride	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
Trichlorofluoromethane	µg/l	1	NONE	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Cis-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
2,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Trichloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1,1-Trichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1-Dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Trans-1,2-dichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Tetrachloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Trichloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Dibromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Bromodichloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Cis-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Trans-1,3-dichloropropene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1,2-Trichloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,3-Dichloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Dibromochloromethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Tetrachloroethene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dibromoethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Chlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1,1,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
p & m-Xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Styrene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Tribromomethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
o-Xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,1,2,2-Tetrachloroethane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Isopropylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Bromobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
n-Propylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
2-Chlorotoluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
4-Chlorotoluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,3,5-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
tert-Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2,4-Trimethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
sec-Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,3-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
p-Isopropyltoluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,4-Dichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0



Analytical Report Number: 21-60171
Project / Site name: Pacific Park Wrexham

Your Order No: 14255-JC-L

Lab Sample Number				1790410	1790411	1790412
Sample Reference				CP101	CP102	WS101
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				01/03/2021	01/03/2021	01/03/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status			
Butylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2-Dibromo-3-chloropropane	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2,4-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
Hexachlorobutadiene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0
1,2,3-Trichlorobenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0

SVOCs

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



Analytical Report Number: 21-60171
Project / Site name: Pacific Park Wrexham

Your Order No: 14255-JC-L

Lab Sample Number				1790410	1790411	1790412
Sample Reference				CP101	CP102	WS101
Sample Number				None Supplied	None Supplied	None Supplied
Depth (m)				None Supplied	None Supplied	None Supplied
Date Sampled				01/03/2021	01/03/2021	01/03/2021
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Water Analysis)	Units	Limit of detection	Accreditation Status			
Butyl benzyl phthalate	µg/l	0.05	NONE	< 0.05	< 0.05	< 0.05
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01

PCBs by GC-MS

PCB Congener 28	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02
PCB Congener 52	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02
PCB Congener 101	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02
PCB Congener 118	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02
PCB Congener 138	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02
PCB Congener 153	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02
PCB Congener 180	µg/l	0.02	NONE	< 0.02	< 0.02	< 0.02

PCBs by GC-MS

Total PCBs	µg/l	0.14	NONE	< 0.14	< 0.14	< 0.14
------------	------	------	------	--------	--------	--------

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



Analytical Report Number : 21-60171
Project / Site name: Pacific Park Wrexham

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
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
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
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
PCB's By GC-MS in water	Determination of PCB by extraction with acetone and hexane followed by GC-MS.	In-house method based on USEPA 8082	L028-PL	W	NONE
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	NONE
TPH1 (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS.	In-house method	L070-PL	W	NONE
TPHCWG (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS, speciation by interpretation.	In-house method	L070-PL	W	NONE
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	ISO 17025
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	NONE
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	ISO 17025
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

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.

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

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

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

APPENDIX 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	PROVISIONAL C4SL
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)	



APPENDIX VIII

GEOTECHNICAL TESTING

RESULTS



LABORATORY REPORT



4043

Contract Number: PSL21/1854

Report Date: 26 March 2021

Client's Reference: 14-255

Client Name: E3P
Taylor Road
Urmston
Manchester
M41 7JQ

For the attention of: Jamie Craig

Contract Title: Pacific Park Wrexham

Date Received: 4/3/2021

Date Commenced: 4/3/2021

Date Completed: 26/3/2021

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

A Watkins
(Director)

R Berriman
(Quality Manager)

S Royle
(Laboratory Manager)

L Knight
(Senior Technician)


S Eyre
(Senior Technician)

H Daniels
(Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,
Doncaster DN4 0AR
tel: +44 (0)844 815 6641
fax: +44 (0)844 815 6642
e-mail: rberriman@prosoils.co.uk
awatkins@prosoils.co.uk

Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
WS101		SPT	2.00		Brown slightly gravelly sandy CLAY.
WS101		Liner	1.50	2.00	Very stiff brown slightly gravelly sandy CLAY.
WS103		SPT	2.00		Brown slightly gravelly sandy CLAY.
WS106		SPT	1.00		MADE GROUND brown slightly gravelly sandy CLAY.
WS106		Liner	2.00	2.50	Very stiff brown slightly gravelly slightly sandy CLAY.
TP103		Bulk	0.30		MADE GROUND reddish brown sandy slightly clayey silty gravel.
TP104		Bulk	0.80		Brown mottled grey slightly gravelly very sandy silty CLAY.
CP101		Liner	3.00	3.45	Stiff brown mottled grey slightly gravelly slightly sandy CLAY.
CP101		Liner	12.50	12.95	Firm brown slightly sandy CLAY.
CP102		Liner	6.50	6.95	Firm brown CLAY.
CP102		Liner	21.50	21.95	Stiff brown slightly gravelly slightly sandy CLAY.



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PSL

Professional Soils Laboratory

Pacific Park Wrexham

Contract No:

PSL21/1854

Client Ref:

14-255

SUMMARY OF SOIL CLASSIFICATION TESTS

(BS1377 : PART 2 : 1990)

[illegible]

SYMBOLS : NP : Non Plastic

*** : Liquid Limit and Plastic Limit Wet Sieved.**



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Pacific Park Wrexham

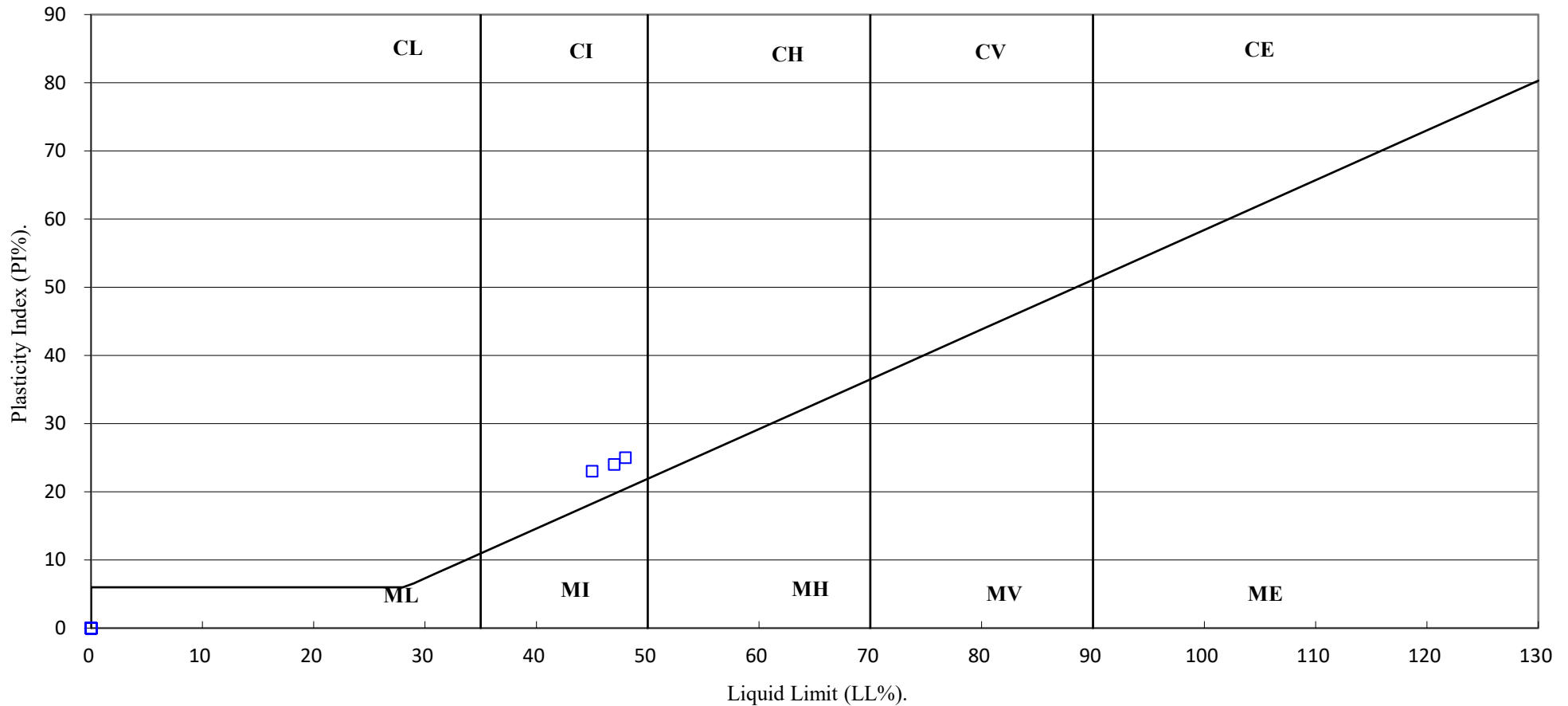
Contract No:

PSL21/1854

Client Ref:

14-255

PLASTICITY CHART FOR CASAGRANDE CLASSIFICATION.



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Contract No:

PSL21/1854

Client Ref:

14-255

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

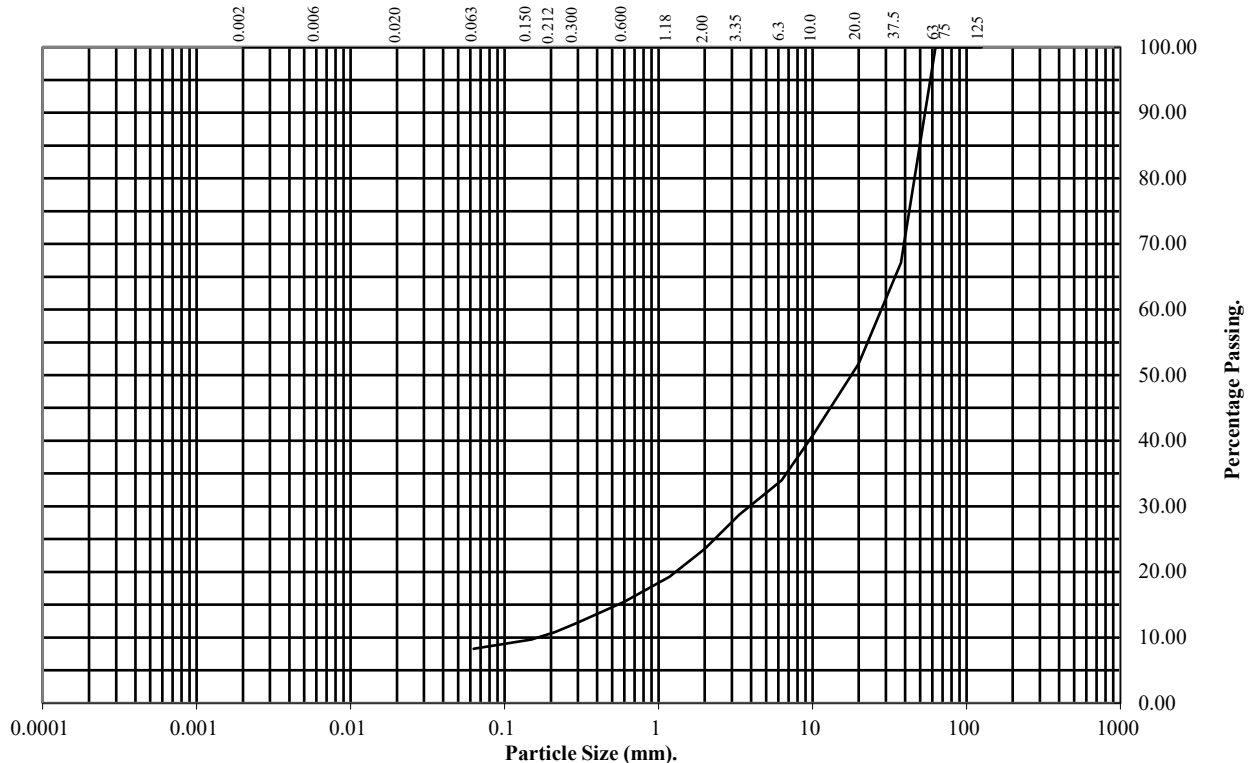
Hole Number: TP103

Top Depth (m): 0.30

Sample Number:

Base Depth(m):

Sample Type: Bulk



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	67
20	52
10	41
6.3	34
3.35	29
2	24
1.18	19
0.6	15
0.3	12
0.212	11
0.15	10
0.063	8

Soil Fraction	Total Percentage
Cobbles	0
Gravel	76
Sand	16
Silt/Clay	8

Remarks:

See Summary of Soil Descriptions



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Pacific Park Wrexham

Contract No:
PSL21/1854
Client Ref:
14-255

PARTICLE SIZE DISTRIBUTION TEST

BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

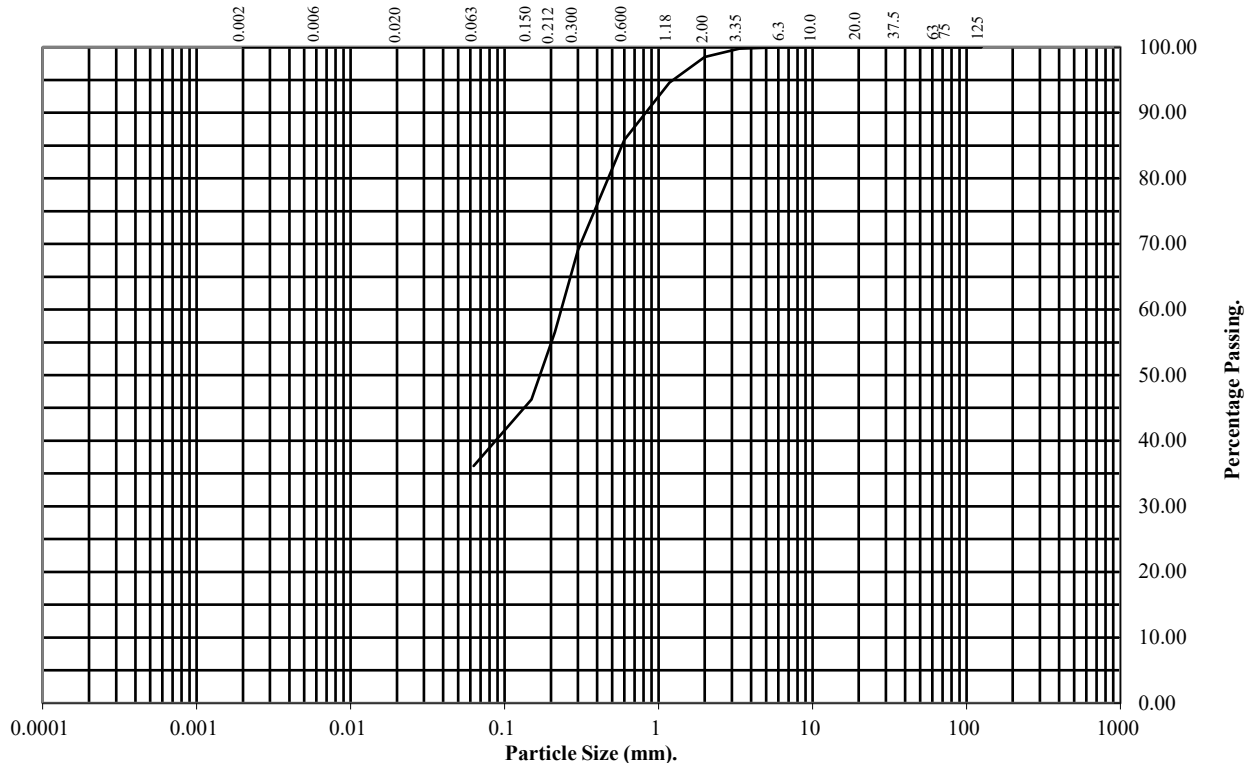
Hole Number: TP104

Top Depth (m): 0.80

Sample Number:

Base Depth(m):

Sample Type: Bulk



BS Test Sieve (mm)	Percentage Passing
125	100
75	100
63	100
37.5	100
20	100
10	100
6.3	100
3.35	100
2	98
1.18	95
0.6	86
0.3	69
0.212	57
0.15	46
0.063	36

Soil Fraction	Total Percentage
Cobbles	0
Gravel	2
Sand	62
Silt/Clay	36

Remarks:

See Summary of Soil Descriptions



PSL
Professional Soils Laboratory

Pacific Park Wrexham

Contract No:
PSL21/1854
Client Ref:
14-255

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number: WS101

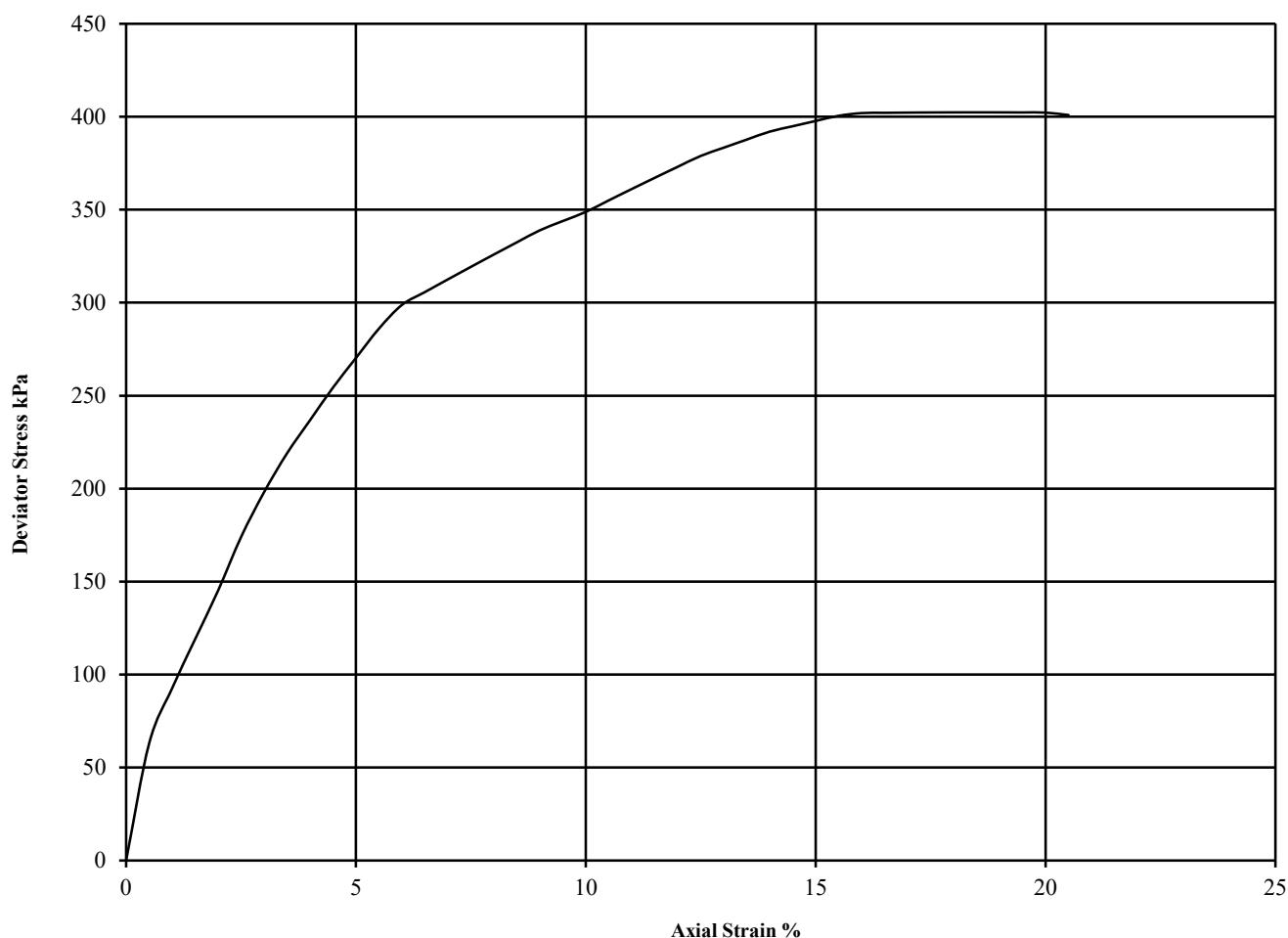
Top Depth (m): 1.50

Sample Number:

Base Depth (m): 2.00

Sample Type

Liner



Diameter (mm):		83	Height (mm):		166	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.40 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	19	2.12	1.78	35	402	201	18.5	Intermediate	



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Professional Soils Laboratory

Pacific Park Wrexham

Contract No:

PSL21/1854

Client Ref:

14-255

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number: WS106

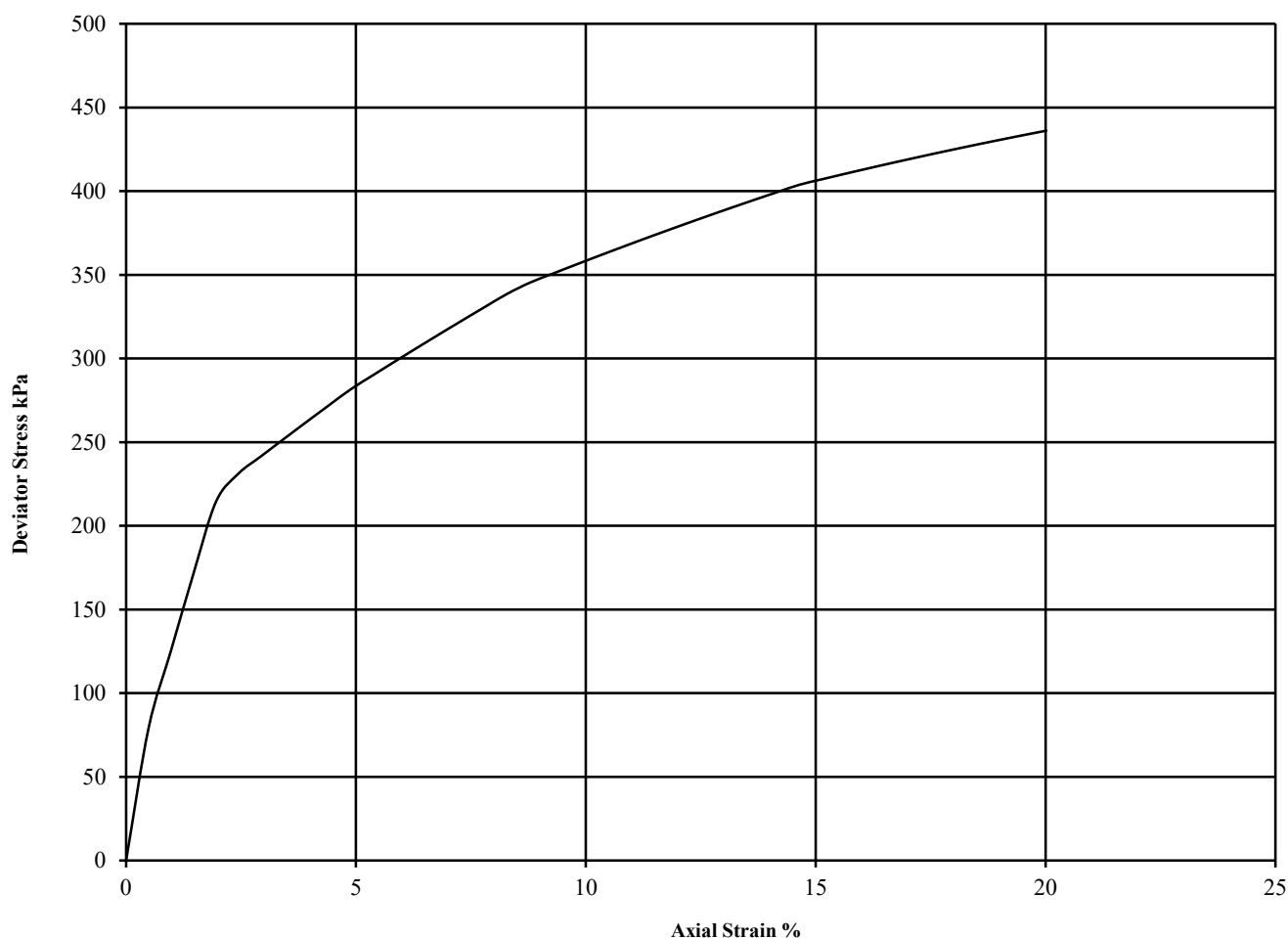
Top Depth (m): 2.00

Sample Number:

Base Depth (m): 2.50

Sample Type

Liner



Diameter (mm):		62		Height (mm):		127	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure		Undisturbed Sample
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$				Sample taken from top of tube
										Rate of strain = 2 %/min
										Latex Membrane used 0.2 mm thick,
										Correction applied 0.50
1	20	2.08	1.74	45	436	218	20.0	Intermediate		See summary of soil descriptions



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Professional Soils Laboratory

Pacific Park Wrexham

Contract No:

PSL21/1854

Client Ref:

14-255

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

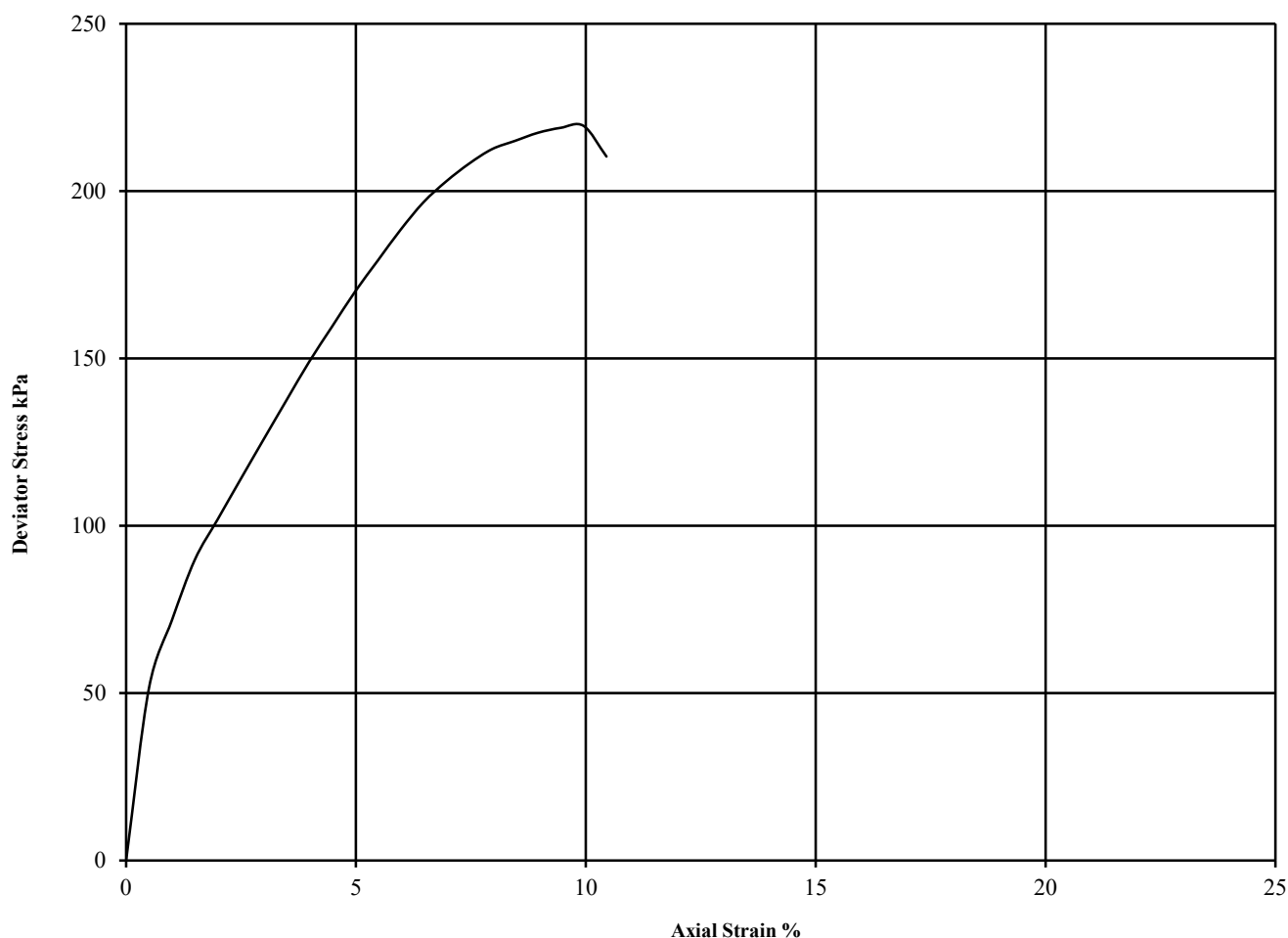
Hole Number: CP101

Top Depth (m): 3.00

Sample Number:

Base Depth (m): 3.45

Sample Type Liner



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.35 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	20	2.03	1.70	64.5	219	110	10.0	Brittle	



4043

PSL

Professional Soils Laboratory

Pacific Park Wrexham

Contract No:

PSL21/1854

Client Ref:

14-255

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

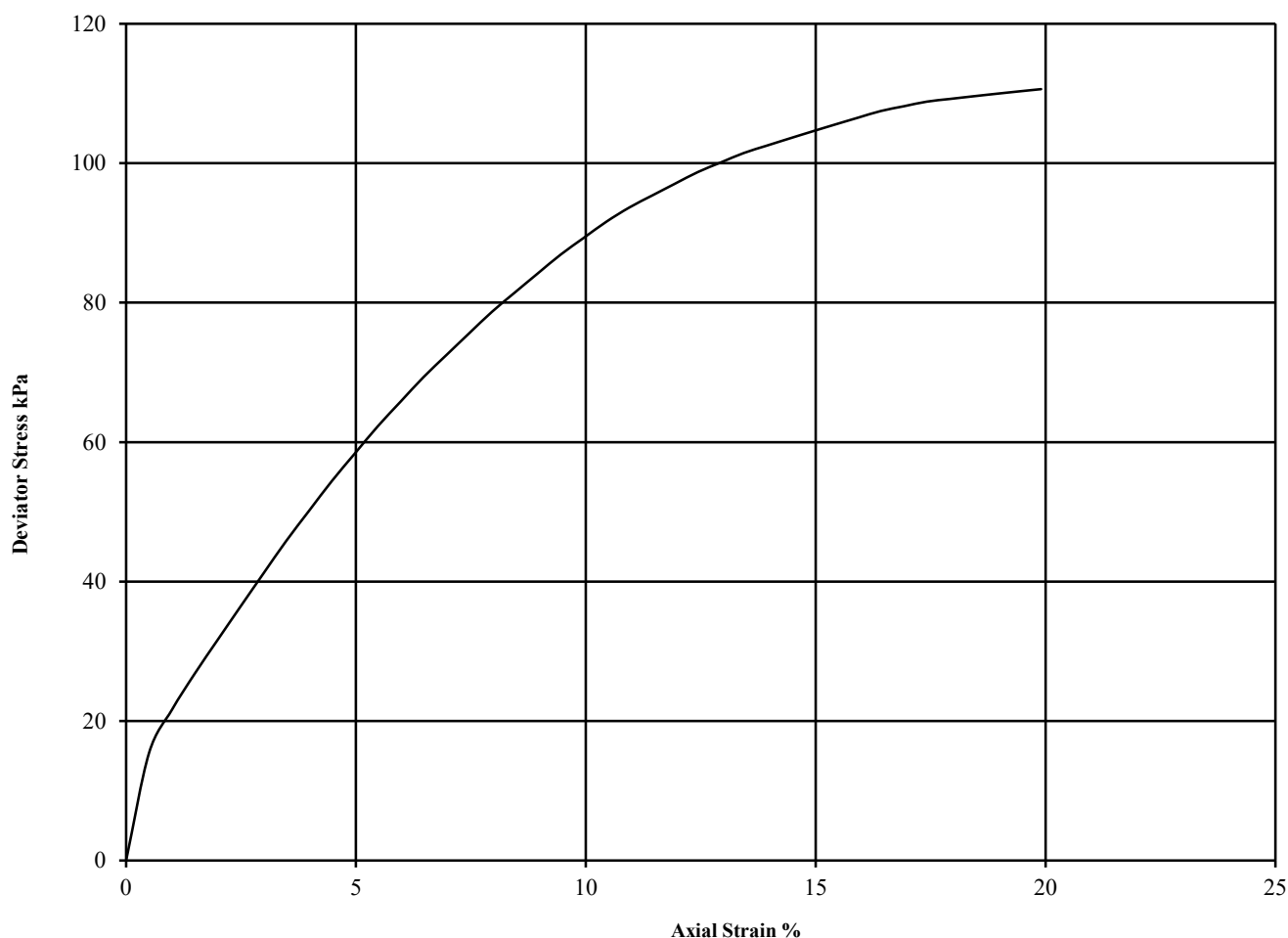
Hole Number: CP101

Top Depth (m): 12.50

Sample Number:

Base Depth (m): 12.95

Sample Type Liner



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.33 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	24	2.00	1.61	254.5	111	55	19.9	Plastic	



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PSL

Professional Soils Laboratory

Pacific Park Wrexham

Contract No:

PSL21/1854

Client Ref:

14-255

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number: CP102

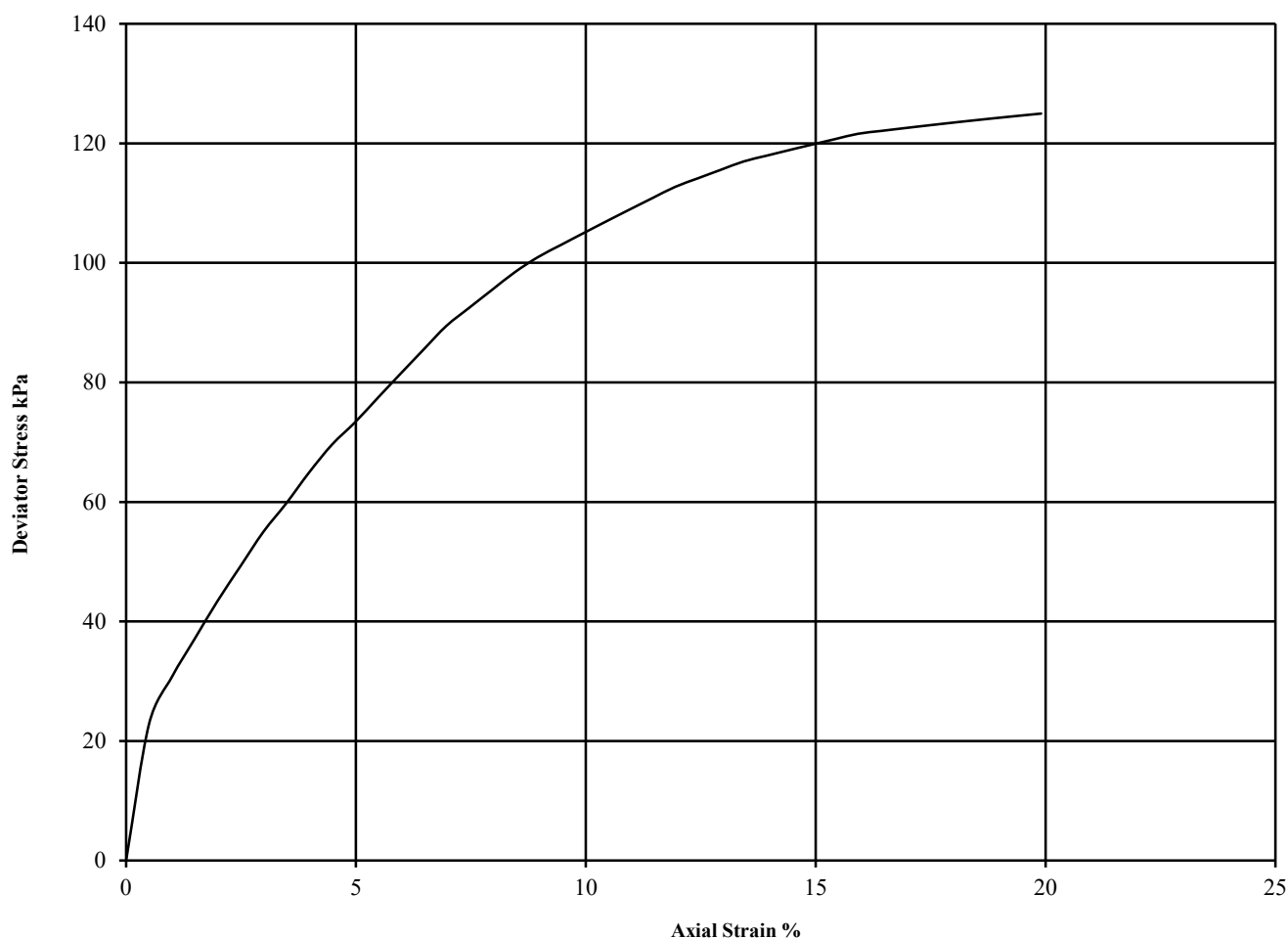
Top Depth (m): 6.50

Sample Number:

Base Depth (m): 6.95

Sample Type

Liner



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.33 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	28	1.98	1.54	134.5	125	62	19.9	Plastic	



4043

PSL

Professional Soils Laboratory

Pacific Park Wrexham

Contract No:

PSL21/1854

Client Ref:

14-255

UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION

WITHOUT MEASUREMENT OF PORE PRESSURE

BS1377 : Part7 : 1990: Clause 8

Hole Number: CP102

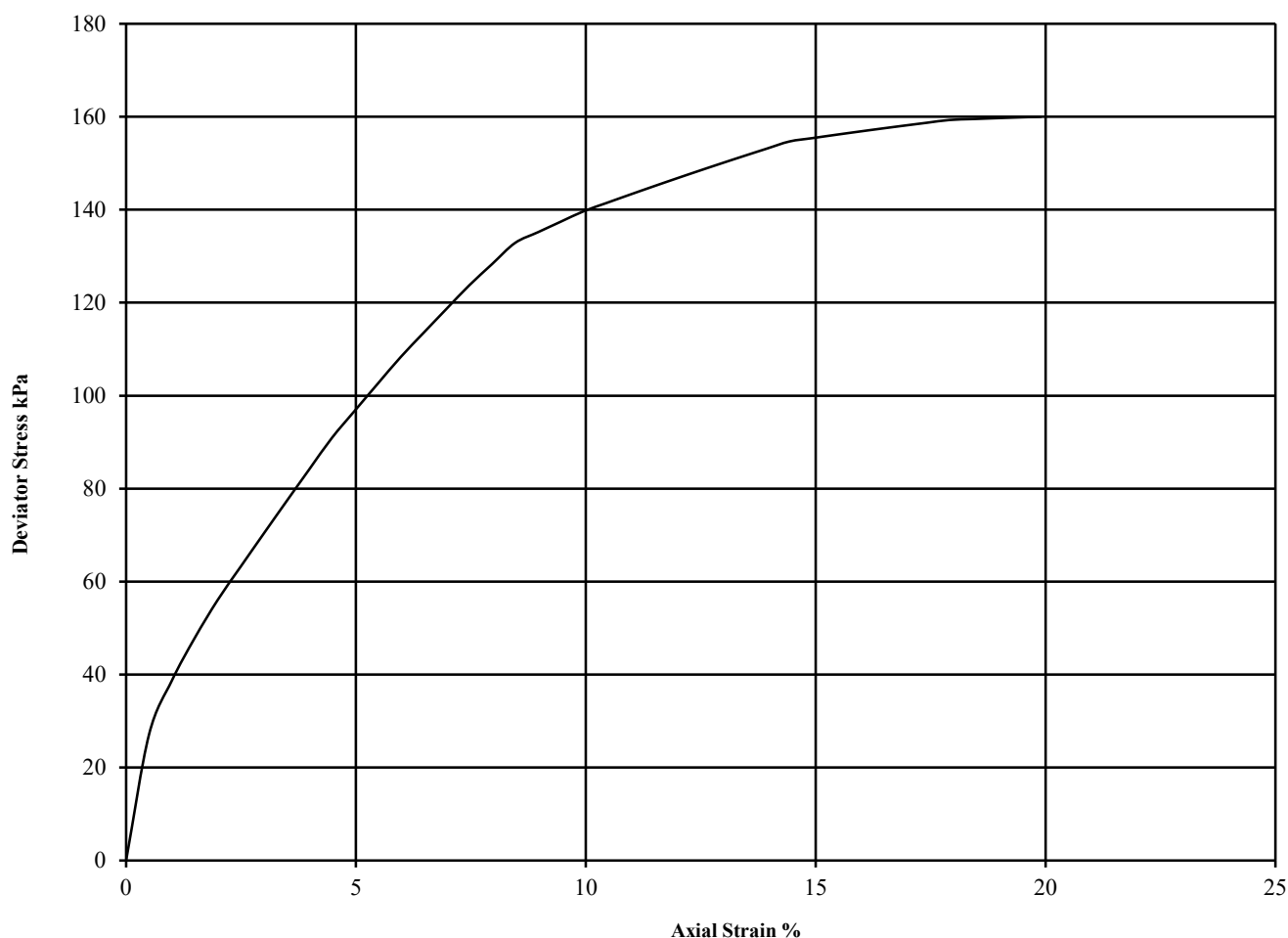
Top Depth (m): 21.50

Sample Number:

Base Depth (m): 21.95

Sample Type

Liner



Diameter (mm):		103	Height (mm):		207	Test:	UU Single Stage		Remarks:
Specimen	Moisture Content (%)	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Cell Pressure (kPa)	Corr. Max. Deviator Stress (kPa)	Shear Strength Cu (kPa)	Failure Strain (%)	Mode of Failure	Undisturbed Sample Sample taken from top of tube Rate of strain = 2 %/min Latex Membrane used 0.2 mm thick, Correction applied 0.33 See summary of soil descriptions
				θ_3	$(\theta_1 - \theta_3)_f$	$\frac{1}{2}(\theta_1 - \theta_3)_f$			
1	22	2.09	1.71	434.5	160	80	19.9	Intermediate	



4043

PSL

Professional Soils Laboratory

Pacific Park Wrexham

Contract No:

PSL21/1854

Client Ref:

14-255

ONE DIMENSIONAL CONSOLIDATION TEST

BS 1377: Part 5: 1990: Clause 3

Hole Number: WS101

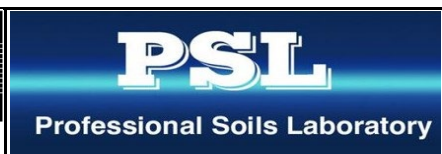
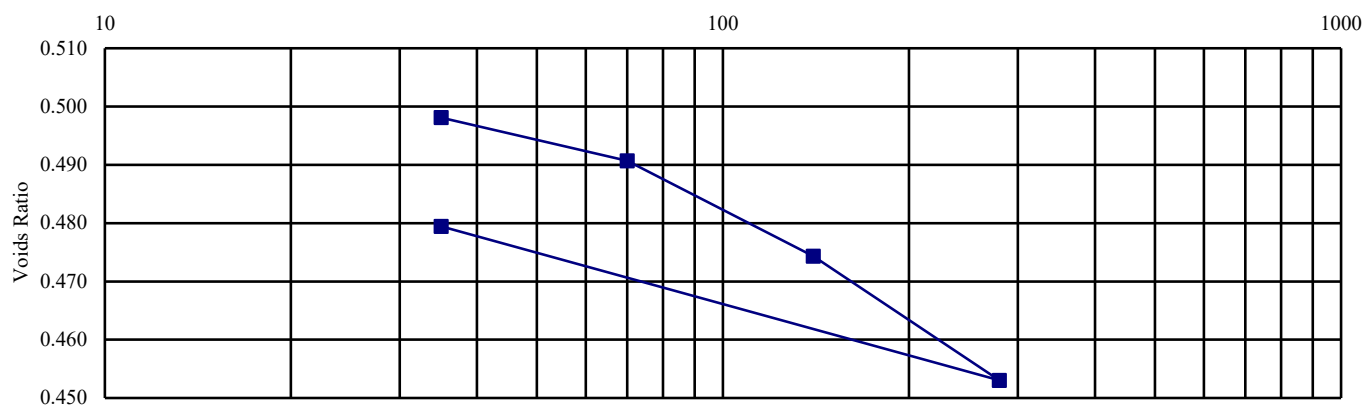
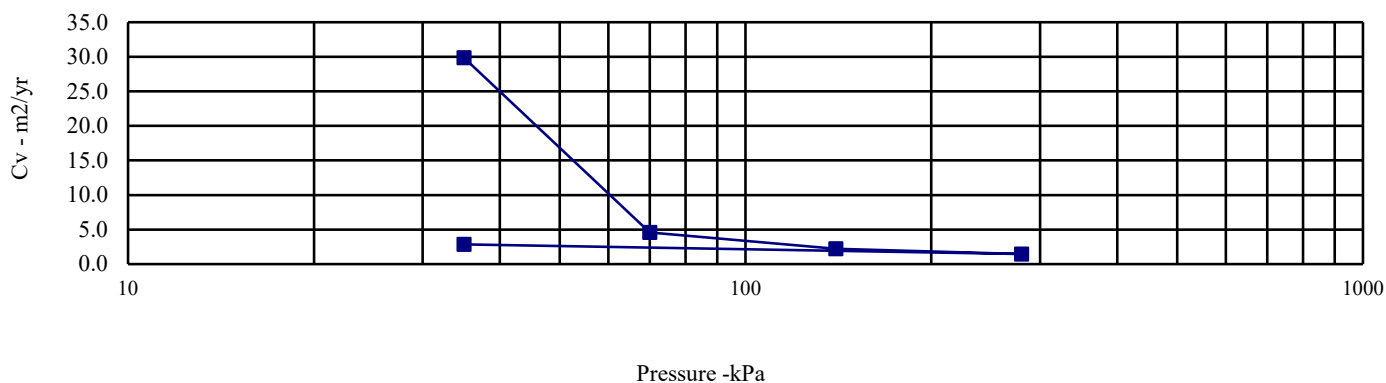
Top Depth (m): 1.50

Sample Number:

Base Depth (m) : 2.00

Sample Type: Liner

Initial Conditions		Pressure Range		Mv	Cv	Specimen location	
Moisture Content (%):	20	kPa		m2/MN	m2/yr	within tube:	Top
Bulk Density (Mg/m3):	2.10	0	35	0.295	29.857	Method used to	
Dry Density (Mg/m3):	1.75	35	70	0.141	4.597	determine CV:	T90
Voids Ratio:	0.514	70	140	0.157	2.228	Nominal temperature	
Degree of saturation:	101.5	140	280	0.103	1.461	during test ' C:	20
Height (mm):	20.022	280	35	0.074	2.843	Remarks:	
Diameter (mm)	74.995					See summary of soil descriptions	
Particle Density (Mg/m3):	2.65						
Assumed							



Pacific Park Wrexham

Contract No:
PSL21/1854
Client Ref:
14-255

ONE DIMENSIONAL CONSOLIDATION TEST

BS 1377: Part 5: 1990: Clause 3

Hole Number: WS106

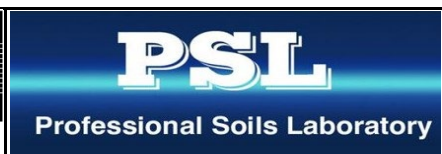
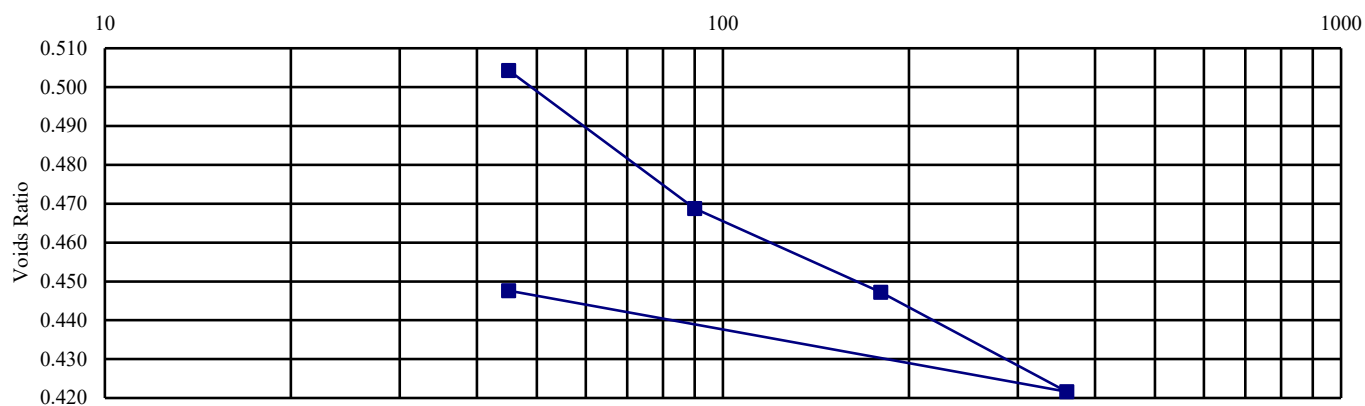
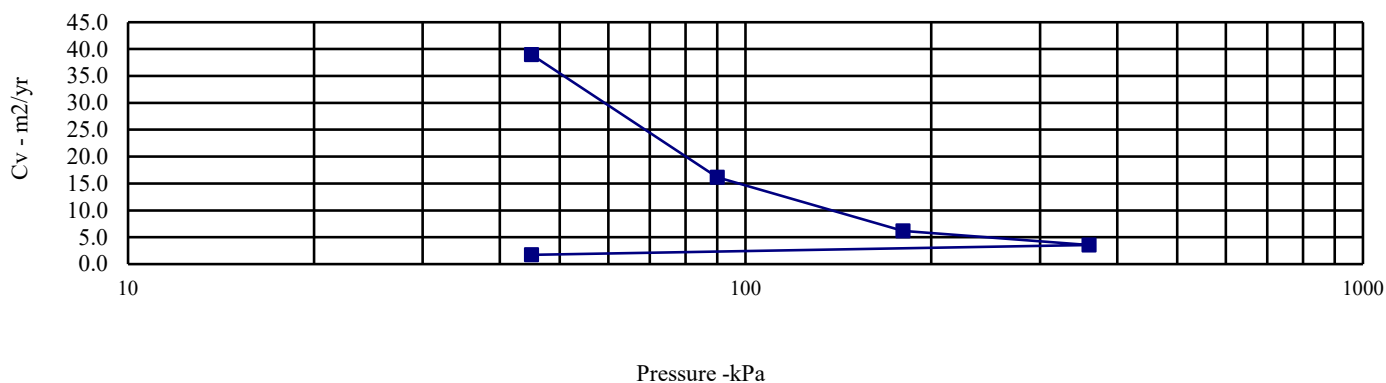
Top Depth (m): 2.00

Sample Number:

Base Depth (m) : 2.50

Sample Type: Liner

Initial Conditions		Pressure Range		Mv	Cv	Specimen location	
Moisture Content (%):	20	kPa		m2/MN	m2/yr	within tube:	Top
Bulk Density (Mg/m3):	2.07	0	45	0.527	38.983	Method used to	
Dry Density (Mg/m3):	1.72	45	90	0.525	16.171	determine CV:	T90
Voids Ratio:	0.541	90	180	0.163	6.151	Nominal temperature	
Degree of saturation:	99.4	180	360	0.098	3.537	during test ' C:	20
Height (mm):	19.99	360	45	0.058	1.725	Remarks:	
Diameter (mm)	50.003					See summary of soil descriptions	
Particle Density (Mg/m3):	2.65						
Assumed							



Pacific Park Wrexham

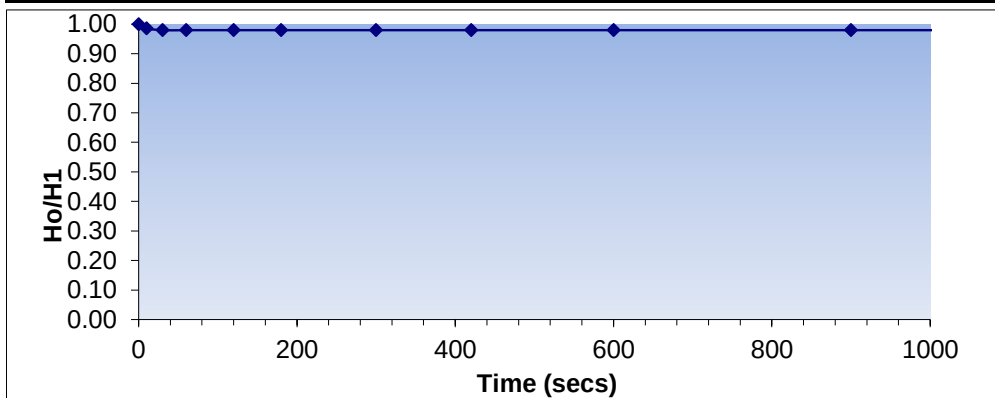
Contract No:
PSL21/1854
Client Ref:
14-255

APPENDIX IX FALLING HEAD PERMEABILITY TEST CERTIFICATES

Falling Head Test**Borehole:** WS101 **Test No:** 1

Contract No:	14-225	Casing Diameter: (m)	0.05
Contract Title:	Pacific Park	Height of Casing:	0
Date of Test:	11/02/2021	Depth of Borehole: (m)	3.45

Recorded Time			Total Time (secs)	Depth (m)		H/Ho
Hours	Minutes	Seconds				
0	0	0	0	0	0	1.0000
0	0	10	10	0.05	10	0.9855
0	0	30	30	0.07	30	0.9797
0	1	0	60	0.07	60	0.9797
0	2	0	120	0.07	120	0.9797
0	3	0	180	0.07	180	0.9797
0	5	0	300	0.07	300	0.9797
0	7	0	420	0.07	420	0.9797
0	10	0	600	0.07	600	0.9797
0	15	0	900	0.07	900	0.9797
0	20	0	1200	0.07	1200	0.9797
0	30	0	1800	0.07	1800	0.9797
1	0	0	3600	0.07	3600	0.9797
1	30	0	5400	0.07	5400	0.9797



General Approach

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

$$H_1 = 0.9855$$

$$H_2 = 0.9797$$

k = permeability of soil

F = Intake Factor (figures 6 & 7, BS5930:1999)

H₁ = variable head measured at time t₁ after commencement of testH₂ = variable head measured at time t₂ after commencement of test

A = Cross sectional area of borehole casing or standpipe as appropriate.

$$t_1 = 10$$

$$t_2 = 3600$$

$$F = 2.86$$

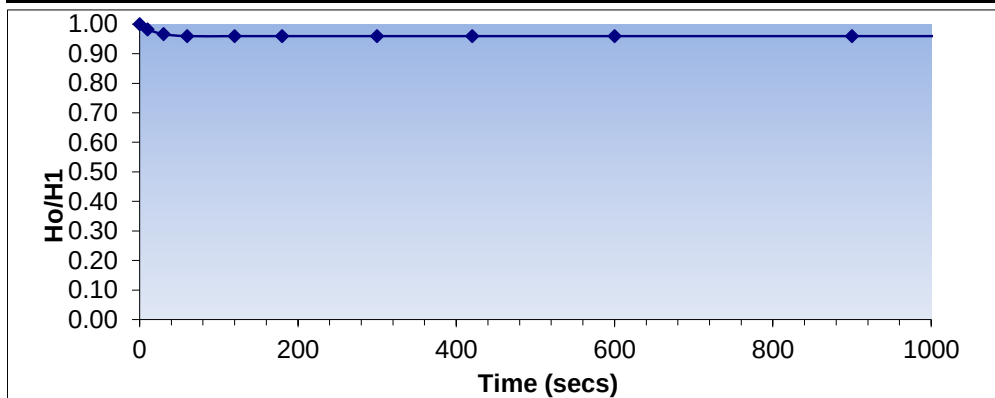
$$A = 0.00196349 \text{ m}^2$$

Coefficient of Permeability, k = 5.23E-07 m/s

Falling Head Test**Borehole: WS105 Test No: 1**

Contract No:	14-225	Casing Diameter: (m)	0.05
Contract Title:	Pacific Park	Height of Casing:	0
Date of Test:	11/02/2021	Depth of Borehole: (m)	4.45

Recorded Time			Total Time (secs)	Depth (m)		H/Ho
Hours	Minutes	Seconds				
0	0	0	0	0	0	1.0000
0	0	10	10	0.08	10	0.9820
0	0	30	30	0.15	30	0.9663
0	1	0	60	0.18	60	0.9596
0	2	0	120	0.18	120	0.9596
0	3	0	180	0.18	180	0.9596
0	5	0	300	0.18	300	0.9596
0	7	0	420	0.18	420	0.9596
0	10	0	600	0.18	600	0.9596
0	15	0	900	0.18	900	0.9596
0	20	0	1200	0.18	1200	0.9596
0	30	0	1800	0.18	1800	0.9596
1	0	0	3600	0.18	3600	0.9596
1	30	0	5400	0.18	5400	0.9596



General Approach

$$k = \frac{A}{F(t_2 - t_1)} \log_e \frac{H_1}{H_2}$$

$$H_1 = 0.982$$

$$H_2 = 0.9596$$

k = permeability of soil

F = Intake Factor (figures 6 & 7, BS5930:1999)

H₁ = variable head measured at time t₁ after commencement of testH₂ = variable head measured at time t₂ after commencement of test

A = Cross sectional area of borehole casing or standpipe as appropriate.

$$t_1 = 10$$

$$t_2 = 5400$$

$$F = 3.93$$

$$A = 0.00196349 \text{ m}^2$$

Coefficient of Permeability, k = 2.58E-07 m/s