BROWNFIELD SOLUTIONS LTD

GEO-ENVIRONMENTAL ENGINEERING EXCELLENCE

FI CONSTRUCTION

The Oaks, Wrexham

Supplementary Phase II Geo-Environmental Assessment Report

CC/C6668/15518 Rev B

May 2026

EXECUTIVE SUMMARY	
Ground Conditions	Generalised ground conditions from the 2025 and 2026 investigations comprise (top down): • Made ground generally comprising clay with varying proportions of sand and gravel encountered from ground level to between 0.20m and 1.50m below ground level (bgl). • Natural superficial deposits mostly comprising firm to hard clay (Glacial Till) proven to depths of at least 4.45m bgl across the proposed development area. Natural deposits consisting of interbedded saturated very loose or very soft sand, silt, and clay (Alluvium) were proven to depths of between 2.40m and 2.70m bgl adjacent to Redwither Brook. • Solid geology was not encountered. • No groundwater was identified across the majority of the site. Groundwater levels ranging between 1.20m and 3.20m bgl were identified at lower elevation adjacent to Redwither Brook.
Foundations and Floor Slabs	Ground beam strip/trench fill and pad foundations are considered suitable. Safe bearing capacity of 110 kN/m^2 should be available at 1.00m begl in natural glacial Till, where present. 150 kN/m^2 should be available at a depth of 2.00m begl in glacial Till, keeping total and differential settlement within acceptable limits. Deepening is likely to be required where made ground or proposed fill is present. Deepening of foundations/heave protection is likely to be required to allow for the effects of trees. Ground bearing floor slab are considered suitable. If the above foundations are not considered to be economical due to significant volumes of infill concrete required, then installation of vibro-stone columns or piles may be used alternatively.
Concrete Classification	DS-1 and AC-1s conditions prevail.
Highways Design	Made Ground CBR – 2% Superficial Strata CBR – cohesive/fine soils– 2% The above should be confirmed by in-situ testing at formation level by a specialist geotechnical engineer during construction.
Site Drainage	Indicative soil infiltration rates are on the order of 10^{-9} m/s. Drainage to soakaways is considered to be unsuitable for this site. Alternative drainage methods may comprise either drainage to a nearby permanently flowing watercourse, or drainage to the council mains system.
Slope Stability & Retaining Walls	A moderately steep slope exists to the southwest of the proposed development that is considered to pose low instability risk in its current state. The Cut/Fill Plan shows >5m of proposed cut along the toe of this slope, which may cause instability. It is recommended that this slope maintains its current angle or alternatively, if the toe of the slope is to be excavated, then further assessment of slope stability and/or design and installation of a retaining wall may be required.
Human Health - Soils Contamination	Testing of the made ground at the site did not reveal any exceedances of heavy metals, explosives, PAHs, petroleum hydrocarbons, PCBs, BTEX or MTBE compounds; no further action required.
Controlled Waters – Surface and Groundwater Contamination	The overall risk to controlled waters is considered to be low and no further action is required.
Ground Gas	Based on previous monitoring, the site is classified as CS1 with respect to carbon dioxide and methane. However, the BGS Radon Report indicates that basic radon protective measures are required for the site.
Outline Remedial Strategy	Aside from basic radon protection, no other specific remedial measures or long-term monitoring is considered necessary at the site.
Waste	Made ground and Natural – All locations classified as non-hazardous.
Further Work	The following further works will be required to progress to the construction phase: • Submission of this report for support of discharge of Condition 9 of planning permission reference P/2025/0430. • Tree survey by qualified arboriculturist. • Detailed foundation design by a structural engineer. • Production of Remedial Strategy, including the production of short specification for radon protection within a Ground Gas Protection Measures Verification Plan. This relates to Condition 9 and 12 of planning permission P/2025/0430. • Production of Design Statement and Materials Management Plan (MMP) under the CL:AIRE DoWCoP, if required. • Production of a Verification Report following remediation (Conditions 10-12 of P/2025/0430).

This executive summary should be read in conjunction with the full report, reference CC/C6668/15518 Rev B and not as a standalone document. Report template version 4.12.

PROJECT QUALITY CONTROL DATA SHEET

Site Name:	The Oaks, Wrexham		
Document Name:	Ground Investigation Report		
Reference:	CC/C6668/15518 Rev B		
Status:	-	14/05/2026	Interim – awaiting chemical testing for explosives screen.
	A	20/05/2026	Final.
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DRAWINGS

Drawing Number	Rev	Title
1256-MCAU-T.02-00-001	T9	Proposed Site Plan
RCFP01	-	Regrade Cut/Fill Plan
C6668/01	-	Site Location Plan
C6668/02	-	Exploratory Hole Location Plan
C6668/03	-	Conceptual Site Model

APPENDICES

Appendix	Title
Photographs	Site Walkover Photographs
Appendix A	BSL Methodology and Guidance
Appendix B	Exploratory Hole Logs
Appendix C	Geotechnical Testing Results
Appendix D	Chemical Testing Results
Appendix E	Waste Assessment Report

1.0 INTRODUCTION

1.1 Context

This report describes a Supplementary Phase II Geo-Environmental Assessment carried out by Brownfield Solutions Limited (BSL) for FI Construction on a site off Oak Road, Wrexham, and has been completed in general accordance with the following guidance:

- Environment Agency guidance - Land Contamination: Risk Management (LCRM).
- BS 10175:2026 Investigation of Potentially Contaminated Sites.
- BS5930: 2015+A1:2020 Code of Practice for Ground Investigations.
- BS EN 1997-1:2004+A1:2013 Eurocode 7. Geotechnical design. General rules plus UK National Annex.
- BS EN 1997-2:2007 Eurocode 7 Geotechnical design. Ground investigation and testing plus UK National Annex.

Definitions of terms and acronyms used within this report is presented in Section 11.0.

1.2 Proposed Development

The proposed development will comprise an approximately 80,000 sq.ft Hiab warehouse/office/distribution unit, with associated hardstanding car parking, infrastructure and soft landscaped areas as per MCAU drawing reference 1256-MCAU T.02-00-001-T7 dated September 2025. The wider area will be retained as managed woodland/soft landscaped areas.

1.3 Relevant Reports and Documents

Relevant reports and documents pertaining to the site are given below:

- Phase I Geo-Environmental Assessment Report was issued by SP Associates, reference S1916, dated March 2024.
- Phase II Geo-Environmental Assessment Report was issued by SP Associates, reference S1916-2, dated September 2025.
- Planning correspondence was issued by Natural Resources Wales (NRW), reference CAS-288516-J8L2, dated 9th January 2026.
- BGS Radon Report was purchased by BSL (reference BGS_348020/67330), dated 15th April 2026.
- Wrexham County Borough Council planning permission (reference P/2025/0430) granted on 8th May 2026.

1.4 Objectives and Scope

The SP Associates Phase II Geo-Environmental Assessment, and following NRW correspondence, outlined the requirements for a supplementary ground investigation in the southern half of the site when vegetation clearance had been undertaken. Recent site clearance has since been undertaken, resulting in a supplementary ground investigation and associated reporting to be undertaken by BSL. A review of the previous investigations carried out at the site has also been undertaken and summarised within this report.

The objectives of this report are to determine the geo-environmental setting and ground conditions in the southern half of the site, highlighting potential risks and areas of concern that may govern the development under the current planning regime.

This supplementary Phase II report is intended to support discharge of Condition 9 of the granted planning permission reference P/2025/0430. Conditions 10-12 shall be fully addressed under separate cover via a

Remediation Strategy and, following remediation on site during construction, and the production of a Verification Report.

The ground investigation was scoped and designed by FI Construction as the principal contractor, and the investigation was supervised by BSL.

The factual and interpretive sections of this report are produced in general accordance with the recommendations for a Tier 2 Generic Quantitative Risk Assessment as described in LCRM guidance. This assessment is also intended to fulfil the requirements of a Ground Investigation Report (GIR) as detailed in BS EN 1997-2:2007.

1.5 Limitations

This assessment has been prepared in accordance with the relevant current legislative framework, guidance and risk assessment methodology as outlined in Appendix A. BSL is not liable for any subsequent changes in the guidance and legislation.

The findings and opinions conveyed via this report are based on information obtained from a number of sources as detailed within this report, BSL have assumed this information is correct and reliable. Nevertheless, BSL cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

BSL have used reasonable skill, care and diligence for the investigation of the site and the production of this report. There may be other conditions prevailing on the site which are outside the scope of work and have not been highlighted by this assessment and therefore have not been considered by this report. Responsibility cannot be accepted for such site conditions not revealed by the assessment.

This report has been prepared for the sole use and reliance of the Client, FI Construction. No other third parties may rely upon or reproduce the contents of this report without the written permission of Brownfield Solutions Ltd (BSL). If any unauthorised third party comes into possession of this report, they rely on it at their own risk and BSL do not owe them any Duty of Care. This report may not be relied upon by the client or submitted to a third party for their reliance for the purposes of valuation, mortgage, insurance and regulatory approval, until all invoices have been settled in full.

The investigation carried out on the site has been conducted to provide the best information on the ground conditions within site access and budgetary constraints. The inherent variation of ground conditions allows only for definition of the actual conditions at the locations and depths of exploratory locations at the time of the investigation. Different ground conditions may exist that have not been identified within this investigation.

The recommendations in this report assume that ground levels will remain as existing, unless stated otherwise within the report. If there is to be any re-profiling (e.g. to create development platforms or flood defences) then the recommendations may not apply.

The groundwater results described are only representative of the dates on which they were recorded, and levels may vary seasonally (e.g. due to changes in weather).

This assessment has been based on the proposed planning layouts provided. Any subsequent change to the planning layout may have an impact on the validity of recommendations made within this report. Furthermore, new information, changed practices or new legislation may necessitate revised interpretation of the report after the date of its submission.

Although every effort has been made to position exploratory holes in the least sensitive areas of the site, exploratory hole positions were located approximately as part of this investigation, and no guarantee can

be given as to their accuracy. Consideration should be given to the possibility that exploratory holes excavated as part of this investigation and indeed any previous ground investigation work by others may be encountered beneath or within the influence of individual foundations. BSL cannot be held responsible for structural failures caused by the location of foundations of any form of structure within the influence of exploratory holes.

Where it has not been possible to reasonably use an EC7 compliant investigation technique, a practical alternative has been adopted to obtain indicative soil parameters and any interpretation is based upon engineering experience, local precedent where applicable and relevant published information.

The chemical testing carried out for this report was not scoped to comply with the requirements of the water supply company and further work may be required, unless otherwise stated.

Notwithstanding site observations concerning the presence or otherwise of archaeological issues, asbestos-containing materials (ACM) or invasive weeds (e.g. Japanese knotweed), this report does not constitute a formal survey of these potential issues.

Asbestos in structures was not covered in this report. It should be noted that an asbestos demolition survey will be required prior to any demolition of structures. If asbestos is present in soils, these will need to be dealt with in accordance with the Control of Asbestos Regulations (CAR) 2012.

The site plans enclosed in this report should not be scaled off. Any site boundary line depicted on plans does not imply legal ownership of land.

Any recommendations made in this report should be confirmed with the Regulatory Authorities prior to implementation to ensure compliance. Please note that whilst every effort has been made to pre-empt the likely requirements of the Local Authority, Environment Agency and warranty providers, they may have specific requirements that will need to be discussed and addressed at a later date.

Site specific limitations listed in section 4.2.

2.0 THE SITE

2.1 Location

The site is located off Oak Road, Wrexham, LL13 9RG, centred on National Grid Reference 338615, 349350, as shown on the Site Location Plan, Drawing No. C6668/01.

2.2 Site Description

A site walkover was carried out at the site on the 15th and 16th of April 2026. The main site features and potential issues identified are detailed below. A selection of photographs from the site walkover are presented to the rear of this report.

Feature	Description
Site Area	Approximately 4 hectares of proposed development area within the tenant boundary, however the site comprises 17 hectares overall within FI ownership. The site is defined based on the tenant boundary and proposed development area.
Site Access	Access is gained off Oak Road to the north of the site.
Current Land Use and Site Features	The site is mostly bare ground comprising recently deforested scrubland and woodland, however the southern extents of the site near Redwither Brook consist of woodland and grassed areas. A medium-sized brick building is present slightly beyond the northeast of the site and the proposed development area. Two sets of overhead powerlines cross the site, a 132 kV overhead service passing through the eastern boundary of the site and proposed development area, and a 33 kV overhead service passing through the western boundary of the site and proposed development area. A manhole cover was identified adjacent to Redwither Brook to the south of the site, denoting possible drainage/sewers. A concrete road provides access into the northern extent of the site, however most of the site is accessed using trackways.
Potential Sources of Gross Contamination	No obvious signs of potential contamination were identified during the site walkover.
Vegetation / Ecology	There are sporadic mature/semi-mature trees across the majority of the site. There is also woodland comprising abundant mature and semi-mature trees near Redwither Brook at the southern extents of the site.
Topography	The site generally comprised flat and undulating ground, varying in elevation but gradually increasing from 25.5m AOD in the south of the site to 28.5m AOD in the north of the site (approximately 3m difference). However, an embankment was present along the southwestern boundary of the site sloping down to an area of flat land adjacent to Redwither Brook at a substantially lower elevation of 22.50m AOD (approximately 3-6m below the majority of the site).
Site Boundaries	Oak Road borders the site to the north and Redwither Brook borders the site to the south. The remaining site boundaries are not defined by discernible features, except for an industrial warehouse that forms the western site boundary.
Surrounding Area	The site lies to the south of Wrexham Industrial Estate and Redwither Business Park. Industrial buildings are present to the north and west, and agricultural fields to the south and east. Immediately north of the site beyond Oak Road is an electricity substation.

3.0 SUMMARY OF RELEVANT REPORTS

A summary of the relevant points from the Phase I Geo-Environmental Assessment completed by SP Associates (reference S1916 issued March 2024) is presented below:

- The site was agricultural land until the early 1940s. During World War Two the site was developed as part of Royal Ordnance Factory (ROF) Wrexham, used primarily to manufacture cordite for explosives and subsequently as an ammunition dump. Post-war, bunkers and structures were removed and likely infilled with imported material. Since the early 1980s, the site has remained as undeveloped woodland and scrub.
- The surrounding area had a similar history, remaining undeveloped until establishment of ROF Wrexham in World War Two and post-war has included expansion of Wrexham Industrial Estate.
- Superficial geology comprised Glacial Diamicton (Till) deposits of Devensian age forming a Secondary Aquifer (undesignated) that consisted of clay, silt, sands and gravels (BSL also note the wider area includes alluvium) The underlying bedrock geology was the Kinnerton Sandstone (Principal Aquifer) of Triassic age comprising red-brown sandstone.
- The site was within Source Protection Zones 2 and 3. There were three licensed groundwater abstractions within 250m of the site (likely from the deep Principal Aquifer).
- No evidence of historic mining or quarrying affecting the site, and therefore mining-related instability risk was considered to be negligible.
- The nearest watercourse was Redwither Brook, approximately 50m south-west of the site.
- The site was not considered susceptible to flooding from rivers, groundwater at surface, or the sea. However, land approximately 30m south-west of the site showed flood susceptibility. A separate specialist flood risk assessment was recommended if required for planning.
- No registered landfills or waste transfer stations within 250m of the site. However, there were several licensed waste management and treatment facilities present within 250 m, reflecting the industrial nature of the area.
- On-site ground gas risk was moderate, due to potential Made Ground within infilled bunkers containing biodegradable material. Off-site ground gas risk was low to moderate due to possible Made Ground in surrounding former ROF areas.
- Site was in an Intermediate Radon Probability Area (5–10% of dwellings exceed action level), therefore basic radon protection measures were required for the proposed development.
- The site was part of ROF Wrexham explosives manufacturing and ammunition storage, resulting in a moderate to high UXO risk. A detailed UXO Risk Assessment was therefore recommended before intrusive ground works.
- The risk to human health was moderate to high, primarily due to possible explosive residues (e.g. cordite), and unknown made ground used to infill former bunkers across the site.
- The risk to controlled waters was low due to low-permeability glacial deposits that would restrict contaminant migration, and regulated upgradient industrial sources reducing the likelihood of uncontrolled releases.
- The Phase I report recommended a ground investigation comprising:
    - Windowless sampling boreholes with SPT testing.
    - Trial Pitting and bulk sampling.
    - Soakaway Testing to BRE 365 guidance.
    - In-situ CBR testing.
    - Searching for underground bunkers using ground penetrating radar (GPR).
    - Soil chemical laboratory testing.
    - Groundwater sampling and testing where boreholes encounter groundwater.
    - Installation of gas monitoring wells and completion of a gas monitoring regime.

A summary of the relevant points from the Phase II Geo-Environmental Assessment completed by SP Associates (reference S1916-2 issued September 2025) is presented below:

- Ground investigation comprised windowless sampling boreholes, trial pits, soakaway tests, soil laboratory testing, and ground gas monitoring.
- Investigations encountered made ground from the surface to 0.70-1.50m below ground level (bgl), comprising firm clay and loose sand with varying amounts of angular gravel of concrete, brick, and shale. The made ground was underlain by glacial Till consisting of firm to stiff clay. Groundwater and bedrock were not encountered during the investigations.
- Soakaway tests failed to drain successfully, therefore an alternative remedial strategy for surface water disposal was recommended either comprising connection to the mains drainage network, or drainage to a nearby permanently flowing surface water body.
- Geotechnical laboratory testing confirmed the natural glacial Till soils to be intermediate plasticity with a plasticity index ranging from 10-35%. The ratio between Natural Moisture Content (NMC) and Liquid Limit (LL) were used to estimate the natural glacial Till soils as displaying signs of desiccation.
- Chemical laboratory testing results were compared to screening criteria for industrial/commercial land use, finding all test results to be below acceptance criteria values. Therefore, the risk to human health from contaminants within onsite soils was considered to be low and no remedial measures were determined to be required.
- The risk to controlled waters was considered to be low. This was due to no contaminants being identified in onsite made ground, the underlying glacial Till comprising low permeability clay soils, and installed standpipes remaining dry throughout the groundwater monitoring regime. Therefore, there was no identified contaminant source and pathway.
- Ground gas monitoring and assessment identified a CS1 characterisation for the site and subsequently a very low risk with respect to methane and carbon dioxide. However, the site was within an area that required basic radon protection measures.
- Conventional strip or pad foundations were recommended for the proposed industrial warehouse, with embedment in the glacial Till deposits.
- The Phase II report recommended a supplementary ground investigation in the southern half of the site as dense vegetation had prevented the 2025 investigation from reaching these areas. The recommended supplementary investigation comprised:
    - Purchasing of a detailed UXO report.
    - Windowless sampling boreholes.
    - Trial Pitting and soil sampling.
    - Soil laboratory testing for an explosive's suite and PCBs.
    - GPR survey to investigate potential underground buried structures and obstructions, with follow up trial pitting.

Natural Resources Wales (NRW) issued planning correspondence on 9th January 2026 in response to previously supplied information and subsequently granted planning permission on 8th May 2026. The granted planning permission highlighted that further information was required including:

- A site investigation in the southern half of the proposed building area and attenuation basin with associated soil and groundwater chemical laboratory testing (Condition 9).
- Consideration of risk to controlled waters regarding the underlying Principal Aquifer and the nearby Redwither Brook (Condition 9).
- Based on the results of the investigation, a remedial options appraisal and verification plan and validation report, if required (Conditions 10 and 11).
- Based on the results of the investigation, a long-term monitoring plan for land contamination (Condition 12).

Due to the recommendations previously outlined in the SP Associates Phase I and Phase II reports, a BGS Radon Report for the site was subsequently obtained by BSL. A summary of the BGS Radon Report (reference BGS_348020/67330 issued 15 April 2026) is presented below:

- The property is in a radon affected area where 5-10% of properties are estimated to be at or above the action level.
- Basic radon protective measures are therefore required for the report area.

4.0 METHOD OF INVESTIGATION

4.1 Objectives

To confirm the risks to the identified receptors and confirm the ground conditions in respect to the identified geotechnical and geo-environmental risks, a supplementary intrusive investigation was undertaken as per the recommendations of the Phase II Geo-Environmental Assessment previously issued by SP Associates and subsequent Wrexham Borough Council planning permission conditions. This resulting supplementary Phase II report is intended to support discharge of Condition 9 of the granted planning permission.

The ground investigation was designed by FI Construction as the principal contractor and was supervised by BSL.

The aim of the fieldwork was to:

- Investigate ground conditions in the southern half of the site as recent vegetation clearance had made this portion of the site accessible.
- Install standpipes to allow future groundwater monitoring (if groundwater encountered).
- Assess the potential contamination on the site and obtain samples for contamination screening.
- Assess the potential impact of any contamination on controlled waters.
- Obtain geotechnical information on the ground conditions at the site for preliminary foundation design and preliminary pavement design purposes.
- Give an assessment of the geo-environmental risks associated with redevelopment of the site.

4.2 Site Works

The following site works have been undertaken as part of the supplementary intrusive investigation between the dates of 15th and 16th April 2026.

Method	No.	Range Depths (m bgl)	Purpose
Window sample boreholes – Tracked WS rig	8	2.45 – 4.45	Establish ground conditions across the southern section of the site that has recently undergone vegetation clearance. Allow Standard Penetration Tests (SPTs) to be carried out and obtain samples for contamination and geotechnical testing. Determine soil strengths/densities for preliminary foundation design. Installation of groundwater monitoring wells (if required).

Borehole WS103 was repositioned due to the survey located flag being hidden by tree branches and soil cover and undulating terrain making the initial test location inaccessible. Borehole WS105 was repositioned as the proposed location was directly beneath overhead services. Boreholes WS106, WS107, and WS108, were repositioned as the initially proposed location was on the moderately steep slope embankment and the location was inaccessible due to dense vegetation.

The surveyed locations of the exploratory holes are indicated on the Exploratory Hole Location Plan, Drawing No C6668/02. The exploratory hole logs are presented in Appendix B.

The exploratory holes were logged by an experienced geo-environmental engineer in general accordance with the following guidance:

- BS 5930:2015+A1:2020 Code of Practice for Site Investigations.

- BS EN 14688-1:2018 Geotechnical Investigation and Testing – Identification and classification of soil.

The client remained as Principal Contractor for the site and was therefore responsible for service clearance and UXO clearance. In accordance with BSL RAMS and in the absence of a specialist UXO study or specialist UXO surveyor, a safe standoff distance to each borehole was adhered to by the BSL Geo-environmental Consultant while drilling was undertaken. No evidence of UXO was identified during the investigation.

4.3 Sampling Strategy

Representative samples were taken from exploratory holes at regular intervals to assist in the identification of the soils and to allow subsequent laboratory testing. They were stored and transported in general accordance with BS 10175:2026.

The type of sample was dependent upon the stratum and the purpose of analysis in accordance with current environmental and geotechnical guidance. The distribution of samples taken across the site is recorded on the exploratory logs.

Investigatory hole locations were specified by the client, being spaced relatively evenly across the southern half of the site that had previously been covered in dense vegetation. Five of the boreholes (WS101-105) were located across the main development area, and three boreholes (WS106-108) were situated at lower elevation adjacent to Redwither Brook to the southwest of the proposed development area.

4.4 Laboratory Testing

Representative disturbed samples were obtained for all soil types encountered. Selected samples were scheduled for testing at an approved laboratory in accordance with BS 1377 'Method of Test for Soils for Civil Engineering Purposes' and BS EN ISO 17892- Parts 1-12:2018 'Geotechnical investigation and testing. Laboratory testing of soil'.

The following tests were scheduled for geotechnical purposes:

Description	No. of Samples
Atterberg Limits (i.e. Plasticity Index Analysis) including water content.	5
BRE SD1 Greenfield (Pyrite Absent) - Suite A.	3
BRE SD1 Full Suite.	2

The Geotechnical Laboratory Testing Results are presented in Appendix C.

As part of the further assessment for potential contamination of the site, selected samples were taken for the purpose of chemical contamination testing.

Based on the potential contaminative processes identified from historical site use, the following suite of determinands were analysed at a UKAS approved laboratory to screen for potential site impacts:

Determinand	No of Samples
BSL Default Soil Suite: Arsenic, Cadmium, Chromium (III), Chromium (VI), Copper, Nickel, Mercury, Lead, Zinc, Selenium, speciated polycyclic hydrocarbons (PAH 16), water soluble sulphate (2:1 Extract), soil organic matter (SOM) and pH.	14
Petroleum Hydrocarbons (TPH CWG) inc BTEX and MTBE.	4
Asbestos Screen and ID	8
PCB Compounds (7 Congeners).	4
Explosives Screen	3

The Chemical Laboratory Testing Results are presented in Appendix D.

4.5 Groundwater Monitoring

Groundwater monitoring standpipes were installed in three boreholes drilled adjacent to Redwither Brook. The standpipes were installed in a precautionary manner to monitor groundwater if required, as discussed in Section 8.5 of this report. The standpipes were constructed in general accordance with the relevant guidance, and a summary of the installation construction is presented in the table below:

Location	Internal Diameter Pipe	Response Zone (m bgl)	Targeted Strata	Purpose
WS106	50mm HDPE	1.60 – 3.60	SAND, Sandy SILT, Sandy CLAY	Groundwater
WS107	50mm HDPE	0.80 – 2.80	SAND, Sandy SILT, Sandy CLAY	Groundwater
WS108	50mm HDPE	1.00 – 3.00	SAND, Sandy SILT, Sandy CLAY	Groundwater

4.6 Gas Monitoring

Ground gas monitoring was outside of the scope of work and therefore no ground gas monitoring wells were installed during this ground investigation. Gas monitoring and risk assessment is discussed further in Section 8.7 of this report.

5.0 GROUND CONDITIONS

5.1 Summary

A brief summary of the ground conditions encountered is presented in the table below (this includes the previous SP Associates 2025 ground investigation and the BSL 2026 investigation):

Stratum	Range Depths - Top (m bgl)	Range Depths - Base (m bgl)	Range Thickness' (m)	Brief Description
Made Ground	Surface	0.20 – 1.50	0.20 – 1.50	Variable but generally CLAY with varying proportions of gravel and sand. Less commonly SAND and GRAVEL. Gravel was comprised of brick, concrete, quartz, coal, mudstone, shale, and sandstone.
Natural Topsoil	Surface	0.20	0.20	CLAY or silty CLAY with frequent roots and rootlets.
Natural Superficial Strata (WS101-WS105)	0.20 – 1.50	2.45 - >4.45	0.95 - >3.75	CLAY with varying proportions of sand and gravel.
Natural Superficial Strata (WS106-WS108)	0.20 – 0.90	3.45 – >4.45	3.25 – >3.55	Interbedded Alluvial SAND, SILT, and CLAY with varying proportions of gravel. Underlying CLAY with varying proportions of gravel, silt, and sand.

Details are provided in the logs in Appendix B and the individual strata are described in the sections below, using the 2025 SP Associates and 2026 BSL ground investigations.

5.2 Made Ground

Made Ground – Topsoil
Made Ground Topsoil was encountered across the site (WS102, WS103, WS105, WS106, BH2 and BH5) from ground level to between 0.10m and 0.30m bgl, comprising either brown sand or dark brown clay with frequent tree roots, rootlets, and anthropogenic inclusions of fine to medium gravel-sized brick fragments.

Made Ground – General
Made ground was encountered within 6 locations across the site (WS101-106 and all 2025 investigation locations) and was observed from ground level to depths between 0.20m and 1.50m bgl.

The composition of the made ground was variable across the site, but comprised clay with varying proportions of gravel and cobbles, and less commonly gravel or sand with varying proportions of silt and clay. Gravel was subangular to angular fine to medium of brick, concrete, quartz, burnt shale, mudstone, sandstone, charcoal, and coal fragments. Cobbles were present in one borehole and were subangular 70-80mm of concrete.

5.3 Natural Topsoil

Natural Topsoil was encountered in two locations in the lower elevation southwestern area of the site adjacent to Redwither Brook (in WS107 and WS108).

Topsoil was encountered from ground level to 0.20m bgl, comprising either dark brown clay or dark brown slightly sandy silty clay with frequent small tree roots and rootlets.

For the purpose of this assessment, topsoil is defined as the upper darker and more fertile layer of the soil profile which is a product of natural chemical, physical, biological and environmental processes. This does not imply compliance with BS 3882:2015.

5.4 Natural Superficial Strata

The natural strata underlying the site can be subdivided into two main areas. The natural superficial deposits at higher elevation across the majority of the site (WS101-105), and the natural strata in the lower elevation southwestern area of the site adjacent to Redwither Brook (WS106-108).

The natural strata encountered at higher elevation across the majority of the site (WS101-105) were generally firm to stiff clay with varying amounts of gravel and sand as a minor constituent. This is interpreted to represent Glacial Till.

The natural strata in the lower elevation southwestern area of the site adjacent to Redwither Brook (WS106-108) comprised interbedded saturated sand, silt, and clay, with varying amounts of organic matter and gravel. This is interpreted to represent alluvial deposits. SPT values in the alluvial soils indicated the sand to be very loose and the silts and clays to be very soft.

5.5 Solid Geology

The western half of the site is mapped as the Salop Formation comprising mudstone, sandstone, and conglomerate. The eastern half of the site is mapped as the Kinnerton Sandstone Formation consisting of sandstone.

The bedrock geology was not encountered in the investigations. A BGS borehole located approximately in the north of the site encountered clay soils to 18m depth. A nearby BGS borehole situated approximately 100m north of the site encountered mostly clay soils to 45m depth with occasional sand lenses, while a BGS borehole 300m west of the site encountered interbedded mudstone and sandstone from 16.50m depth.

5.6 Groundwater

The depths to groundwater and locations present during site works are shown in the table below:

Location	Depth During Site Works (m)	Comments
WS106	1.30, 2.50, 3.20	-
WS107	1.50, 2.10	-
WS108	1.20, 2.00	-

5.7 Observations

Contamination
During the works undertaken by BSL, observations for both visual and olfactory evidence of contamination were undertaken.

With the exception of charcoal and burnt shale observed as a minor constituent in the made ground soils, no other evidence of contamination was observed at the site.

Stability of Excavations/Boreholes
The sides of the boreholes were generally stable, however minor collapse of the natural strata was observed in WS106, WS107, and WS108 due to groundwater inundation.

The firm to hard nature of the clay across the site resulted in relatively shallow SPT N value refusals in boreholes.

The borehole sidewalls were generally stable, and window sampling progressed without the need to install casing.

Obstructions
No obstructions were observed during the ground investigations on site.

UXO
No known possible UXO was encountered during the works.

6.0 TEST RESULTS

6.1 Geotechnical Laboratory Testing

Plasticity Index Analysis
Plasticity index results ranged between 23% and 26%. Associated water contents ranged between 18.7% and 32.6%.

After modification of particle size in accordance with BRE 240 the modified plasticity indices are in the range 22% to 25% indicating the cohesive soils to be of medium volume change potential.

6.2 Aggressive Ground Conditions – Geotechnical Chemical Testing

The test results for the assessment of aggressive ground conditions are presented in Appendix D. The results are summarised and assessed within Section 7.7 of this report.

6.3 In Situ Geotechnical Testing

In Situ Standard Penetration Tests
Standard Penetration Tests (SPTs) were carried out within the window sample boreholes at regular 1.0m to 1.2m intervals. The results of the individual blows and the N-values are recorded on the Exploratory Hole Logs in Appendix B.

All SPT N values are uncorrected. Density and strength descriptors are reported in accordance with the guidelines stated in BS 5930:2015+A1:2020, incorporating requirements of BS EN ISO 14688-1:2018, BS EN ISO 14688-2:2018 and BS EN ISO 14689-1:2018.

Soil Infiltration Test Results
In the 2025 SP Associates ground investigation, soil infiltration tests were undertaken within trial pits, and a summary of the results is presented in the table below. These were carried out in general accordance with BRE Digest 365 (BRE 2016) where infiltration rates allow three test runs during a working day (or where there is no infiltration), but where low infiltration rates were encountered the available time may not have been sufficient to fully comply with the BRE test method.

Where less than three tests were possible in a particular location the results provided should be considered as indicative only. Further discussion concerning the suitability of infiltration testing at the site is provided in Section 7.9.

Location	Stratum Type	Depth (m)	Infiltration Rate (m/sec) Test 1
TP1	CLAY	1.02 – 1.90	Test run for 4 hours then abandoned due to very slow rate of infiltration in stiff clay.
TP2	CLAY	0.98 – 1.80	Test run for 4 hours then abandoned due to very slow rate of infiltration in stiff clay.
TP3	Sandy CLAY	1.03 – 1.90	Test run for 4 hours then abandoned due to very slow rate of infiltration in stiff clay.

6.4 Geo-Environmental Testing

Chemical Laboratory Testing
The chemical test results for soils are presented in Appendix D. The results are summarised and assessed within Section 8.0 of this report.

Ground Gas Monitoring

SP Associates ground gas monitoring results are summarised and assessed within Section 8.7 of this report.

7.0 GEOTECHNICAL ASSESSMENT

7.1 Ground Model

The site is currently undulating and exposed ground with sparse mature trees due to recent vegetation clearance. An embankment is present to the southwest of the proposed development, and a brick building is present slightly beyond the northeast of the proposed development.

The ground conditions can be summarised as below (top down):

- Made ground generally comprising clay with varying proportions of sand and gravel from ground level to between 0.20m and 1.50m bgl.
- Natural superficial deposits mostly comprising firm to hard clay (Glacial Till) proven to depths of at least 4.45m bgl. Natural deposits consisting of interbedded saturated very loose or very soft sand, silt, and clay (Alluvium) were proven to depths of between 2.40m and 2.70m bgl to the southwest of the proposed development adjacent to Redwither Brook.
- Solid geology was not encountered in the 2025 or 2026 ground investigations. A BGS borehole conducted in the northern part of the site encountered clay soils to 18.00m depth. Other nearby BGS boreholes varied, with one having encountered clay soils to 45.00m depth, and another having encountered mudstone from 16.50m depth.
- No groundwater was identified across the majority of the site. Groundwater levels ranging between 1.20m and 3.20m bgl were identified during site works at lower elevation adjacent to Redwither Brook.

Infilled former bunkers and structures were historically removed and likely infilled with imported material, however the exact location(s) across the site are unknown. This will need to be taken into consideration for foundation design and earthworks; similar features may still be present.

The site is considered moderate to high UXO risk as it was formerly ROF Wrexham known for manufacturing explosives and storing ammunition. A detailed UXO Risk Assessment is therefore recommended before intrusive ground works.

The site is not considered to be susceptible to flooding from rivers, groundwater at surface, or the sea. However, land approximately 30m south-west of the site does show flood susceptibility. A separate specialist flood risk assessment is recommended if required for planning.

7.2 Design Soil Parameters

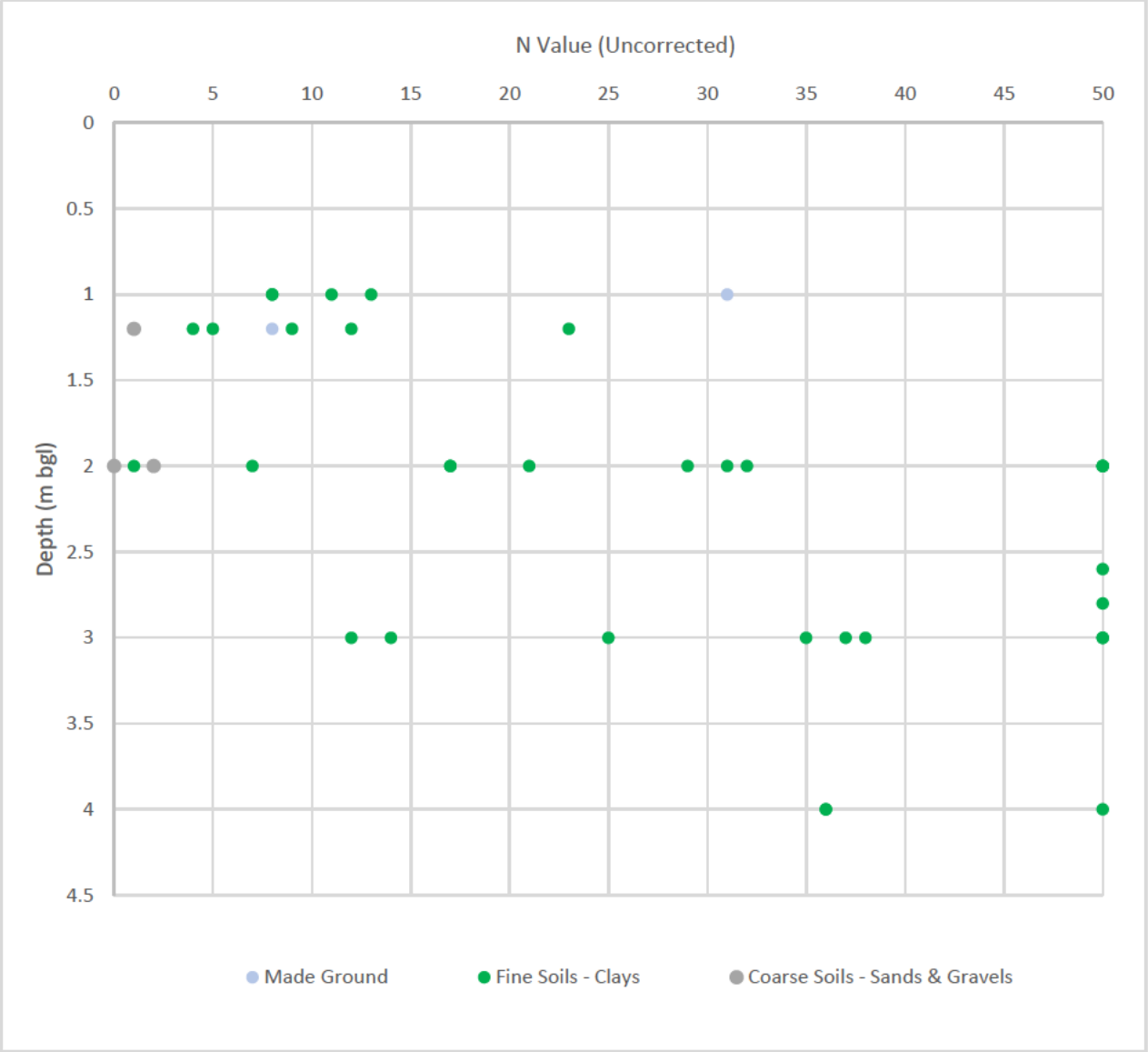
The relevant test results from the prior section have been evaluated to derive geotechnical soil parameters for the site.

For cohesive (fine) soils, the equivalent approximate undrained shear strengths (Cu) have been calculated from the recorded SPT N values, adopting f1 values based on the correlation of Stroud (1975) and the ‘average’ plasticity.

The equivalent approximate coefficients of volume compressibility (mv) have also been calculated from the recorded SPT N values, adopting f2 values based on the correlation of Stroud (1975) and the ‘average’ plasticity.

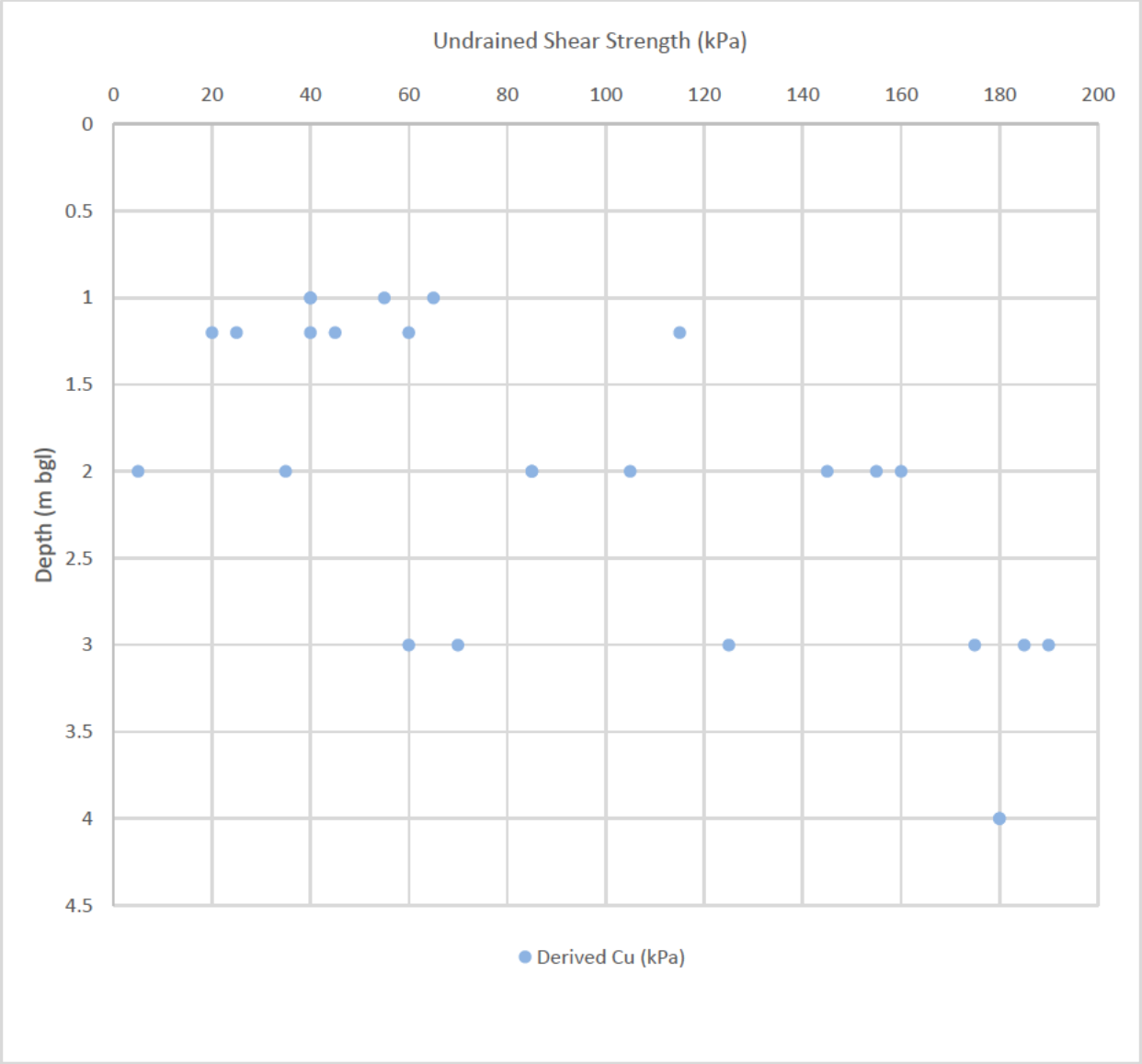
The angle of shearing resistance (ϕ') of the granular (coarse) soils has been derived from the uncorrected SPT N value data and the correlation of Peck (1967).

A depth (m bgl) vs SPT N value graph is also provided below to provide a profile of the materials underlying the site.



The above graph shows that the natural fine soils are variable but generally have higher N values with increasing depth, although it should be noted that the three lowest N values (N = 1, 4, 5) in the natural fine soils are all in interbedded alluvium beyond the proposed development area. The graph also shows the natural coarse soils to all be very loose in density, and that only two N values were recorded within the made ground which varied significantly in soil strength.

A depth (m bgl) vs derived shear strength (Cu) graph is provided below to provide a profile of the cohesive soils underlying the site.



The above graph shows a general increase in soils strengths as depth increases. It should be noted that the three lowest derived Cu values (5, 20, 25 kPa) in the natural fine soils are all in interbedded alluvium beyond the proposed development area.

Characteristic Values

Characterisation of the geotechnical parameters above has been undertaken to obtain characteristic values, which are a cautious estimate of the values affecting the occurrence of the limit state, taking into consideration typical minimum foundation depths for cohesive and granular soils.

Characteristic values for made ground are not presented due to the heterogeneity of the deposits and that they are not typically considered to be a suitable bearing stratum without some form of ground improvement.

Cohesive
Based on the medium volume change of the cohesive soils, foundations should be placed at a minimum depth of 0.90m bgl, therefore characteristic values are presented for this approximate depth, although may need to be deeper in areas due to made ground thickness.

The granular soils encountered in the investigation were all beyond the proposed development area, therefore founding depths in granular soils are not required to be assessed.

The characteristic value for undrained shear strength (Cu) in natural cohesive deposits below the proposed development at 1.00-1.20m begl is interpreted to be 55 kN/m^2, increasing to 150 kN/m^2 at 2.00m begl. These characteristic values are only for the proposed development area and are excluding the very soft or very loose soils encountered adjacent to Redwither Brook.

Approximate coefficients of volume compressibility (mv) derived from the in situ SPT testing within the cohesive materials range from 0.04 m^2/MN to 2.00 m^2/MN adopting an f2 value of 0.5 (based on the 'average' plasticity of 24).

Summary of derived geotechnical parameters
The table below summarises the characteristic geotechnical parameters for the site:

Stratum	Depth (m begl)	C_u (kN/m^2)	Mv (m^2/MN)
Superficial Deposits – Cohesive	1.00-1.20	55	0.195
	2.00	150	0.093

7.3 Foundations

The development will comprise an industrial warehouse building with a steel frame and is considered to be classed as Geotechnical Category 2 in accordance with Eurocode 7.

Preliminary design by calculation has been undertaken to determine the design resistance of the bearing strata in the following section. Note that the made ground, present to depths down to 1.50m bgl, is not considered to be a suitable bearing stratum.

Proposed structural loads of 150-200 kN/m were provided at the time of writing, therefore the following recommendations are provisional and should be reviewed at the detailed design stage.

The prior assessment recommended traditional shallow strip/pad foundations founded within the natural glacial Till deposits.

This foundation assessment utilises the provided Regrade Cut/Fill Plan (Drawing No. RCFP01) dated 20 March 2025. Any revisions to this Cut/Fill Plan would change the foundation recommendations, therefore the following recommendations are provisional and should be reviewed at the detailed design stage.

Shallow Foundations – Ground Beam Strip / Trench Fill and Pads
The most suitable foundations for the proposed warehouse building are considered to be ground beam strip / trench fill foundations for line loads/masonry in combination with pad foundations for steel portal frame elements.

Based on the medium volume change potential foundations should be placed at a minimum depth of 0.90m bgl into the natural cohesive deposits and deepened near trees and hedges in accordance with NHBC Chapter 4.2.

Over most of the proposed building area, there is minimal cut or fill shown on the provided Regrade Cut/Fill Plan. Therefore, building foundations will require embedment into natural cohesive deposits. Embedment can either be to:

- At least 0.90-1.00m below existing ground level (begl) into cohesive glacial Till deposits with estimated Cu of 55 kPa. Foundations are to be deepened where made ground is still present at 1.00m begl.
- 2.00m begl into cohesive glacial Till deposits with estimated Cu of 150 kPa. Foundations are to be deepened if made ground is still present at 2.0m begl.

The southern extent of the proposed building is shown to have >3.00m of engineered fill to be placed during earthworks. Made ground varies in thickness across the site, although it is thickest (1.50m bgl) at the southern extents of the proposed building platform. Therefore, embedment depth through the proposed engineered fill and into natural glacial Till may be approximately 4.50m deep in the south of the site, if taken to the top of the glacial Till.

If it is decided to embed the foundations deeper into the cohesive glacial Till deposits to obtain a higher bearing capacity, then an embedment depth of approximately 5.5m may be required in the south of the site.

The ground beam foundations may either be taken to approximately 1.00m begl to found on undisturbed natural firm clay or embedded approximately 2.00m begl into undisturbed natural stiff to very stiff clay. Foundations may either be placed at embedment depth or infilled with lean mix concrete to formation level.

At 1.00m bgl, an allowable bearing capacity not exceeding 110 kN/m^2 may be assumed. At 2.00m bgl, an allowable bearing capacity not exceeding 150 kN/m^2 may be assumed. This adopts a factor of safety of 3 which should limit settlements to within acceptable limits.

The surface water drain proposed to be constructed on site will need to be considered when designing the foundations. It is unadvisable for construction to be undertaken over the feature, foundations will either need to be taken to below the base of the feature or situated 3 to 4 times the breadth of the foundation away from it, this would ensure that the surface water drain is outside the pressure bulb of the foundation and that no load is being transferred to it.

Trees are noted within the area of the site proposed for development. Depending on their size, type and maturity, the required depth of founding based on the recommendations of BRE 298 may exceed 2.5m. Should this prove to be the case, then piled foundations should be considered as a potentially more economical solution, unless it can be proven that the soils are not desiccated.

Alternative Solutions
Alternatively, given the likely depth of fill across the southern part of the structure, foundations could be either placed in engineered fill if the end performance can be validated, or a deep solution such as the installation of vibro-stone columns or piles would need to be adopted. To minimise the effects of differential settlement, it is recommended that a single foundation option is designed and constructed across the entire building platform.

If a deep solution is opted for, then additional investigation may be required, subject to input from a vibro/piling contractor. In addition, prior to commencement of any penetrative works (piling/vibro), a working platform will be required for tracked plant. This should be designed and installed in accordance with BR470 (BRE 2004) based on the plant requirements, data and rig loadings.

General Advice for Shallow Foundations
The bearing stratum should be inspected for 'soft spots' within the natural clay strata, resulting for instance from localised groundwater perched within the overlying fill materials. If unsuitable soft soils are encountered, then foundations will need to be deepened to found on suitable strata or soft or loose zones should be excavated and replaced with well compacted suitable granular fill or lean mix concrete. The stratum should also be inspected for 'hard spots" which may require removal.

If the ground conditions encountered during the construction phase differ significantly to the conditions encountered during construction, work should cease and BSL be contacted for further advice.

During the construction phase, supervision should be on a continuous basis to check the design assumptions are correct and construction conforms to design. Supervision should include inspections, Control Ground Investigations and monitoring.

UXO
Based on the available information to date, specialist UXO advice and/or supervision will be required for all groundworks.

7.4 Building Near Trees

The clay soils on site are of medium volume change potential. Where foundation excavations (or piles if adopted) encounter cohesive strata in the vicinity of existing, proposed or recently removed trees, foundations should be adjusted in full accordance with BRE 298. All foundations should be deepened below roots of greater than 5mm diameter during excavations for footings.

A survey of all trees and hedges on the site and within influencing distance of the site boundary should be undertaken to identify tree species and heights by a qualified arboriculturist in accordance with BS 5837:2012. This information will be required in order to assess the effects of trees on the cohesive strata.

Where foundation depths due to trees already present or recently removed exceeds 1.50m, there is a possibility for heave to occur on removal of the tree and guidance states that compressible material or void former is required against the inside face of the foundation, unless it can be satisfied that the soil is not desiccated.

7.5 Floor Slabs

Ground bearing slabs may be adopted at the site providing the following criteria are satisfied:

- Any other compressible or unsuitable materials (topsoil containing vegetation and organic matter, including tree roots), are excavated and either removed and replaced with suitable materials or, if suitable (e.g. soft clays), improved by methods such as addition of lime/cement.
- The foundation depth (such as due to the influence of trees) is less than 1.5m.
- Any fill beneath the slab is suitable, well-compacted granular material placed in an appropriate thickness in accordance with a suitable specification (e.g. CC 601) designed and supervised by an appropriately qualified consultant, with the end performance validated.
- The slab is adequately reinforced.
- Regular construction joints and ties are provided to allow for differential settlement.

Given the thickness of made ground present (generally >600mm), suspended floor slabs may alternatively be adopted at the site.

The final floor slab design should be of sufficient thickness and sufficiently reinforced to accept the envisaged applied loads, without unacceptable total or differential movement.

Vertical elements within the structure, such as columns and walls will need to be isolated from the ground bearing slab in order to allow for the slab to expand against them without resulting in cracking.

Prior to the placement of the founding materials and the construction of a ground bearing floor slab, the sub-formation and formation will need to be inspected and checked by a geotechnical engineer to ensure the ground conditions are as expected. If soft spots or hard spots are identified at the formation level, they should be reported to the Geotechnical Engineer immediately and remedial actions agreed.

Incorporation of geogrid reinforcement at formation level, before granular material is placed and compacted, will likely minimise required excavation depths and help provide a suitable foundation for the ground bearing slab.

Ground floor slabs should also be designed to incorporate any ground gas protections measures; basic radon protection is required in this instance.

7.6 Site Preparation and Construction

If former underground relict structures (e.g. infilled bunkers) are encountered during construction, they will need to be grubbed out and fully removed. Topsoil and subsoil should be removed from beneath all proposed buildings and hardstanding areas.

There is a high voltage overhead powerline running through the western extents of the site, and another high voltage overhead powerline slightly to the east of the proposed development. There are also underground electricity services mapped slightly to the south of the proposed building area and underground water services mapped to the southwest of the site adjacent to Redwither Brook. To allow construction, all services will need to be disconnected, and any suspected dead services confirmed as dead by testing.

Instability of excavations through natural cohesive soils is not anticipated provided they are not exposed to adverse weather conditions for any substantial period of time. Instability of the made ground and alluvial deposits should be allowed for as they contain a combination of granular and cohesive material. All excavations should be carried out in accordance with CIRIA Report 97 'Trenching Practice'.

Excavation depths should generally be readily achieved using conventional plant (JCB or similar) although high specification plant (tracked 360^{o} or similar) is recommended to maintain the build programme. Breaking equipment may potentially be required locally to penetrate old, infilled bunkers or structures associated with former ROF Wrexham.

The presence of substantial depths of made ground and proposed fill across the site may result in settlement of newly installed drainage. This should be taken into consideration during the design of drainage, which may include flexible joints to allow for some differential settlement.

It should be noted that undertaking treatment locally or using deepened foundations (i.e. focussing only on the footprint of structures) means that the surrounding areas (roads and landscaping) may settle relative to the structures if disturbed. This risk can be mitigated by undertaking site wide earthworks to an appropriate specification.

To protect against the effects of heave, new drainage in cohesive soils should be designed to take account of potential ground movement, including where pipes and services which pass through substructure walls

or foundations. The volume change potential on this site is medium and the potential ground movements that need to be considered for design are 100mm.

7.7 Concrete Classification

The soluble sulphate and pH test results have been assessed in accordance with BRE Special Digest 1 "Concrete in aggressive ground" 2005. The Design Sulphate (DS) classification and the Aggressive Chemical Environment for Concrete (ACEC) classification are presented in the table below.

For the purposes of this assessment, the groundwater has been classified as static given that the site is predominantly underlain by low permeability clay soils.

Stratum	No. Samples	Characteristic SO_4 (g/l)	Characteristic pH	DS Class	ACEC Class
Topsoil	1	35.1	6.9	DS1	AC-1s
Made Ground	6	49.1	7.6	DS1	AC-1s
Natural Superficial Strata	9	144.2	7.2	DS1	AC-1s

Based on the above, the results of laboratory pH and sulphate content, alongside the BRE full suite tests, indicate that sulphate class DS-1 and ACEC Class AC-1s conditions prevail in accordance with BRE Special Digest 1 "Concrete in aggressive ground" 2005.

The specific concrete mixes (the Design Concrete Class) to be used on site will be determined by the site-specific concrete requirements in terms of the durability and structural performance. These are assessed in terms of the Structural Performance Level (SPL) and any need for Additional Protective Measures (APM) detailed in Part D of BRE Special Digest 1 with further guidance in Pt E and F.

The 2025 SP Associates ground investigation included pH and soluble sulphate testing on 10 soil samples. The resulting concrete classification assessment identified a DS class of DS-1 and a corresponding ACEC class of AC-1.

7.8 Highways

Based on Table 5.1 from DMRB IAN 73/06 Rev 1 equilibrium CBR values of 5% are likely to be achieved in undisturbed natural granular soils and 2% for natural clay soils for pavement design purposes, unless proven otherwise by in-situ testing at formation level by a specialist geotechnical engineer. Equilibrium CBR values are likely to be 2% within the made ground.

Where the CBR is found to be less than 2%, the sub-grade is unlikely to be suitable for both the trafficking of site plant and as a permanent highway foundation without improvement of the soils.

To achieve the required design CBR value, improvement works should be carried out in accordance with DMRB IAN 73/06 Rev 1 Chapter 5 and may include proof rolling, excavation and re-engineering / replacement of weaker soils, the inclusion of a geogrid or use of stabilisation techniques such as the addition of hydraulic binders (e.g. cement/lime).

Based on the fines content of the soils, they are considered to be frost susceptible, therefore highway construction should be a minimum thickness of 450mm to mitigate against the risk.

Care should be taken to ensure the stratum at formation level is protected against inclement weather, as this is likely to lead to surface deterioration and a decrease in soils strengths.

7.9 Site Drainage

Based on the 2025 SP Associates ground investigation, the use of traditional soakaways within the natural ground was not considered to be feasible at the site due to the low infiltration rates obtained (on the order of 10^{-9} m/s) and the presence of low permeability cohesive strata underlying the site.

A soakaway test was initially proposed for the 2026 BSL ground investigation, however this was cancelled prior to the investigation as we understand NRW commented that the previous soakaway testing data would be sufficient for the site.

Due to the low infiltration rates obtained from natural superficial deposits on the site, an alternative drainage method will be required.

7.10 Slope Stability

A slope exists to the southwest of the proposed development, decreasing approximately 4m in elevation from the proposed development area to Redwither Brook below. The slope is moderately steep and vegetated with brambles and mature trees, with the walkover revealing the slope embankment to be clearly comprised of made ground (concrete and brick boulders) in one location.

This slope is situated beyond the proposed development area, displayed no obvious signs of slope instability during the site walkover, and was largely vegetated, therefore the slope is considered likely to pose minimal risk to the proposed development in its current state.

The provided Regrade Cut/Fill Plan shows significant depths (>5m) of proposed cut material along the bottom of this slope. It is not recommended that the toe of this slope be over-steepened as shown on the provided Cut/Fill plan, as this may result in the destabilisation of the slope and the ground failing towards Redwither Brook. If material is to be excavated from this slope for re-use elsewhere onsite, it is recommended that the current slope angle remains approximately the same or reduced is feasible. Alternatively, if the development will cut into the toe of the slope as shown on the Cut/Fill plan, then further assessment of slope stability may be required, or design and installation of a retaining wall may be required.

7.11 Earthworks

Given the variability of existing site levels and development layout requirements, earthworks will be required in order to achieve the desired development platform levels.

Design of the earthworks, particularly in the southwestern part of the site, should consider the stability of any cut or fill slopes. Any fill should be placed in accordance with an appropriate specification, as discussed further below. Designs should allow for incorporation of suitable drainage to prevent the build-up of pore water pressure which could lead to slope instability.

An initial assessment reveals spoil resulting from excavations within the made ground and superficial deposits should generally be suitable for re-use as general fill subject to further testing and specification or may be disposed off site.

The topsoil may only be used as landscaping fill subject to the necessary approvals or should be disposed of off site to a suitable facility.

Recorded water contents range from 18.7% to 32.6%, with an average of 24.8%.

The soils may be suitable for stabilisation and improvement by the inclusion of binders, subject to further detailed design and testing.

Where it is proposed to re-use site won materials as an engineered fill, it will be necessary to develop an appropriate Earthworks Specification. The basis for the Specification should be BS 6031:2009 and the latest version of the Standards for Highways, CC 601 Earthworks. Note that testing for earthworks was not within the scope of the investigation but is recommended.

If site-won material is to be re-used on site, it is recommended this is carried out under the CL:AIRE Development Industry Code of Practice (DoWCoP CL:AIRE March 2011).

8.0 GEO-ENVIRONMENTAL RISK ASSESSMENT

8.1 Introduction

The samples were tested for an assessment of the chemical contamination that may pose a risk to human health. The results were examined with reference to a selection of guidance documents as detailed in Appendix A. In this case the LQM/CIEH S4ULs and DEFRA C4SLs for a commercial end use have been adopted as Tier 1 generic screening values.

Where samples record determinand concentrations that exceed the relevant screening values then these will be considered further.

A summary assessment sheet is presented in Appendix D alongside the chemical test results. Results are discussed in detail in the sections below.

8.2 Previous Geo-Environmental Assessment

A geo-environmental assessment was previously undertaken by SP Associates following their 2025 ground investigation. The assessment utilised soil samples from window sample boreholes that were tested for asbestos, phenols, heavy metals, inorganic chemicals, speciated petroleum hydrocarbons, PAHs, and BTEX. The assessment compared the chemical data to Tier 1 chemical screening criteria for industrial/commercial end use.

The SP Associates geo-environmental assessment found that none of the above tested determinands were present at concentrations that exceeded their Tier 1 screening acceptance criteria values. Therefore, the risk to human health from contaminants within onsite shallow soils was considered to be low.

8.3 Soils Test Results and Risk Assessment – Human Health

Metals
No metals have been detected above the adopted screening criteria.

Asbestos
No asbestos has been detected in any of the eight samples screened.

Poly Aromatic Hydrocarbons (PAHs)
No PAHs have been detected above the adopted screening criteria.

Total Petroleum Hydrocarbons (TPH CWG)
No petroleum hydrocarbons have been detected above the adopted screening criteria.

BTEX and MTBE
No BTEX or MTBE compounds have been detected above the adopted screening criteria.

PCBs
No PCBs have been detected above the adopted Atkins AtRisk Soil SSVs screening criteria.

Explosives
No explosives suite chemicals have been detected above the adopted LQM/CIEH screening criteria; essentially all determinands were at or below laboratory detection limits.

8.4 Summary – Human Health Risk Assessment

Based on the testing and assessment undertaken, no further action is required in respect to human health risks from soils contamination, based on the intended end use.

8.5 Soil, Water and Leachate Test Results – Controlled Waters

Soils

No significant concentrations of contaminants were identified in the soils tested. As soil contamination is a recognised indicator of potential groundwater impaction (i.e. with the soils as a potential source), the absence of any significant concentrations in the soils tested, the lack of visual and olfactory evidence of contamination and combined with the low permeability strata and the controlled waters risk assessment rationale in Section 8.6 below, indicates a low risk is posed to the identified and groundwater receptors. On this basis, groundwater monitoring is not considered necessary.

8.6 Controlled Waters Risk Assessment

Groundwater/surface water testing has not been carried out based on the preliminary CSM risk assessment and the site is not considered to pose a significant risk to controlled water for the following reasons:

- Whilst the nearest groundwater abstraction is 160m southwest of the site, likely abstracting from the Principal Aquifer, no significant gross or mobile contamination has been identified on site in soils based on the results obtained as a potential indicator of groundwater contamination.
- There is no indication under present conditions of significant pollution of controlled waters and conditions following development of the site will not be any worse, indeed they may improve with increased hard cover and water retaining imported soft landscaping soils.
- There is unlikely to be any significant input of new contamination at the site in future, and the nature of the proposed development is considered to be low risk.
- The nearest watercourse is Redwither Brook approximately 10m southwest of the proposed development and 90m southwest of the proposed building platform, which provides some distance for attenuation and contaminant degradation from possible minor leachate generation from the made ground.
- The majority of the site is underlain by low permeability clays which will inhibit lateral and vertical contaminant migration.
- A BGS borehole situated in the north of the site indicates at least 18.00m thickness of low permeability cohesive deposits which as stated above will inhibit lateral and vertical contaminant migration.
- For the made ground, the preparation of samples for leachability analysis has not been undertaken as this is an aggressive methodology and provides theoretical values which are unlikely to be representative of existing site conditions, real site leaching concentrations will be reduced significantly from that indicated by the laboratory testing, furthermore this would not be representative of post construction conditions, which will significantly reduce infiltration.
- The concentrations of leachable substances that could emanate from the site will be subject to dilution and dispersal during transport and so the risks will reduce with distance from the site and into the identified surrounding water bodies.
- The findings of this investigation concur with prior investigation and the assessment of a low risk to controlled waters by an independent consultant.
- Additionally, sampling of perched water has not been carried out as:
  - No significant groundwater body has been encountered with the glacial Till which underlies the majority of the site; boreholes were dry.
  - There is no perceived risk to the underlying sensitive Principal Aquifer due to the geology; perched waters within the superficial aquifer are highly unlikely to be in hydraulic continuity with the underlying bedrock.
  - Given the very low to negligible permeability nature of the superficial deposits as proven by infiltration testing, and interbedded nature of thin granular lenses in limited alluvium in the south,

such bands are unlikely to provide any significant volume of groundwater to other features via baseflow.
- Given the above factors, there would be little merit or benefit from sampling and testing the likely highly limited quantities of perched groundwater. Even if there were exceedances of EQS values within such waters, it would likely be extremely challenging, disproportionally costly and unsustainable to remediate these within discontinuous perched water groundwaters to pre-input stages, especially in light of potential diffuse pollution from wider area sources.
- Based on the infiltration testing carried, drainage to soakaways will not be feasible at the site, further reducing the risk of potential leachate generation, thus making any chemical testing of such strata of little worth.
- Whilst an attenuation basin is proposed in the south, construction will include low permeability membranes/low permeability natural site woncohesive fill, minimising the potential for contaminant transport.
- The proposed foundation solution for structures will likely be mass trench fill concrete. This option will not create any new pathways, as these methods are unlikely to advance deeper than 2-3 into the very stiff clays; there would still be a significant thickness of very low to negligible permeability clay between the base of foundations and the Principal Aquifer. In addition, as stated above, there will be increased hard cover and improved drainage which would reduce the propensity for leachate generation in any case.
- Good site practice and modern construction techniques and equipment mean the risk of spillages from construction plant is unlikely and this temporary potential source is considered to have a low risk to controlled waters.

Based on the above, no further action is considered to be required with respect to controlled waters.

8.7 Ground Gas Risk Assessment

A summary of the SP Associates ground gas monitoring regime and assessment are discussed below.

The carbon dioxide measured within the boreholes had a maximum concentration of 1.6%, while methane was effectively absent. A resulting gas screening value (GSV) of 0.0016 l/hr was calculated for carbon dioxide. In accordance with Ciria C665 guidance, the GSV placed the site into a Characteristic Situation 1 (CS1) classification which classified the site as very low risk with respect to methane and carbon dioxide, therefore no further action is required.

The BGS Radon report indicated that property is in a radon affected area where 5-10% of properties are estimated to be at or above the action level, and that basic radon protective measures are required for the proposed development in accordance with BRE 211.

8.8 Qualitative Risk Assessment

The previous SP Associates CSM has been revised based on the findings of this site investigation and laboratory testing results and these are presented overpage and displayed on drawing C6668/03.

Human Health						
Potential Source	Potential Pathway	Potential Receptor	Likelihood	Severity	Level of Risk	Justification
On site Made Ground Metals, PAH's, asbestos, explosives	Root uptake, ingestion, direct contact, inhalation of dusts	End-users	Unlikely	Severe	Low	The site was formerly used to manufacture explosives and store ammunition, with former bunkers that have likely been infilled with imported unknown material, therefore there was considered to be the potential for contaminated made ground to be present on site. However, the concentrations of heavy metals, PAHs, explosives, and asbestos across the site are below the relevant screening values. Additionally, the presence of hardstanding across the commercial development will break the pathway to site end users. The risk is considered to be low.
On site Made Ground Metals and organic contamination	Migration into/chemical attack of water supply pipelines	Water Pipelines / End users	Unlikely	Mild	Low	Contaminants within the soil/groundwater could potentially attack the clean potable water supply pipe and should be assessed to determine the correct pipe material and level of precautions required, however, the risk is considered to be low at this stage.
On site and Off Site Made Ground, Small offsite Ponds Ground Gas (carbon dioxide and methane)	Migration into confined spaces, inhalation and asphyxiation/ explosion	End-users / property / structures	Unlikely	Medium	Low	No significant elevations of methane, carbon dioxide, VOCs, carbon monoxide or hydrogen sulphide were detected during the gas monitoring programme conducted by SP Associates. Underground structures immediately to the west, east, and south of the site were historically infilled with unknown material that possibly represents a ground gas source. However, ground gas monitoring identified a very low ground gas risk with respect to methane and carbon dioxide. Small ponds were also historically present within 100m of the site to the west, north, and east, that have since been backfilled, although as stated no significant concentrations have been recorded and lateral gas migration will be mitigated by the low permeability soils encountered on site. The ground gas risk assessment by SP characterised the site as Characteristic Situation 1 with respect to carbon dioxide and methane. Additionally, the 2026 BSL investigation identified the site to be mostly underlain by low permeability deposits and no credible significant ground gas sources were encountered; whilst alluvial deposits were recorded in the south these do not directly underly the proposed structure and in combination with the low permeability glacial Till alongside the inherent protection afforded by basic radon protection measures, the risk is considered to be low from permanent ground gas.

Human Health						
Potential Source	Potential Pathway	Potential Receptor	Likelihood	Severity	Level of Risk	Justification
Natural Geology Radon	Migration into confined spaces, inhalation	End-users	Likely	Medium	Moderate	Site-specific BGS Radon Report and BRE 211 radon advice indicates basic radon protection measures are required.
Off site Electricity Substation PCBs	Ingestion, direct contact, inhalation of dusts	End-users	Unlikely	Mild	Low	The mobility of PCBs is low, PCBs were measured to be below the adopted screening values, and the substation is situated off site. In addition, the proposed development will be covered in hardstanding which will break the pathway to site end users. The risk is considered to be low.
Off site Backfilled pond Metals, PAHs, petroleum hydrocarbons	Ingestion, direct contact, inhalation of vapours	End users	Unlikely	Medium	Low	Small ponds were historically present within 100m of the site to the west, north, and east, that have since been backfilled. However, lateral migration of contaminants will be mitigated by the low permeability soils and lack of groundwater encountered across most of the site. The risk is considered to be low.

Controlled Waters						
Potential Source	Potential Pathway	Potential Receptor	Likelihood	Severity	Level of Risk	Justification
Made Ground PAH's, Metals	Overland flow, / migration through saturated zone	Redwither Brook 10m away (Surface waters)	Unlikely	Medium	Low	Contamination testing by SP Associates and BSL has not identified any significant concentrations of contaminants within the soils analysis as a potential indicator of groundwater impaction. In respect to surface waters, contaminants are also likely to attenuate and degrade over the distance to the Brook. Whilst there are three groundwater abstraction licences or Source Protection Zones within 250m of the site, all relating to a borehole 160m southwest of the site, likely abstracting from the Principal Aquifer, the low permeability of the underlying clay soils will inhibit lateral and vertical migration and further mitigate the risk. The site is also proposed to be surfaced in hardstanding, with a new surface water drainage system installed which will further reduce the risk to controlled waters. By virtue of the development taking place, this should contribute to an overall "betterment" of groundwater quality. Therefore, a low risk to controlled waters is posed from the made ground.
	Leaching through unsaturated zone / Migration through saturated zone	Secondary A Aquifer – Undesignated (Groundwater)				
	Migration through saturated zone	Principal Aquifer (Groundwater)				

8.9 Outline Remedial Measures

No sources of contamination have been identified on site, therefore no specific remedial measures are required for soils in respect to human health for the proposed end use.

Chemical analysis of the natural clay deposits have identified these soils to be acceptable for use as subsoil and general fill.

The previous Phase I Geo-Environmental Assessment identified historical infilled underground structures on site, however none were identified during the investigations undertaken on the site. If infilled structures are encountered with unexpected contamination, then works should cease in that area and BSL be consulted for advice.

Utilities
The level of protection for the clean potable water supply pipes should be determined using the local water company risk assessment criteria in accordance with UKWIR.

As the site is brownfield, there is the assumption that barrier pipe would be utilised, although requirements should be confirmed by risk assessment and with the water supply company.

Ground Gas Protection Systems
Basic radon protection measures in accordance with BRE 211(2023) are required for new buildings at this location.

As radon gas membranes are a passive protection system, after installation and verification they typically do not require associated long-term monitoring (as stipulated by Condition 12). The incorporation of basic radon protection measures would generally be considered an appropriate and proportionate mitigation measure for a commercial development. Therefore, long term monitoring of ground gas is not considered to be required for the site.

Once the above bodies have approved the above outline remedial proposals, a short Remediation Strategy including a Verification Plan for Ground Gas Protection Measures will need to be produced to meet planning requirements and submitted to the regulatory authorities for approval. This will address planning conditions 10-12 and will also give guidance to enable a suitably qualified contractor to carry out the works.

All installations should be subject to verification. The verifier should be independent, competent and suitably trained; BSL can provide this service. We recommend validation requirements should be discussed with the Local Authority prior to installation.

General
It is recommended that the approval of the Regulators (Local Authority / Environment Agency) is obtained in regard to the above prior to any irrevocable action is taken at the site.

In addition, the writing and approval of a Design Statement and Materials Management Plan (MMP) or suitable exemptions/permits will be required to allow re-use of suitable material at the site.

A watching brief is recommended during groundworks for any unidentified sources of contamination. If any gross contaminated material is encountered works should cease in that area and BSL be consulted.

Once remediation is complete, verification reports will need to be produced by a suitably qualified independent geo-environmental engineer, such as BSL, in order to achieve regulatory sign off.

8.10 Health and Safety Issues

During the reclamation and construction phases of the site development it will be necessary to protect the health and safety of site personnel. The risk to construction and ground workers is assessed in the table below:

Potential Source	Potential Pathway	Potential Receptor	Likelihood	Severity	Level of Risk
Made Ground (heavy metals, PAHs, petroleum hydrocarbons)	Ingestion, direct contact, inhalation of dusts.	Construction Workers	Low likelihood	Mild	Low
Asbestos	Ingestion, direct contact, inhalation of dusts.	Construction Workers	Low likelihood	Medium	Low
Ground gas	Inhalation in confined spaces/trenches	Construction Workers	Low likelihood	Severe	Low

The risk from made ground will be mitigated by standard PPE including gloves. Welfare facilities should be made available to wash before hand to mouth activities.

General guidance on these matters is given in the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the Redevelopment of Contaminated Land". In summary, the following measures are suggested to provide a minimum level of protection:

- All ground workers should be issued with the relevant protective clothing, footwear and gloves. These protective items should not be removed from the site and personnel should be instructed as to why and how they are to be used.
- Hand-washing and boot-washing facilities should be provided.
- Care should be taken to minimise the potential for off-site migration of contamination by the provision of dust suppression control and wheel cleaning equipment during the construction works.
- Good practices relating to personal hygiene should be adopted on the site.
- The contractor shall satisfy the Health and Safety Executive with regard to any other matters concerning the health, safety and welfare of persons on the site.

8.11 Asbestos

The investigation of asbestos issues within structures was beyond the scope of this report. However, guidance from UK Government indicates that asbestos should be assumed to be present in buildings unless proven otherwise.

Any asbestos within structures will require removal prior to re-development. This will need to be done by a suitably qualified experienced and licensed contractor, who ensures that adequate PPE is provided to operatives, and that all the relevant legislation is adhered to.

In addition, as asbestos may be present within the ground it will require a safe system of work to be set up on site to deal with the asbestos risk from the made ground. This may include but be not limited to:

- The use of qualified personnel where required.
- Careful segregation of stockpiles on site.
- Defining transport routes.
- Cleaning down of machinery in designated areas.
- Decontamination unit for ground workers.

- Damping down of soils to prevent dust migration.

Excavations in soils containing asbestos should comply with the CL:AIRE publication 'Interpretation for Managing and working with Asbestos in Soil and Construction and Demolition Materials' (CARSOIL) and CAR 2012. All such works will need to be agreed with the regulatory bodies (HSE and/or LA).

Additional guidance is provided within the BSL methodology Guidance Note in Appendix A.

9.0 WASTE SOIL CLASSIFICATION & ASSESSMENT

9.1 Summary

BSL have undertaken a preliminary assessment of potential excavation waste to arise from the site during redevelopment to:

- Classify the excavation waste to arise as either hazardous or non-hazardous.
- Identify the most sustainable options for the wastes to arise in accordance with the waste hierarchy.
- Provide a written description of the waste required as part of the Duty of Care.
- Provide details of "hazardous properties" to complete hazardous waste consignment note (where applicable).
- Be able to provide a basic classification report to a landfill operator (where waste is destined for landfill disposal).

It should be noted that testing requirements for contaminated land risk assessment differ to those for waste classification purposes. Unless otherwise stated, the assessment in this section has been carried out to provide initial indications in respect to disposal of waste soils, however this may not be fully compliant with waste testing requirements or frequencies, with further testing potentially required.

9.2 Soils Waste Classification Procedure

As described in the 'Waste Duty of Care Code of Practice (2016)' any substance or object that the holder discards, intends to discard or is required to discard is a waste. It is the responsibility of the waste producer to classify this waste. The classification process is described in the 'Guidance on the classification and assessment of waste' WM3 and aims to determine whether the waste is Hazardous or Non-Hazardous to human health and the environment.

Waste classification should be based on soils analyses that are representative of the actual waste load. At the stage of ground investigation, the materials that will become waste have generally not been defined yet, however test data can provide a useful guide to the likely waste classification before it is generated.

Further guidance is provided in Appendix A.

The Landfill Directive (Directive 1999/31/EC on the landfilling of waste, Decision 2003/33/EC and Landfill Regulations 2005) led to the establishment of a methodology for classifying wastes. Wastes first need to be classified based on their total concentrations and classified as either hazardous or non-hazardous waste. WAC testing is only required if the end disposal route is a landfill and WAC analysis must not be used for waste classification.

Wastes can only be accepted at a landfill if they meet the relevant Waste Acceptance Criteria (WAC) for that type of landfill. A waste must comply with the WAC limits for the relevant landfill, otherwise the soil will need to be pre-treated. There are three different WAC criteria, these are:

- Inert waste.
- Stable Non-Reactive Hazardous Waste (SNRHW).
- Hazardous waste.

Details of how material should be classified for waste disposal are presented in the BSL Methodology and Guidance in Appendix A and are summarised in the table below:

Classification based on Total Concentrations[1]	PRIOR TO LEAVING SITE			
	Non-Hazardous Waste		Hazardous Waste	
	IF SOILS CANNOT BE RE-USED ELSEWHERE AND MUST GO TO LANDFILL			
WAC testing	Below inert WAC limit values	Above inert WAC limit values	Below hazardous WAC limit values[4]	> WAC limit values
Landfill requirements	INERT landfill	NON-HAZARDOUS landfill[2]	HAZARDOUS landfill	PRE-TREATMENT[3]

1 Total concentrations are defined as tests results on solids as opposed to leachate (i.e. a liquid).
2 Individual sites may have certain limit values pre-determined in their licence.
3 After pre-treatment the material characteristics may have changed to an extent that allow the soil to be re-classified.
4 Possibility that wastes could be classified as stable Nonreactive HAZARDOUS waste in non-hazardous Landfill (e.g. soils containing low concentrations of asbestos, gypsum or sulphate bearing soils).

Inert Waste
The possibility of automatic inert classification of the naturally occurring "clean" soils should be explored in accordance with Section 4.3 of the EA guidance document. See Appendix A for further guidance.

9.3 Waste Classification and Waste Acceptance Criteria (WAC)

We have reviewed the testing results and assessed them through a waste classification database (HazwasteOnline™) which allows users to code and classify waste as defined in the EWC (European Waste Catalogue) based on EC Regulation 1272/2008 on the Classification, Labelling and Packaging of Substances and Mixtures (CLP) and latest Environment Agency guidance (WM3 "Guidance on the classification and assessment of waste -Technical Guidance").

The samples tested were screened against assessment criteria within WM3 using the HazWasteOnline tool to assess whether they contained any contaminants in the hazardous range.

The Waste Classification Report is presented in Appendix E.

Based on the waste classification database assessment, all of the made ground and natural soils have been classified as **non-hazardous.**

Note that further testing of the soils (WAC testing) may be required on the actual arisings in order to satisfactorily categorise the soil for its suitability for disposal to landfill.

Waste Containing Asbestos
Should soils contain asbestos, the concentration and type of asbestos identified, in addition to the chemical composition (i.e. hazardous or non-hazardous detailed above), will determine which waste code is applicable to the soils and which landfill will accept it as summarised below:

Waste	Conc. by Weight (%)	EWC 2002 Catalogue Entry Code	Waste Disposal Route
Non-hazardous containing asbestos fibres	<0.001 - <0.1%	17 05 04 (soil and stones other than those mentioned in 17 05 03*)	Non-hazardous landfill subject to achieving Waste Acceptance Criteria (WAC) for a stable non-reactive hazardous landfill site.
Hazardous containing asbestos fibres	<0.001 - <0.1%	17 05 03* (soil and stones containing dangerous substances)	Hazardous landfill subject to achieving Waste Acceptance Criteria (WAC) for a hazardous landfill site.
Non-hazardous soils containing asbestos fibres	<0.1%	17 05 03* (soil and stones containing dangerous substances)	Hazardous landfill authorised to receive asbestos, or in a stable non-reactive hazardous waste cell at a non-hazardous landfill authorised to receive asbestos.

Waste	Conc. by Weight (%)	EWC 2002 Catalogue Entry Code	Waste Disposal Route
Non-hazardous Soils containing ACM (Mechanically separable)	>0.1%	17 06 05 (construction material containing asbestos) 17 05 04 (soil and stones other than those mentioned in 17 05 03*)	ACMs disposed of at a hazardous landfill authorised to receive asbestos, or in a stable non-reactive hazardous waste cell at a non-hazardous landfill authorised to receive asbestos. Soils should be disposed of at a non-hazardous landfill subject to achieving Waste Acceptance Criteria (WAC) for a stable non-reactive hazardous landfill site.
Hazardous soils containing ACM	>0.1%	17 05 03* (soil and stones containing dangerous substances)	Hazardous landfill subject to achieving Waste Acceptance Criteria (WAC) for a hazardous landfill site.

General

Following the classification of waste materials, the options available for the waste can be considered in the context of the waste hierarchy as below:

- Onsite re-use (with or without prior treatment) under suitable exceptions/permits.
- Offsite processing for recycling or recovery e.g. screening.
- Offsite disposal (with or without prior treatment) i.e. landfill.

Where feasible, efforts should be made to retain soils for onsite re-use to minimise costs and maximise the sustainability of projects.

If any gross hydrocarbon contaminated material is encountered during the construction phase, it is possible that this may be classified as hazardous and testing should be undertaken at that time.

Where it is necessary to dispose material off site it is recommended that materials are segregated and sufficient time is allowed to further classify the actual soil arisings that constitute the waste, including discussion with landfill sites and waste transfer stations to find the best disposal route. It is illegal to dilute and mix soils without a suitable permit.

Where possible, the option that the soils could be recycled at a suitable local waste treatment plant or transfer station rather than a landfill disposal route should be explored.

9.4 Re-use of Soils

By definition in law, any material excavated from the ground becomes waste at the moment of excavation. If that soil (now a "waste") is then placed on another part of the development site (or used on another development site) without an appropriate materials management plan, permit or exemption being in place, by law this material is defined as "illegally deposited waste".

In order to comply with UK legislation and avoid excessive costs, if the re-use of soils is proposed on site, this should be done in accordance with the relevant exemptions or permits in place.

Soils Re-use Under DoWCoP

One of the main industry mechanisms for allowing the re-use of soils in construction is the CL:AIRE "Development Industry Code of Practice for the Definition of Waste" (CL:AIRE DoWCoP) also known as a Materials Management Plan (MMP). Further guidance is provided in the BSL Methodology and Guidance in Appendix A.

In order to re-use soils under the DoWCoP, there are four key criteria that need to be met:

- The aims and objectives of the project meet the requirements of the Waste Framework Directive (does not harm human health or the environment).
- The soils can be demonstrated to be suitable for use (backed up by chemical/geotechnical testing and assessment).
- There is certainty of use (planning consents are in place alongside materials tracking, which should be in place as part of good site practice in any case).
- Quantity (the quantity of materials used should be known).

Information on existing site levels, proposed levels, volumes generated (e.g. foundation / drainage excavation arisings) would need to be known in order to complete the MMP.

If the DoWCoP is the chosen route, the MMP should be in place and declared by a Qualified Persons (QP) before works commence, otherwise excavated soils could constitute an illegal deposit of waste and enforcement action could be taken by the EA and HMRC.

Once the project is complete, a verification report detailing soils re-use/import will need to be produced and submitted to CL:AIRE, which may be subject to a random audit process. Sites found to be non-complaint with the CoP can be referred to the EA for further investigation.

Note that for re-use of landfilled materials or mining wastes, the DoWCoP may not apply and a Waste Recovery Permit (or others) may be required. Liaison with the Environment Agency would be needed on a case by case basis to determine the best option.

Re-use of soils containing asbestos should comply with the CL:AIRE publication 'Interpretation for Managing and working with Asbestos in Soil and Construction and Demolition Materials' (CAR-SOIL™) and CAR 2012.

In terms of the re-use of brick/concrete crush materials, the DoWCoP does cover aggregates, but only on the site of origin, and the EA WRAP aggregate Quality Protocol might best apply to ensure quality standards, which are discussed further below.

Soils Re-use under Exemptions and Permits

Other potentially suitable re-use mechanisms may include U1 Exemptions, WRAP quality protocols (for aggregates) or Waste Framework Directive (WFD) Exclusions, amongst other mechanisms. Further details are provided in Appendix A.

10.0 CONCLUSIONS

10.1 Geo-Environmental

This report is intended to support discharge of Condition 9 of planning permission reference P/2025/0430.

Geo-Environmental – Human Health – Soils
Testing of the made ground at the site did not reveal any exceedances of heavy metals, explosives, PAHs, petroleum hydrocarbons, PCBs, BTEX or MTBE compounds for a commercial end use, therefore no specific remedial action is required in respect to soils at this stage.

Geo-Environmental – Ground Gases and Vapours
Ground gas monitoring by SP Associates has revealed a maximum peak carbon dioxide concentration of 1.6%v/v and methane concentrations of <0.1%v/v. Based on the gas monitoring the site is classified as Characteristic Situation 1 (CS1) with respect to carbon dioxide and methane. However, basic radon protection measures are required for the site. This should be detailed within a short specification and verification plan in order to address the applied planning conditions. Based on the CS1 site characterisation with respect to carbon dioxide and methane and required installation and verification of a radon gas membrane, long term monitoring of ground gas is not considered to be required for the site.

Geo-Environmental – Controlled Waters
The findings of this assessment corroborate with the prior assessment by SP Associates; the overall risk to controlled waters is considered to be low and no further action is required.

Waste
Waste classification for the made ground and natural soils at the site has revealed all of the soils to be non-hazardous.

10.2 Geotechnical

Foundations and Floor Slabs
Foundations are to be embedded into natural cohesive deposits, either to 1.00m begl with an estimated Cu of 55 kPa (safe bearing capacity of 110kN/m^2), or to 2.00m begl with an estimated Cu of 150kPa (safe bearing capacity of 150kN/m^2). If made ground is present at these depths, foundations are to be deepened into natural strata.

The proposed foundation type is ground beam strip footings to support the building masonry walls, concrete pad footings to support the steel frame structure, and a ground bearing floor slab. Provided structural loads are 150-200 kN/m^2 across the building platform.

Due to significant filling to be placed across the southern part of the structure, foundations could be either placed in engineered fill if the end performance can be validated, or a deep solution such as the installation of vibro-stone columns or piles may be adopted. To minimise the effects of differential settlement, it is recommended that a single foundation option is designed and constructed across the entire building platform.

Concrete classification
The site has been assessed to be sulphate class DS-1 and ACEC Class AC-1s conditions in accordance with BRE Special Digest 1 “Concrete in aggressive ground” 2005.

Highways
CBR values of 5% are likely to be achieved in undisturbed natural granular soils and 2% for natural clay soils for pavement design purposes, unless proven otherwise by in-situ testing at formation level by a specialist geotechnical engineer. Equilibrium CBR values are likely to be 2% within the made ground.

Based on the fines content of the soils, they are considered to be frost susceptible, therefore highway construction should be a minimum thickness of 450mm to mitigate against the risk.

Drainage (SuDS)
Based on the 2025 SP Associates ground investigation, the use of traditional soakaways within the natural ground is not considered to be feasible at the site due to the low infiltration rates obtained (on the order of 10^{-9} m/s) and the presence of low permeability cohesive strata underlying the site. Therefore, an alternative drainage method will be required.

Slopes & Retaining Structures
A 4m high slope exists beyond the proposed development area to the southwest of the site. The slope displayed no obvious signs of slope instability in its current state. If the slope is to be altered during earthworks or construction, it will require further assessment for stability purposes.

Earthworks
Design of the earthworks, particularly in the southwestern part of the site near Redwither Brook, should consider the stability of any cut or fill slopes.

An initial assessment reveals spoil resulting from excavations within the made ground and superficial deposits should generally be suitable for re-use as general fill subject to further testing and specification or may be disposed off site.

10.3 Further Work

The following further work is considered necessary to progress the site to construction phase:

- Submission of this report for support of discharge of Condition 9 of planning permission reference P/2025/0430.
- Tree survey by qualified arboriculturist.
- Detailed foundation design by a structural engineer.
- Production of Remedial Strategy, including the production of short specification for radon protection within a Ground Gas Protection Measures Verification Plan. This relates to Conditions 9 and 12 of planning permission P/2025/0430.
- Production of Design Statement and Materials Management Plan (MMP) under the CL:AIRE DoWCoP, if required.
- Production of a Verification Report following remediation to fully address Conditions 10-12 of P/2025/0430.

11.0 ABBREVIATIONS AND DEFINITIONS

GLOSSARY	
Term / Abbreviation	**Definition**
AST	Above Ground Storage Tank.
B(a)P	Benzo (a) Pyrene.
BGS	British Geological Survey.
BRE	Building Research Establishment.
BS	British Standard.
BSL	Brownfield Solutions Ltd.
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes.
CBR	California Bearing Ratio (used in pavement/highways design).
CAR 2012	Control of Asbestos Regulations (2012).
CBCB	Cheshire Brine Compensation Board.
CBCD	Cheshire Brine Compensation District.
CBR	California Bearing Ratio.
CIEH	Chartered Institute of Environmental Health.
CIRIA	Construction Industry Research Association.
CL:AIRE	Contaminated Land: Applications in Real Environments.
CLEA	Contaminated Land Exposure Assessment.
CLO	Contaminated Land Officer.
COMAH	Control of Major Accident Hazards.
Contamination	Presence of a substance which is in, on or under land, and which has the potential to cause significant harm or to cause significant pollution of controlled water. There is no assumption in this definition that harm results from the presence of the contamination. Naturally enhanced concentrations of harmful substances can fall within this definition of contamination. Contamination may relate to soils, surface water, groundwater or ground gas.
Controlled Waters	Inland freshwater (any lake, pond or watercourse above the freshwater limit), water contained in underground strata and any coastal water between the limit of highest tide or the freshwater line to the three-mile limit of territorial waters.
CPT	Cone Penetration Test.
CSM	Conceptual Site Model. A schematic hypothesis of the nature and sources of contamination, potential migration pathways (including description of the ground and groundwater) and potential receptors, developed on the basis of the information from the preliminary investigation and refined during subsequent phases of investigation and which is an essential part of the risk assessment process. The conceptual site model is initially derived from the information obtained by the preliminary investigation (i.e. the Phase I Geo-Environmental Assessment). This conceptual model is used to focus subsequent investigations, where these are considered to be necessary, in order to meet the objectives of the investigations and the risk assessment. The results of intrusive investigations can provide additional data that can be used to further refine the conceptual site model.
DCP	Dynamic Cone Penetrometer.
DNAPL	Dense Non-Aqueous Phase Liquid.
DoWCoP	Definition of Waste Code of Practice.
DWS	Drinking Water Standard.
EA	Environment Agency.
EHO	Environmental Health Officer.
EQS	Environmental Quality Standard.

GLOSSARY	
Term / Abbreviation	**Definition**
GAC	Generic Assessment Criteria.
GDR	Geotechnical Design Report.
GFR	Geotechnical Feedback Report.
GIR	Ground Investigation Report.
GSV	Gas Screening Value.
Harm	Adverse effect on the health of living organisms, or other interference with ecological systems of which they form part, and, in the case of human health, including property/structures and water supply pipelines.
Hazard	Inherently dangerous quality of a substance, procedure or event.
HDPE	High Density Polyethylene.
HSV	Hand Shear Vane.
K	Modulus of Subgrade Reaction.
LCRM	Land Contamination: Risk Management (EA guidance).
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel, kerosene).
LOD	Limit of Detection (for particular method adopted).
MMP	Materials Management Plan.
Mv	Modulus of Volume of Compressibility.
ND	Not Detected.
NHBC	National House Building Council.
NR	Not Recorded.
OS	Ordnance Survey.
PAH	Polycyclic Aromatic Hydrocarbon.
Pathway	Mechanism or route by which a contaminant comes into contact with, or otherwise affects, a receptor.
PCB	Poly-Chlorinated Biphenyl.
PCSM	Preliminary Conceptual Site Model.
pH	Scale used to specify how acidic or basic a water-based solution is.
PHC	Petroleum Hydrocarbons.
PID	Photo Ionisation Detector.
PNEC	Predicted No-Effect Concentration.
Precision	Level of agreement within a series of measurements of a parameter.
PSD	Particle Size Distribution.
PVC	Polyvinyl Chloride.
Receptor	Human health, living organisms, ecological systems, controlled waters (surface waters and groundwater within aquifers), atmosphere, structures and utilities that could potentially be adversely affected by contaminant(s).
Risk	Probability of the occurrence, magnitude and consequences of an unwanted adverse effect on a receptor.
Risk Assessment	Process of establishing, to the extent possible, the existence, nature and significance of risk.
Sampling	Methods and techniques used to obtain a representative sample of the material under investigation.
SOM	Soil Organic Matter.
Source	Location from which contamination is, or was, derived. This could possibly be the location of the highest soil, groundwater or gas concentration of the contaminant(s).
SPT	Standard Penetration Test.
SVOCs	Semi Volatile Organic Compounds.
TOC	Total Organic Carbon.

GLOSSARY	
Term / Abbreviation	**Definition**
TPH CWG	Total Petroleum Hydrocarbon (Criteria Working Group).
TVOCs	Total volatile organic compounds.
UCS	Unconfined Compressive Strength.
Uncertainty	Parameter, associated with the result of a measurement that characterises the dispersion of the values that could reasonably be attributed to the measurement.
UST	Underground Storage Tank.
UXO	Unexploded Ordnance.
VCCs	Vibro Concrete Columns.
VSCs	Vibro Stone Columns
VOCs	Volatile Organic Compounds.
WAC	Waste Assessment Criteria.
WFD (in waste context)	Waste Framework Directive.
WFD (in water context)	Water Framework Directive.
Units	**Definition**
°	Degrees
Φ	Phi angle (in degrees)
g/l	Grams per Litre
Km	Kilometres
kPa	Kilo Pascal (Equivalent to kN/m^2)
$KN/m^2/mm$	Kilo Newton per metered squared per millimeter
kN/m^2	Kilo Newtons per metre squared
kPa	Kilo Pascal (Equivalent to kN/m^2)
l/hr	Litres per hour
MJ/kg	Mega joule per kilogram
MN	Mega Newton
M^2/MN	Mega Newton per metre squared
M	Metres
m bgl	Metres Below Ground Level
m OD	Metres Ordnance Datum (sea level)
µg/l	Micrograms per Litre (parts per billion)
µm	Micrometre
mb	Millibars (atmospheric pressure)
mg/kg	Milligrams per kilogram (parts per million)
mg/m^3	Milligram per metre cubed
mm	Millimetre
ppb	Parts Per Billion
Ppm	Parts Per Million

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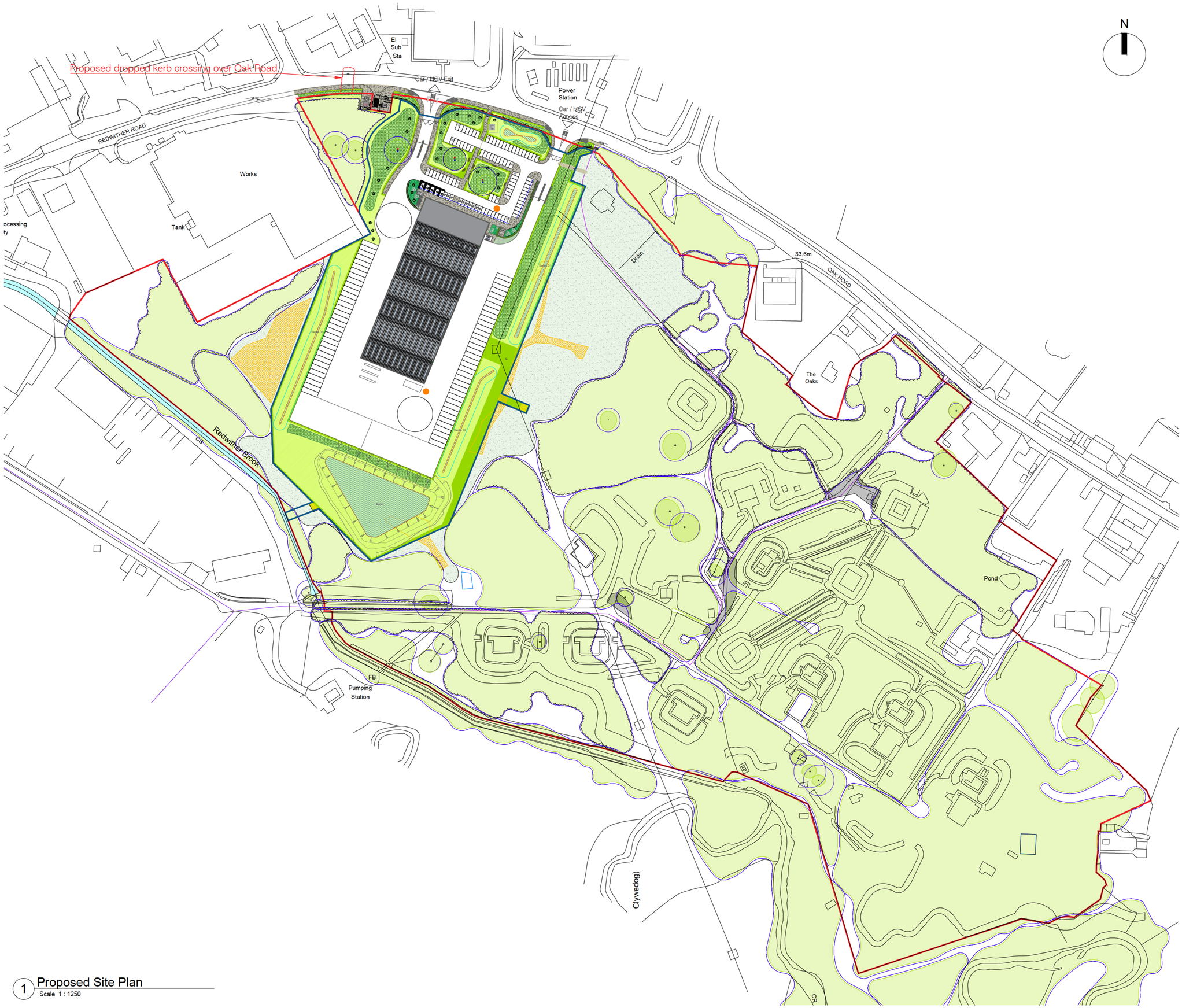
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DRAWINGS



	Description	By	Date
T1	Stage 4 Initial issue	LM	30.09.25
T2	Parking spaces added	LM	19.11.25
T3	Tenant boundary adjusted	LM	02.12.25
T4	Tenant boundary adjusted	LM	10.12.25
T5	Tender Issue	LM	12.12.25
T6	Building set out	LM	10.02.26
T7	Bin store relocated	LM	30.03.26
T8	Annotation update	LM	01.04.26
T9	Oak Road crossing	LM	17.04.26

1 Proposed Site Plan
Scale 1 : 1250

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Client
F.I Real Estate Management

Project
The Oaks
Wrexham

Description
Proposed Site Plan

Status
Stage 4 Technical Design

Drawn By
LM

Job Number
1256-MCAU

Scale
1:1250@A1

Date
Sep 25

Drawing Number
T.02-00-001

Revision
T9

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