



- Contractors must check all dimensions on site. Only figured dimensions are to be worked from. Discrepancies must be reported to the Architect or Engineer before proceeding.
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CONTROL TABLE: LINKED TO NATIONAL GPS NETWORK SF=1.000			
Name	Easting	Northing	Height
STN1	470590.376	167042.225	46.721
STN2	470518.118	167042.225	46.371
STN3	470602.415	167173.873	46.807
STN4	470447.700	167248.372	46.870
STN5	470606.804	167346.945	47.856
STN6	470620.173	167346.945	47.856
STN7	470600.436	167417.887	47.756
STN8	470605.585	167460.597	47.815
STN9	470913.666	167491.703	47.636
STN10	470620.269	167546.964	47.856
STN11	470944.205	167540.909	47.864
STN12	470606.721	167547.491	47.903
STN13	470605.788	167371.244	46.871
STN14	470626.177	167434.828	47.856
STN15	470611.495	167546.236	47.863

DETAILS

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PLEASE CONSIDER THE ENVIRONMENT BEFORE PRINTING THIS DRAWING

APPENDIX III

GROUND INVESTIGATION INFORMATION

Phase II & Geotechnical Ground Investigation Report

**for
Proposed Commercial Development**

**at
Observer Park, Arborfield
Reading**

On behalf of:

**Angle Property (Arborfield) LLP
c/o Carbide Properties Ltd**
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Please note that all the above contents are actively linked to the appropriate section within this report.

1 INTRODUCTION

This Ground Investigation Report (GIR) was instructed by the Client, Carbide Properties Ltd, by email, dated 13/03/2024, on behalf of Angle Property (Arborfield) LLP, and has been prepared by PRP, Consulting Engineers. The subject of this report is the land to the south of Bridge Farm, situated between the A327 and Greensward Lane, to the west of Arborfield, and throughout this report this area will be referred to as the “Site”, differentiating it from other sites.

1.1. Proposed Development

The proposed development comprises the construction of a number of commercial units, along with associated enabling groundworks, access point, hardstanding areas, and utility infrastructure. At the time of writing this report, the proposed development is as outlined on the HTC Architect’s drawing *Proposed Site Plan*, reference 3389 F401 A, dated 14/02/2024, which is presented in [Appendix A](#).

The general layout may be subject to minor changes throughout the planning, design and development process. As ground investigations are considered pre-works and this report assesses the potential ground conditions at the Site, any minor changes to the development layout for the same end-use will not alter the findings of this report and will therefore not require any amendment to and reissue thereof unless a fundamental change of end-use category is enacted.

With respect to the proposed development, the Site should be assessed in the context of the ‘commercial’ end-use risk assessment criteria outlined by the LQM CIEH S4UL (suitable for use limits) and Defra C4SL (category 4 screening levels).

1.2. Summary and Clarification of Brief

The scope for the on-site intrusive investigation was outlined by emailed letter, reference KLH/E14164-02, dated 29/02/2024. Please refer to [Section 3.1](#) for any restrictions particular to this Site; general reporting limitations are outlined below in [Section 1.4](#).

In accordance with the Client’s specific objectives and requirements, the purpose of the ground investigation is to:

- assess the physical characteristics of the underlying strata to inform tender submissions and earthworks design, foundations and floor slabs design, and to advise on potential exceptional or geotechnically difficult ground conditions that may have an influence on the development as far as is reasonably possible.
- assess and confirm the chemical condition of the underlying strata, as highlighted by the pQRA referenced below in [Section 2.1](#) and in line with current guidance and legislation, as indicated in [Section 1.3](#), pertaining to the potential for exposure to contamination and consequential impact on human health and the wider environment, both during the development stages and on completion of the works.
- provide a Stage I, Tier 2 generic quantitative risk assessment (GQRA) for contaminated land and briefly outline any further targeted investigation requirement, should it be deemed necessary.

- include, where appropriate and able, a Stage 1, Tier 3 (detailed) site-specific assessment criterion (SSAC) where a generic assessment criterion has been exceeded, thus superseding the GQRA for that or those particular substances in accordance with the current guidance.
- provide a summary of requirements to be considered in the design of any mitigation or remedial measures, where necessary and appropriate to the proposed development scheme.

1.3. Terms of Reference

This GIR includes a Phase II quantitative assessment for land contamination and constitutes a Stage 1, Tier 2 risk assessment, as defined by UK LCRM guidance 2022, and is in general accordance with PRP's terms listed in [Appendix G](#) with reference to the guidance listed in [Appendix H](#).

Where appropriate it also takes account of the requirements of the National Planning Policy Framework (NPPF) and has been written to ensure that the Client complies with their obligations under the current UK contaminated land legislative regime.

However, acceptance of this report must be gained from the Local Planning Authority before any commencement of works on the Site as defined by the planning conditions issued by the Regulatory Planning Authority.

1.4. General Limitations of Reporting

PRP do not undertake surveys of flora or fauna. Any such surveys should be undertaken by specifically qualified professionals, these include, but are not restricted to, ecology, invasive plant species, and arboriculture.

PRP do not consider or assess the archaeological potential of soils beneath the Site.

PRP are not UXO specialists and do not undertake any research or investigations pertaining to the presence of explosives or any other military associated hardware.

This report should also be read in conjunction with the information, advice and reports obtained from the sources listed in [Section 2](#). Aspects of this report may include an assessment of data previously reported on, as referenced in [Section 2.1](#). Responsibility for permission to rely on such data is with the Client. PRP are not responsible for the validity of third-party data, and assume all to be an accurate reflection of the Site conditions.

An assessment of flood potential or drainage capacity at the Site is beyond the scope of this report. For a full assessment of site-specific potential for flooding and drainage, a flood risk and drainage strategy report should be undertaken, which may be informed by, and include data that was recovered during the ground investigation presented within this and other ground investigation reports. PRP do offer this service if required.

A structural survey of any existing buildings or structures that may be, or have previously been, present at the Site, or an assessment of asbestos containing materials (ACM) is beyond the scope of this report and, if appropriate to the Site, should be considered separately and undertaken by appropriate personnel. PRP do offer these services if required.

2 SUMMARY OF INFORMATION

2.1. Previous Reports

Although it was clear from the Site reconnaissance survey that an intrusive investigation has been undertaken since the area was used as a construction compound, no resultant report was forwarded to PRP for assessment to aid the design of the ground investigation.

To date, the following reports relating to the in-ground environment at the Site and immediately surrounding area have been produced by or submitted to PRP for assessment:

- *Phase I (pQRA) Desk Study Report*, reference 64065-01, dated 08/04/2024, produced by PRP.

2.2. Review of Phase I Report

2.2.1. Preliminary Contamination Assessment

The Site is undeveloped former woodland; later cleared for arable use. With the construction of the adjacent (west) A327 Observer Way, the Site was used as the construction compound thus indicating potential for Made Ground near to surface. The historical maps indicate cleared land (non-wooded) nearby was known to be marshy ground, which is borne out by the coverage of marshland grasses now prolific across the Site.

A substantial amount of material has been tipped within the Site along the northern boundary. Whilst this is likely the arisings of the Topsoil scrape for the A327 development, there is clearly other material mixed within, including demolition debris. This may be inert waste, however, there do not appear to be any recorded licenses for this material albeit that the works contractor and local authority should have the appropriate documentation; without access to this or previous ground investigation information, inert and uncontaminated arisings cannot be assumed. With the RTD being classified as minor (secondary A) aquifer and the Site being within a Zone 2 GSPZ, potential vulnerability to this source must be considered.

Other than that outlined above, there is little apparent on the Site that would be considered a source of contamination, either current or historical, that might present a significant risk of significant harm to the receptors.

Ground gas impact is unlikely due to a lack of source, with the underlying strata not predisposed to producing an adequately impacting quantity that would be detrimental to human health, therefore ground gas is not considered to present any significant risk of significant harm to the Site receptors and ground gas monitoring is not considered necessary.

As part of the preparatory works, Topsoil will be removed from the development areas exposing the bare earth, which may cause fugitive dust, particularly during dry periods, which although unlikely to be chemically toxic, can still impact the human respiratory system as well as being a nuisance to the adjacent road users and local businesses and residents.

Beyond the Site, there are no historical activities or land uses that raise concern for in-ground contamination. Whilst the impact from vehicles using the adjacent A327 may impact the Site through accidents, the risk of such an event is considered very low.

Based on our assessment of the available data and inspection of the local area, there is little presence of any visible above-ground or viable in-ground contamination sources that would impact the Site or present significant risk of significant harm to environmental, building and human receptors.

2.2.2. Preliminary Geotechnical Assessment

With consideration of the underlying natural geology, desk research indicates the need for ground improvement would be unlikely, however, confirmation of this would result from a ground investigation.

Made Ground beyond 1m bgl is not anticipated at the Site; it is assumed that the tipped materials in the north of the Site will be removed prior to development. Assessment of Made Ground would form part of a Phase II ground investigation.

According to the desktop data reviewed, the Site has not been developed, and therefore, no associated in-ground structures (foundations) are anticipated.

According to the BGS data, the underlying stratum across the Site is London Clay, however, in the northwest corner, this is likely to be overlain with River Terrace Deposits.

The use of superficial soakaway pits will likely not be viable at this Site due to the previous indications of marshland and underlying impermeable stratum. The historical removal of Pound Copse from across the Site has undoubtedly resulted in a diminished natural dewatering afforded by the presence of trees, therefore the Site was always likely to transition to marshy ground. This is evident from the number of semi-permanent water-logged areas; the proliferation of marsh grasses indicates this to be a regular occurrence. The underlying London Clay is all but impermeable thus any surface water has nowhere to dissipate apart from by evaporation or very slow infiltration by fracture flow. The presence of drains and balancing ponds in the wider area supports this hypothesis.

The underlying stratum, London Clay, may present moderate to high sulphate concentrations; SO_4 causes ionic exchange within the cement mix, leading to the production of ettringite, gypsum or, less commonly, thaumasite. This can cause expansion and softening of the concrete leading to structural failure. Therefore, appropriate testing for sulphates and pH must be undertaken and assessed in accordance with BRE SD1. Should high sulphates or acidic conditions be established at the Site, this is simply rectified with an appropriately specified concrete mix in accordance with BRE SD1 and BS 8500 Parts 1 & 2.

The combination of deciduous trees on the east and north boundaries, and underlying fine (clayey) soils requires consideration for risk of volume change with variation in moisture content, which can result in lifting and movement of in-ground elements if not appropriately designed for where proposed structures are within zones of root influence. Assessment for this would form part of a geotechnical ground investigation.

Where trees are to be maintained, a root protection zone must be observed, which must be cordoned to ensure it remains a no-dig area and free of plant to ensure retention of healthy root systems.

2.3. Recommendations

Following a review of the available desk study information a preliminary ground investigation involving a number of dynamic sampler holes is recommended to depths of around 5mbegl (if achievable); the London Clay usually increases in strength quite quickly with depth.

With no meaningful depth of Made Ground anticipated and the River Terrace Deposits indicated in the northwest corner only, the weathered fraction of the underlying London Clay is easily sampled by this modality of investigation, offering little resistance, therefore, this is seen to be the most cost effective method of data collection at this stage. This method allows for the retrieval of samples for both geotechnical and contamination testing if appropriately recovered, gives an indication of the soil strength through *in situ* testing, and allows for the installation of monitoring wells, if required.

It will allow for better understanding of likely foundation requirements and whether further (deeper and more expensive) investigation is required with larger plant. However, should the previous ground investigation GIR be available, a greater understanding of the Site will be enabled and a better targeted investigation may be designed.

2.4. Planning Conditions

No planning permission conditions have been indicated to PRP and it is therefore assumed that this has not yet been sought.

The standard requirements that all LPAs must consider for contaminated land assessment are always pre-commencement, meaning that the finalised GIR and RS (if required) must be signed off by the LPA before any groundworks or founding can commence on Site. It is best practice within the industry that tender packs should include these signed off reports otherwise (a) there is a risk that additional investigation is required before the LPA will sign off, and (b) contractors will not have an appreciation of the ground conditions for which they are expected to tender.

Following completion of any remedial works, validation of the measures undertaken and the production of a verification report must be submitted to the LPA. Depending on the form of remediation undertaken, validation of the measures is often undertaken following construction completion, but must always be signed-off prior to hand-over/occupation. The verification report should also detail imported materials and waste certificates for any materials removed from Site.

In the event that further investigative works or monitoring are deemed necessary to ensure the safe progression of the proposed development and its end-users, additional investigation or monitoring must be undertaken unhindered and will always be pre-commencement unless special dispensation is agreed upon in writing with the LPA.

All submission of reports to the LPA for scheme approval and condition discharge is the responsibility of the planning consultant.

3 FIELDWORK

3.1. Site Features & Constraints

The Site is roughly triangular shaped, covering an area of around 2.8ha, and appears to be topographically reasonable level. Boundaries to the north and east are defined by tree plantation, known as “Pound Copse”, comprising a variety of predominately broad-leaf deciduous of varying maturity. A public footpath traverses the Site along the eastern and southern boundaries.

Along the northern boundary, within the Site, tipped material likely originating from the Topsoil scrape for the A327 construction mixed with other demolition debris; the exact contents of this cannot be ascertained during this investigation due to being overgrown and unsafe to traverse. A little way into the Site is a mound of waste comprising a number of pallets, wood, tree cuttings, and plastic.

Although the Site appears to be greenfield, brick fragments are evident in the Topsoil across much of the north of the Site. At the time of the investigation, the ground was waterlogged with much of the Site unable to be walked across, however, it is clear from the coverage of marshland grasses and reeds that this is a common, if not permanent situation.

3.2. Scope of Works

The purpose of a Phase II investigation is to assess the potential for in-ground contamination or naturally derived toxic substances within the accessible near-surface soils at concentrations that may have the potential to cause significant risk of significant harm to human receptors within the remit of the end-use classification, the proposed design and those undertaking the site works, as well as considering the wider environmental and proposed in-ground structural receptors. In addition, the geotechnical properties of the underlying strata have been assessed with reference to foundation and floor slab design or other geotechnical design elements, such as earthworks, ground improvements, or retaining structures.

The intrusive fieldwork element was undertaken over three days; Monday to Wednesday, 25th to 27th March 2024, with locations set out by PRP being considered carefully and in line with the constraints outlined so far in this report and the historical findings. Where there was no observed source of contamination or geotechnical influence, locations were chosen with reference to the proposed scheme and the risks outlined by the Phase I report, as referenced in [Section 2.1](#).

A site-specific utility plan for the Site was not provided by the Client, however, prior to borehole advancement, the immediate area was CAT scanned to check for unexpected or unmapped utilities carrying an electrical signal.

During borehole advancement, SPTs (soil penetration tests) were to be undertaken at metre intervals to assess the strength and compaction qualities of the underlying soils with depth. Where a location cannot be advanced to full depth due to any other situation than refusal, dynamic probing is to be undertaken to full depth.

Due to the high saturation of the underlying soils, no *in situ* falling head tests were carried out for percolation assessment. No monitoring wells were installed due to the collapsed ground; although no ground gas is anticipated, the monitoring of groundwater would have been useful.

Small, disturbed samples were recovered from the near-surface materials and placed in amber glass jars or plastic tubs, as necessary, and taken to a laboratory for contamination testing. A sampling methodology in line with the current guidance and based on a random stratified non-targeted approach was used as no visual evidence of contamination was present. Further rationale of the specific testing undertaken is given in [Section 6](#).

Stratigraphic logging of the tubes recovered during dynamic sampling was undertaken in accordance with BS5930:2015. Samples for geotechnical testing were recovered from the various stratigraphic types directly from the continuous tubes once logging was completed.

3.3. Rationale for Locations

In addition to a wider assessment for potential contamination, the locations were positioned as follows as true to the proposed development layout as possible with consideration given for accessibility due to ground softness and saturation:

Location	Relationship to Proposed	Rationale
WS01	Access route	Assess depth of Made Ground. Assess geoenvironmental. Assess for subbase.
WS02	Footprint of Unit 1.	Assess depth of Made Ground. Assess geoenvironmental. Assessment for foundation design.
WS03	Footprint of Unit 4.	Assess geoenvironmental. Assessment for foundation design.
WS04	Yard slab/parking.	Assess depth of Made Ground. Assess geoenvironmental. Assess for subbase.
WS05	Undeveloped area.	Assess geoenvironmental.
WS06	Footprint of Unit 7.	Assess geoenvironmental. Assessment for foundation design.
WS07	Footprint of Unit 6.	Assess geoenvironmental. Assessment for foundation design.
WS08	Yard slab/parking.	Assess depth of Made Ground. Assess geoenvironmental. Assess for subbase.
WS09	Footprint of Unit 3.	Assess depth of Made Ground. Assess geoenvironmental. Assessment for foundation design.
WS10	Yard slab/parking.	Assess depth of Made Ground. Assess for subbase.
WS11	Footprint of Unit 2.	Assess depth of Made Ground. Assess geoenvironmental. Assessment for foundation design.

4 GROUND CONDITIONS IDENTIFIED

According to the BGS online database, the underlying natural strata across the area investigated is recorded as the London Clay Formation apart from the northeast corner, where this is recorded as being overlain with River Terrace Deposits.

4.1. Summary of Geology

The geology encountered during the ground investigation is fully detailed in the stratigraphic logs presented in [Appendix B](#). Below is a synopsis of those findings.

Strata	Description	Top Depth (mbegl)	Base Depth (mbegl)	Thickness (m)
Surface Topsoil (Made Ground)	<u>All bar WS01</u> Grass over saturated, soft, organic-rich, placed Topsoil: generally comprising a soft, dark brown, peaty clay with occasional to slightly flint-dominated gravel with fine brick fragments. Strong eutrophic odour. Sometimes with straw mixed at base.	GL	0.20 – 0.90	0.20 – 0.90
Surface Backfill (Made Ground)	<u>WS01 only</u> Grass over firm, grey-brown clay containing fragments of concrete and brick, with gravel of flint and sandstone	GL	0.20	0.20
Made Ground	<u>WS01, WS03</u> Large concrete and brick fragments in clay matrix.	0.20	0.30	0.10
	<u>WS02 only</u> Firm, grey-brown or clay containing fragments of concrete and brick, with gravel of flint and sandstone	0.45	0.70	0.25
River Terrace Deposits	<u>All bar WS08, WS09, WS10, WS11</u> Soft to firm, olive and brown, becoming lighter with depth, slightly gravelly, sandy, silty, CLAY.	0.30 – 1.50	0.60 – 2.00	0.15 – 1.40
	<u>WS08</u> Soft, saturated (running), yellowish brown SILT.	0.40	0.80	0.40
	Loose to dense, saturated and locally running, orangish brown, slightly clayey, slightly silty variably gravelly, medium grained SAND. Gravel of flint and sandstone.	0.40 – 2.00	0.90 – 3.00+ *Beyond depth of boreholes	0.20 – 2.20+ *Beyond depth of boreholes
London Clay Formation	<u>WS01, WS03, WS07</u> Very soft, dark grey, silty CLAY. Dynamic probing indicated increase in strength with depth.	2.60 – 2.80	3.00+ Beyond depth of boreholes	0.20+ – 0.40+ Beyond depth of boreholes
Groundwater	The surface soils were saturated. Water strikes were recorded within the RTD at between 0.9m and 2.2mbegl with all strikes indicating slight rising to between 0.35m and 1.9mbegl by the end of sampling. On casing removal, water rose further to between 0.18m and 1.5mbegl, which may be due to lateral inundation.			

All locations terminated prior to instructed depth due to wall collapse from water inundation, therefore follow-on dynamic probing was undertaken as indicated on the table below.

Location	WS01	WS02	WS03	WS04	WS05	WS06	WS07	WS08	WS09	WS10	WS11
Instructed Depth	4m	5m	4m	6m	5m	6m	5m	4m	5m	4m	5m
Achieved Depth	2.4m	1.9m	2.6m	1.60m	1.4m	1.9m	2.5m	1.6m	1.7m	1.6m	1.7m
DP Depth	6m	6m	6m	6m	5m	6m	5m	6m	5m	5m	6m

The natural geological succession revealed was generally in accordance with the published geological data, however, the superficial River Terrace Deposits clearly extends across the entire Site rather than being confined to the northwest corner.

The presence of the coarser River Terrace Deposits across the Site, in conjunction with the level of ground saturation prevented deeper penetration of the dynamic sampler holes and recovery of the samples from greater depths.

5 GEOTECHNICAL ASSESSMENT & ASSOCIATED RISKS

A programme of testing was instructed to determine the geotechnical properties of the near-surface soils following assessment of the stratigraphic logs.

Laboratory based geotechnical testing was undertaken by Soil Property Testing (SPT) of Huntingdon in accordance with the requirements of BS1377:1990. SPT follow a Quality Audit system which has been designed to ensure continual compliance to BSEN ISO/IEC 17025:2005. The laboratory is regularly audited by UKAS and holds accreditation for specific tests identified; full details of their UKAS schedule may be found on their website.

In addition to the *in situ* standard penetration tests (SPT) undertaken, the following laboratory-based geotechnical tests were scheduled:

Quantity:	Test:
6	Moisture Content
3	Atterberg (plasticity)
4	Particle Size Distribution (PSD)
3	Particle Size Distribution (PSD) with fines separation by hydrometer
16	Sulphate/pH (include 4 BRE Suite B: greenfield with pyrite)

The resultant data is presented in [Appendix C](#).

An assessment of the geotechnical risks associated with the Site and proposed development, as seen during the initial site reconnaissance survey and the intrusive ground investigation, has been considered in general accordance with the guidance outlined in the DMRB CD 622 (2020) document 'Managing Geotechnical Risk' (formerly HD22/08, BD10/97, HA120/08).

This assessment considers the degree of risk attached to various ground related elements of the proposed development posed by common ground related problems, and identifies suitable measures to control the risk to an acceptable level should it be deemed appropriate; If present, these are discussed as part of the geotechnical design recommendations outlined below.

5.1. Stratigraphic Interpretation and Geotechnical Assessment

Made Ground was recorded to depths of between 0.2m and 0.9mbegl and, in the form of placed Topsoil, generally comprised an organic-rich medium with a strong eutrophic (anoxic) odour, which was often mixed with straw presumable to form a stabilising matrix within this very soft material. At the base of this material, a thin layer of "hard core" was encountered in WS01 and WS03 (western boundary) giving evidence of previous use as a construction compound. In WS01 and WS02, a clayey backfill was present, which contained concrete and brick fragments.

It should be noted that the placed Topsoil cannot be used in any engineered capacity due to its inherent low strength and high organic content. It can however be reused in areas of soft landscaping with a low angle of slope unless seeded meshing is incorporated.

Contrary to BGS records, the natural River Terrace Deposits (RTD) was encountered across the entire Site as a cyclic variably gravelly, variably sandy CLAY, generally defined by its yellowish and greenish colouring, interbedded with clayey, variably gravelly SAND. However, locally this included elements of running sand or silt. Figure 1 below, shows a wide range in strength within the natural RTD, through comparison with the logs ([Appendix B](#)) it can be seen that the lower strength relates to the finer clay-dominated deposits having much lower strength and the higher strengths to the sands and gravels.

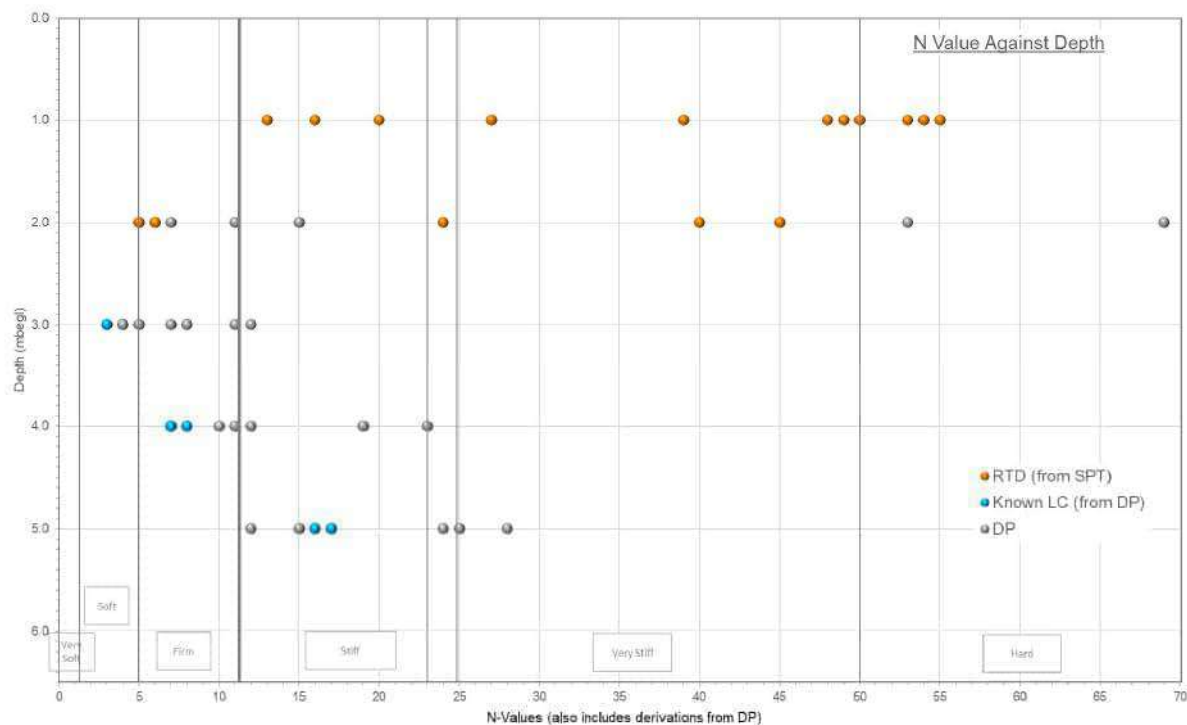


Figure 1: N Value against Depth

Also shown in Figure 1 is the low strength of the underlying London Clay (LC). As previously noted, the ground surface was water-logged across much of the Site, which appears to be a common, if not permanent, situation. This saturation has a softening impact on the surface of the clay, which itself acts as an aquiclude (capable of absorbing water slowly but cannot transport it, therefore acts as a confining bed relative to the RTD overburden). This hypothesis is supported by the increase in strength within the LC with depth. Therefore, it would be recommended that some form of ground improvement that is compatible with the level of groundwater/surface water should be considered.

As noted earlier, the saturation of the soils caused collapse within the dynamic sampling holes, therefore dynamic probing (DP) was used to ascertain the interface between RTD and LD and to assess the soil strength at depth. Figure 1 shows a comparable strength drawn from the DP data at equivalent depths to where SPTs would have been undertaken; interpretation of this indicates that most of the DP data was drawn from the LC. The table below is an extract from the DP data from each location where LC was not encountered through dynamic sampling (shaded blue were encountered by dynamic sampling). This shows a likely RTD/LC interface in the majority of locations (represented by the blue line); full DP data is presented with the logs in [Appendix B](#).

From this data, it can be concluded that LC was encountered from between 2.2m and 3.1mbegl; data recovered from WS02, WS04, and WS06 is inclusive as the collapsed material would be very loose, therefore, a clear distinction between that and LC is not apparent. However, it can be assumed that the interface between the two strata would likely fall within the range indicated above. Location WS05 is the further position southward and therefore it would be reasonable to interpret this as likely having the shallowest RTD overburden.

Depth (mbegl)	Blow count per 100mm										
	WS01	WS02	WS03	WS04	WS05	WS06	WS07	WS08	WS09	WS10	WS11
2.0 – 2.1				3	8			15	18	13	8
2.1 – 2.2				3	8			17	14	11	16
2.2 – 2.3				2	4			18	8	6	21
2.3 – 2.4				2	2			18	4	3	24
2.4 – 2.5				2	1			17	1	2	23
2.5 – 2.6				5	1			12	2	1	23
2.6 – 2.7				5	1			7	1	1	24
2.7 – 2.8				3	1			4	2	1	24
2.8 – 2.9				2	2			2	2	2	20
2.9 – 3.0				3	3			2	2	1	14
3.0 – 3.1		2		3	2	1		2	3	2	8
3.1 – 3.2		1		3	3	1		2	2	2	3
3.2 – 3.3		2		3	4	1		2	3	2	2
3.3 – 3.4		1		3	4	2		3	4	3	1
3.4 – 3.5		2		2	4	1		9	4	3	1
3.5 – 3.6		1		3	4	1		4	4	3	2

According to the current guidance, shrinkable soils are those containing more than 35% fine particles and having a modified plasticity index of 10% or greater. Fine particles are defined as those having a nominal diameter less than 60µm (i.e., clay and silt particles).

The British Soil Plasticity Classification is drawn from the liquid limit, and gives an indication of the potential for moisture absorbency before the soil reaches saturation.

Atterberg limit (plasticity) tests are undertaken on samples with a reasonable clay content (i.e., >30%). The modified plasticity is in accordance with the current standards, which considers the percentage passing through the 425µm sieve (fine particles and any medium and fine grained sand particles with a nominal diameter of less than 425µm as outlined by BS1377). The results are shown in the table below, with all samples recovered from the London Clay.

Location	Depth	LL (%)	PL (%)	PI (%) LL-PL	MC (%)	Passing 425µm (%)	Modified PI (%)	Potential for Volume Change	British Soil Plasticity Classification
WS01	2.6 – 3.0	59	21	38	27.4	0	N/A	Medium	High
WS03	2.8 – 3.0	54	20	34	27.4	0	N/A	Medium	High
WS07	2.85 – 3.0	55	21	34	32.9	0	N/A	Medium	High

The results confirm that the samples tested have a plasticity index (PI) of between 34% and 38%, with no modification necessary (indicating a homogenous fine soil). The results show that the underlying London Clay is of high plasticity and, in accordance with the classification guidance, with medium potential for volume change with variations in moisture content, therefore, **for design purposes, medium volume change potential must be adopted.**

Location	Depth: (m)	LL (%)	PL (%)	PI (%)	MC (%)	MC<0.4LL	LI (MC-PL)/PI	LI<0
WS01	2.6 – 3.0	59	21	38	27.4	×	0.17	×
WS03	2.8 – 3.0	54	20	34	27.4	×	0.22	×
WS07	2.85 – 3.0	55	21	34	32.9	×	0.35	×

In terms of desiccation of the underlying fine soil as a result of tree influence, reference has been made to BRE 412, which indicates that the likelihood of desiccation can be ascertained by comparing the liquidity index to zero, and by considering the relationship between moisture content and liquid limit. However, an apparent desiccation profile can also present as a result of over-consolidated deposits or reworked soils yet to return to porewater equilibrium.

The above results clearly show the fine soils to be in a plastic state although the moisture content recorded is closest to the plastic limit but, as anticipated due to the high saturation level across the Site, with no indication of dewatering within the soil matrix, however, this may change once the Site has been drained in preparation for development.

A number of trees are present around the Site perimeter to the north (mostly hawthorn) and west, which range in size, maturity and species, but predominately broad leaf deciduous. There are elements of the development that may be within zones of root influence and must therefore be appropriately designed for to reflect the potential constraints in accordance with the current guidance. This will still apply even where trees have been removed, to allow for porewater pressure equilibrium within fine soils (which can take decades), particular where high water demand tree species are removed.

Where trees are to be maintained, a cordoned root protection zone must be observed to protect the tree and underlying root expanse to ensure it remains a no-dig area and free of weight, such as plant or construction materials, to ensure retention of the healthy root system.

The moisture content of the samples tested was recorded at between 21% and 23.7% near surface and between 21.4% and 32.9% in the London Clay. **Figure 2** below shows that moisture content is within a relatively narrow band, regardless of stratum or depth; this is reflective of the high saturation state of the soils encountered across the Site.

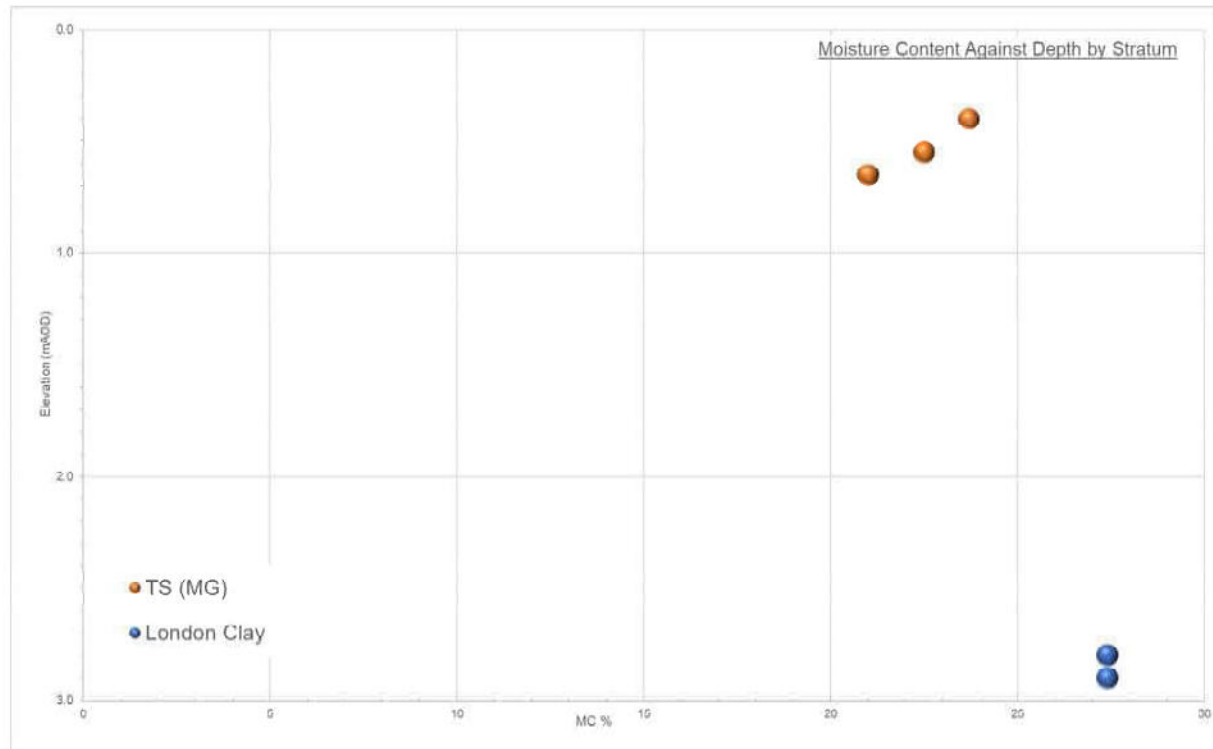


Figure 2: NMC against Depth by Stratum

Particle size distribution (PSD) tests were undertaken on samples recovered from coarser soils to assess the fine content. Soil with a 35% or greater fines content (i.e., silt and clay particles of less than 63µm diameter) is considered to have the engineering properties of fine soils. Of the samples tested, the results from the PSD tests show a well-graded SAND and GRAVEL with finer beds/inclusions of clayey SAND. However, the cyclic nature of the River Terrace Deposits must be appreciated, which includes local inclusions of clayey material as well as running sand and silt. That being said, no element of the RTD is fine to any substantial depth to be subject to volume change with variation in moisture content.

Stratum	No. of Tests	Clay	Silt	Fines	Sand	Gravel
RTD (clay)	1	17%	21%	38%	53%	9%
RTD (S&G)	6	3 - 5 Mean: 4%	2 - 4 Mean: 3%	5 - 25 Mean: 10.6%	34 – 51 Mean: 41.6%	34% - 61% Mean: 47.6%

For the natural (moist) sandy gravel, an angle of repose of no more than 25-30° should be assumed.

5.2. Matrix of Geotechnical Results

Stratum	MC (%)	Plasticity	NHBC Vol. Change Risk	PSD	Bulk Density (Mg/m ³)	Dry Density (Mg/m ³)	Concrete Design
MG (saturated)	21 – 23.7				12-15 (assumed)		DC-3z
RTD Clay (saturated)				38% fines	20 (assumed)	18.5±1.5 (assumed)	DC-1
RTD S&G (saturated)				10% fines (mean)	21.5 (assumed)	19.5±1.5 (assumed)	DC-1
LC (firm)	21.4 – 32.9	High	Medium	100% fines	18 (assumed)		DC-1*

Where noted as assumed, data has been taken from generic tables associated with the soil type. Asterisk denotes reference should be made to the notes within the relevant section below.

5.3. Ground Water/Infiltration

An important factor when considering the geotechnical parameters and competencies across a site is the groundwater regime, as it affects the behaviour of the underlying strata, and therefore, the in-ground design elements.

As indicated in the section above, the moisture content of the soil ranged between 21% and 23.7% for the near surface material and between 21.4% and 32.9% in the London Clay.

Falling heads were not undertaken during the ground investigation due to the surface saturation level. In addition, further water strikes were recorded in all dynamic sampler holes, as indicated in [Section 4.1](#) with water levels at near surface by the end of sampling in many cases.

As indicated above and within the Desk Study Report, the flora across the Site suggests the area is regularly, if not permanently, holding areas of surface water/marshy ground. This would therefore deny the use of soakaways. However, as previously reported upon, a drainage gully is present to the northwest of the Site, to which surface water could drain. Additionally, swales are constructed in the wider area, which would mitigate against overwhelming the drainage ditch.

It is recommended that appropriate drainage feasibility and design be undertaken separately.

5.4. Ground Improvement/Earthworks

No geotechnical structures, such as retain walls or earth bunds, are proposed for the development, therefore, the only apparent earthworks would be the scrape-back for the construction areas. As the logs indicate, material unsuitable for any engineered use ranges in depth from 0.2m to 0.9mbegl, however, reuse in landscaped areas would be suitable due to the high organic content.

Additionally, the material tipped along the northern boundary should be removed. It would be beneficial if this were sorted and could be repurposed within the development rather than removing from Site. However, with the potential quantity of material to be scraped back plus any excavation for swales required to alleviate surface water drainage, removal from Site of some material may be unavoidable.

It is clear from the logs and low strength soils that some form of ground improvement will be required, however, the presence of water at the Site prohibits some modalities. It is likely that the most efficient form would be to install VSC (vibro stone columns) to depths of around 6mbegl around the structural footprints. Discussions with a specialist contractor would be recommended as soon as possible; we have contacted Vibro Menard for feasibility assessment their comments are as follows:

Reviewing the site investigation for this scheme, the ground seems to be quite dense in most of the areas with only very shallow made ground layer to be treated.

However, looking at WS01 and WS04 where they both have low NSPT values of 5 - 6, and the logs have stopped at 2-3 meters as they collapse from the water level, which leaves some uncertainty in the viability of the technique as such logs with low NSPT values, could lead to bulging failure of the stone columns.

We note that these values might have been low because of the high water level and not the stiffness of the layer itself, and to clarify the water has no effects on the viability of the VSC technique, we use different installation methods to cope with the high water table and install our columns as required, hence there isn't any issue with the water table being high and we still can achieve the required criteria as normal.

I would first ask you for the location plan of these logs and if WS01 & WS04 are within the footprints of the proposed structure.

In the case that they are, we would offer ground improvement by Vibro Stone Columns (VSC) subject to further site investigation by Cone Penetration Tests (1 day of CPTs) to be done within the footprints of the proposed structure to confirm the viability of the technique and clear out any doubt/uncertainty there may be. Alternatively, should VSCs not be suitable, we can offer ground improvement by Controlled Modulus Columns (CMCs).

5.5. Concrete Classification

Sulphates and acidity are assessed to ensure the correctly designed concrete mix for in-ground components of the proposed development. High sulphates can cause concrete to expand and degrade to a gelatinous consistency, thus negating structural integrity over time. Acidic conditions act to "dissolve" the cement mix main constituent. Although the Site is undeveloped, it is assumed brownfield due to the previous use as a construction compound and subsequent imported Topsoil material.

The results below show the summation of testing from both the geotechnical and geochemical laboratories:

Stratum	Results (nr.)	SO ₄ conc ⁿ range (mg/l)	Total SO ₄ (%)	pH range	Sulphate Class	ACEC	Concrete Design
Made Ground	5	20 - 100	0.03%	5.1 – 8.2	DS-1	AC-3z	DC-3z
RTD Clay	3	128 - 159	0.042%	6 – 6.8	DS-1	AC-1	DC-1
RTD Sand	4	29.3 - 100	0.015%	6.3 – 7.2	DS-1	AC-1	DC-1
London Clay	3	260 – 370		6.7 – 7.2	DS-1	AC-1	DC-1*

The table above shows that in-ground structures within the natural soils can use DC-1 for concrete design. The breakdown of individual locations can be viewed on the analysis presented in [Appendix D](#), the emboldened numbers in the table above denote the considered exceedances.

The acidic content with the Made Ground was encountered in two locations: WS04 and WS07 which lie on an west-east line across the Site, being the southern end of proposed unit 6. However, this elevation in acidity is undoubtedly associated with the organic content within the near-surface materials, which will be removed prior to development as part of the pre-construction earthworks.

Additionally, it should be noted that only the surface material from LC was tested, it is likely that sulphate content will increase with depth due to some beds within the LC known to contain selenite crystals.

The concrete class shown above should be adopted for the building foundations and other below-ground concrete elements and is based on a structural life span of up to 100 years, determined using a mobile groundwater model, however, the **London Clay at greater depths should be tested as it may increase the concrete requirement to DC-2.**

5.6. Foundations

Made Ground, disturbed ground and general fill material are unsuitable for founding within since they may consolidate excessively and differentially when subjected to a structural load. Made Ground was recorded to depths of between 0.2m and 0.9mbegl and comprised highly organic, soft Topsoil with straw and fine demolition debris material mixed within.

As discussed in [Section 5.1](#), the strength of the natural RTD at 1mbegl is generally of sufficient strength, however, the presence of near surface and surface water means a diminished bearing pressure. Additionally, the natural bedrock, LC, is located at depths of between 2.2m and 3.1mbegl, and due to the soil saturation, has been greatly softened to depths of around 4.5m to 5mbegl, which demonstrates firm to stiff material, however, deepening will be likely for units 5 and 6 (WS07) to around 6mbegl.

London Clay is known for the presence of selenite within some beds; this is a sulphur-based crystalline mineral. Sulphate can react with in-ground concrete elements; this can easily be mitigated by using an appropriate concrete mix, as outlined in the previous section. Although the limited testing ([Section 5.5](#)) indicates DC-1 concrete requirements, an increase in sulphate content should be anticipated with depth in the LC, which may require DC-2 concrete design.

As indicated in [Section 5.4](#), ground improvement is recommended, likely by VSC. Required bearing pressures for the portal frame structures will be in the region of 125kPa, with FoS, a minimum of 175kPa should be sought through ground strengthening.

On completion of the ground improvement works, pad foundations should be founded at 1mbegl.

Inflows are to be expected in all excavations and dewatering techniques will likely be required at all times of the year. Therefore, temporary formwork to excavations may also be required to prevent the collapse of excavation sides; this will be particularly relevant during periods of rainfall.

5.7. Ground Floor Slabs

As discussed in [Section 5.1](#), unsuitable soils were proven to depths of between 0.2m and 0.9mbegl, however, once striped back from the development areas, this will not impact floor slabs or yard slabs. Note the acidity (see [Section 5.5](#)) within this material, undoubtedly due to the high organic content. Ground floors should be constructed as ground bearing slabs in commercial units, therefore the Made Ground must be removed prior to proof rolling the sub-formation.

Laboratory test results indicate that the near-surface coarse (coarse RTD) fraction of the soil at 1mbegl can be considered medium-dense to very dense (N-values of 13 to 55), however, softer areas of clay-dominated material (WS01, WS02, WS06) may require excavation with additional granular material incorporated.

As indicated in [Section 5.3](#), ground improvement is likely in order to increase the soil strength beneath the footprint of the proposed structures. This will reduce any potential effects of differential settlement due to the variable strength within the current underlying soils.

Assuming this is the case, commercial ground floor slabs should be constructed as ground bearing and designed in accordance with TR34. It is recommended that plate bearing tests be undertaken on the proof-rolled formation, post-groundworks, to determine the value for the Modulus of Sub-grade Reaction, k. This can only be undertaken after the sub-formation has been exposed, and only once preparatory groundworks (reprofiling and ground improvement) have been completed.

However, following ground improvement, should any spots of superficial soft material be encountered, these must be removed prior to proof rolling the sub-formation, and all floor slabs should be constructed on properly installed 2000-gauge damp proof membrane; **Characteristic Situation 1** can be assumed due to lack of viable source for gas.

5.8. Access Road & Parking

The structural design of the access road and areas of hard-standing is based on the strength of the subgrade (natural ground) which is assessed on the California Bearing Ratio (CBR) scale.

With regards to the natural coarse (granular) sands and gravel of the RTD, approximate CBR values for the subgrade can be estimated on the basis of the superficial arisings' strength and plasticity ascertained from the intrusive investigation, and with reference to *Structural Design of Bituminous Roads* – TRRL Report LR1132, Appendix C (indicates a CBR of 40). *In situ* CBR values tend to give unreliable results because of the influence of the moisture content on the materials. In practice, the correlation given in TRRL Report 1132 is usually more appropriate than direct determination of the CBR.

In all situations, the stratum revealed at formation level should be trimmed and proof rolled, using suitable plant, where soft spots are identified, these should be excavated and backfilled with compacted 6F5/6F2 granular capping, alternatively large cobbles of natural good quality stone should be rolled in and compacted to refusal.

5.9. Further Geotechnical Assessment

Further assessment is recommended as sample assessment was undertaken only to between 2m and 3mbegl, particularly in light of the likelihood for increased sulphates with depth in the London Clay, which may determine that in-ground concrete elements require DC-2. This will also allow for installation of groundwater monitoring stand pipes.

For design of appropriate groundworks/improvement, the current data outlined above is likely to be sufficient. However, it is recommended that contact be made with a specialist contractor, PRP have reached out to Vibro Menard for a feasibility assessment for VSC to around 6m with localised deepening for Units 5 and 6 likely to be required. However, this would require confirmation by CPT testing.

6 GEOCHEMICAL TESTING RATIONALE AND SCHEDULE

Laboratory testing to determine the environmental properties of the near surface soils was undertaken by i2 of Watford and, where shown in the results, MCERTS accreditation has been provided. i2 follow a quality audit system which has been designed to ensure continual compliance to BSEN ISO/IEC 17025:2005 and the laboratory is also regularly audited by UKAS and holds accreditation for specific tests identified.

No visible evidence of contamination was present at surface, however, Made Ground was identified, which contained demolition debris. Testing was therefore undertaken with the aim of confirming the presence or absence in the underlying strata of a broad spectrum of metal, transition and non-metal compounds, including organics, that may present significant risk of significant harm to the critical human receptor and wider environment, in accordance with the current UK guidance and the pQRA presented in the Phase I report.

Testing of the recovered soil samples was scheduled as outlined below. If asbestos is identified in any of the samples, quantification is automatically undertaken in order that we can properly assess the likely risk to human receptors. Samples submitted for asbestos tested were recovered from adjacent areas to the tipped material along the northern boundary as this would be the most likely area to encounter it, if present, due to the inclusion of some demolition debris.

As excavation is expected to be undertaken as part of the construction for foundations and service trenches, samples were tested with respect to Waste Assessment Criteria (WAC) to ensure correct disposal regime and tax levy are applied.

It should be noted that the tipped material along the norther boundary was not sampled due to unsafe accessibility.

Quantity:	Test:
9	<u>General Environment Suite – Soil</u>
	Soil Organic Matter (%) pH Sulphate (Total)
	Arsenic (Total) Beryllium (Total) Boron (Water Soluble)
	Cadmium (Total) Chromium (Total) Hexavalent Chromium
	Copper (Total) Lead (Total) Mercury (Total)
	Nickel (Total) Selenium (Total) Vanadium (Total)
	Zinc (Total)
	Phenols (Total Monohydric) Cyanide (Total) Sulphide
	Speciated Polycyclic Aromatic Hydrocarbons (PAH) Fractions (USEPA16)
	Monoaromatics & Oxygenates CWG TPH (Total Petroleum Hydrocarbons)
4	Asbestos Screen & ID
4	BRE (Greenfield with pyrite) Suite
3	WAC (Waste Acceptance Criteria)

The results are presented in [Appendix D](#).

7 ANALYSIS OF GEOCHEMICAL RESULTS

7.1. Soil Testing

For the purpose of risk assessment, the LQM/CIEH S4UL (suitable for use level) or, where not published by LQM, the Defra C4SL (category 4 screening level) has been assumed and is noted on the quantitative analysis of results presented in [Appendix D](#).

For a full commentary on the criteria for contamination assessment used by PRP, please refer to [Appendix E](#).

All analyses are against the generic criteria concentrations set for 'commercial' end-use. This category is deemed to be the most appropriate for the proposed end-use and represents the maximum concentrations for the substances assessed; i.e., which do not represent elevated levels of risk to human targets by any pathway in accordance with the development area type.

However, as outlined within EPA: Part 2A of the Statutory Guidance (2012 Defra), "3.29: generic acceptance values relating to human health risk assessment represent cautious estimates of levels of contaminants in soil at which there is considered to be no risk to health or, at most, a minimal risk to health.", i.e., depending on the proposed end-use, any exceedance should be seen as a flag for further scrutiny and discussion rather than an automatic need for remedial measures. Academic computational assessment aside, there is little risk from in-ground soil contamination with a lack of viable source. However, even low concentrations not normally considered for end-use must be considered during construction as site workers are considered the most vulnerable receptor at this stage albeit with short-term exposure. Should a generic assessment criterion be exceeded, where possible, a DQRA (detailed qualitative risk assessment) will be undertaken in the form as outlined in the discussion below for the particular compound in question, and where appropriate or possible, a SSAC (site specific assessment criterion) modelled, using EA CLEA, and will be indicated on the analyses included in [Appendix D](#).

7.1.1. Discussion of Results

The SOM% was recorded at between 0.3% and 6.7%, with a mean average of 2.5%, therefore, the most stringent criteria of 1% on the hydrocarbon compounds was assumed.

Of the 9 soil samples recovered during the ground investigation and submitted for testing, no exceedances of the end-use criteria were established and therefore no significant risk of significant harm to human health or the wider environment can be assumed.

7.2. Asbestos Content

The likely impact to the end-user, should the presence of asbestos be proven is considered negligible as remedial measures would be employed to protect the end-user. The main receptor at risk is considered to be the site worker during the demolition, earthworks, and construction phases as they will be exposed to the soils until any hard surfacing or cover system has been constructed.

According to HSG 248, published 2021, 7.21 ... *Air monitoring has shown that airborne fibre concentrations rarely exceed the LoQ and are unlikely to exceed the control limit unless the work is*

disturbing relatively high percentages (>1%) of unbound asbestos in dry soil. Where there is mostly bound asbestos in soils, below a mass concentration of 0.1% w/w, airborne fibre concentrations are unlikely to exceed the LoQ for personal sampling. When the soil is damp or wet, airborne emissions of asbestos will be suppressed and wind dilution and dispersion of any emissions will also reduce worker and bystander exposures.

The *JIWG (CAR-Soil) Industry Guide on the Control of Asbestos Regulation 2012: Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials* indicates the following concentration descriptors:

- $\geq 0.1\%$ wt/wt is defined as a large quantity
- $\geq 0.05\%$ to $< 0.1\%$ wt/wt is defined as a moderate quantity
- $\geq 0.01\%$ to $< 0.05\%$ wt/wt is defined as a low quantity
- $\geq 0.001\%$ to $< 0.01\%$ wt/wt is defined as a very low quantity.

This guidance is for site workers, and in this case, this is the most likely receptor group to be affected by any in-ground contamination at a site, if present.

7.2.1. Discussion of Results

There was no visual evidence of asbestos presence at the Site, and no source was identified during the Tier 1 assessment. This is supported with no asbestos identified in any of the samples submitted for laboratory testing. Therefore, no significant risk of significant harm to the critical human receptor or wider environmental receptors is considered to be present due to asbestos.

7.3. Ground Gas Assessment

Ground gas was not identified as a risk by the pQRA presented in the Phase I report due to there being no known source. The ground investigation did not reveal material readily associated with the production of ground gas at impactful concentrations to humans and therefore, post-ground investigation monitoring was not considered necessary for the progression of the development.

According to the online page UKradon.org, managed by PHE, the Site is located within an area where less than 1% of properties are above the action level.

This is indicative of low risk and, under England & Wales Building Control Regulations, no radon protection measures are necessary for this commercial development.

7.4. Waste Acceptance Criteria (WAC)

As indicated in [Section 6](#), a total of 3 soil samples were recovered during the ground investigation and tested with respect to Waste Assessment Criteria (WAC) testing. The results of those tests are as follows:

- | | | | | |
|---|------|-------------------|-------|--|
| • | WS01 | 0.10m – 0.20mbegl | (MG) | Non-hazardous (slightly elevated SO ₄) |
| • | WS03 | 1.20m – 1.30mbegl | (RTD) | Inert |
| • | WS04 | 0.70m – 0.80mbegl | (RTD) | Inert |

pH has no limit for inert or hazardous waste landfill, however, for waste acceptance as stable non-reactive hazardous waste in non-hazardous landfill (SNRHW) the pH must be above 6. If any parameter is outside of inert but below the threshold for SNRHW (as is Molybdenum in this case), then the pH must meet the limit of 6.

From the limited testing undertaken, the results suggest that the natural soils will be inert waste classification. However, Made Ground, comprising backfill, Topsoil (placed), tipped material, and compound surfacing is likely to be a combination of inert and stable non-reactive hazardous waste classification. Due to the extent of Made Ground across the Site, it is recommended that WAC testing is undertaken as required and sampled from the stockpiles to be removed. These are for material to be removed from Site to a waste processor facility; these are not a reflection of the end-use criteria for material remaining at Site. The WAC certificates are presented in [Appendix D](#).

It is therefore recommended that any material requiring removal from Site should be stockpiled for further testing, which can be undertaken by the groundworks contractor as and when required. It is recommended (and good practise) that stockpiles are stored on an impermeable membrane. The resultant WAC certificates should then be supplied to the receiving party; copies of which must be retained for inclusion in the validation process as outlined within the planning conditions.

It is the responsibility of the Principal Contractor to ensure that testing undertaken is adequate (of appropriate frequency to m³ of material being removed) and in accordance with the current guidance (Guidance: Disposal of Waste to Landfill, updated 2023), however, it must also be noted that some LPAs supply area-specific guidance which override the national guidance and must be adhered to.

In all cases, Waste Transfer Tickets (pink tickets) must always be retained for presentation within a verification report, should one be requested as proof of due and correct process at the end of the development phase in order that the local regulatory authority can discharge all planning conditions.

7.5. Further Geochemical Assessment

In the event that arisings require removal from Site, further WAC testing should be undertaken as outlined above.

As previously indicated, the tipped material along the northern boundary was not sampled for testing. Should this material require removal from Site, WAC testing should be undertaken, as outlined above.

8 GENERIC QUALITATIVE RISK ASSESSMENT FOR LAND CONTAMINATION

Following completion of the Stage 1, Tier 1 preliminary qualitative risk assessment, as presented in the Phase I report, and analysis of results gained from the ground investigations ([Section 7](#)), a Stage 1, Tier 2 generic quantitative risk assessment for land contamination can be presented. Current guidance on the assessment of contaminated land requires the risk to human health, to buildings and to the wider environment to be reviewed using a source-pathway-receptor linkage relationship. If each of these elements is present, the pollution linkage provides a potential risk to the identified receptors and conversely, if one of these is missing, the model fails to be realised, thereby rendering the risk either '**Negligible**' if present but below criterion, or "**NR**" if no evidence of presence, and thereby no risk, due to the failure of the source-pathway-receptor model (i.e., an element is absent).

This model is set in the context of the proposed development of the Site for '**commercial**' end-use, based on assessment for a 21-y-o adult, and updates the pQRA presented in the Phase I report as discussed in [Section 2.2](#).

8.1. Updated Source - Pathway - Receptor Linkages Risk Assessment

Made Ground was observed to depths of between 0.2m and 0.9mbegl, as discussed in [Section 5.1](#), and being mostly of organic-rich Topsoil with fine demolition arisings and straw in places. The Site was saturated at the time of investigation, with surface water sitting in most areas. Underlying the imported Topsoil is the natural River Terrace Deposits (RTD), comprising variably gravelly, clayey SAND with inclusions of clay-dominated material. The coarse material of the RTD and the high water levels establish potential pathways of in-ground lateral migration and surface saltation. The Site is currently an area of undeveloped land, however, it has previously been used as the construction compound for the adjacent A327. However, on completion, the Site will be dominated by hard landscaping with no additional soft landscaped areas.

As discussed in [Section 7.1](#), no minor exceedances of the assessment criteria in relation to the end-use categorisation were proven, and therefore no significant risk of significant harm to the critical human or the wider environmental receptors is present.

Likewise, the risk of impact to groundwork and construction workers is considered negligible in relation to short-term exposure, with the most plausible pathway being through direct contact (consumption). This can easily be overcome using standard good working practices and PPE, including hand washing prior to eating.

As discussed in [Section 7.2](#), no asbestos fibres were identified from the ground investigation.

Following on from the previous reports for the Site, as referenced in [Section 2.1](#), and the current GI data, the likelihood of risk of contamination or harm to human, environmental, or in-ground structural receptors can be further assessed, as outlined below. Individual sources are often impossible to separate and have therefore been combined by contaminant type. For an explanation of the risk categories identified within the matrix, please refer to [Appendix F](#).

Source (Type and location)	Receptor	Pathway	Initial Assessment from Desk Study Information			Proposed Investigation/Comments	Hazard Linkage	Revised Risk	Proposed Remediation /Management	Residual Risk
			Severity	Prob.	Risk					
Onsite: Toxic & phytotoxic heavy metals and transitions within the MG or shallow soils: Most likely identified sources/compounds: Tipped materials Compound MG Imported TS	Site workers (short-term/ acute exposure)	Direct contact (ingestion/dermal)	Minor	Low	Negligible	No source identified. Although unlikely to be anything other than inert, the tipped material is yet to be fully assessed. However, this material is likely to be either be removed from Site or redistributed and used within the development, which comprises a total hard surfacing thereby rendering any pathway blocked. Therefore, negligible risk is assumed. No evidence of toxic substances within the surface materials across the Site.	No	Negligible	None required.	None
		Dust inhalation	Minor	Low	Negligible					
		Vapour inhalation			NR					
	Future site users (long-term/ chronic exposure)	Direct contact (ingestion/dermal)	Minor	Unlikely	Negligible					
		Dust inhalation	Minor	Unlikely	Negligible					
		Vapour inhalation			NR					
	Controlled water (surface)	Migration by surface run-off	Minor	Low	Negligible					
		In-ground lateral migration	Minor	Unlikely	Negligible					
	Controlled water (aquifer)	In-ground vertical migration	Minor	Unlikely	Negligible					
	Plants	Root uptake	Minor	Unlikely	Negligible					
Onsite: Toxic & phytotoxic non-metals and solvents within the MG or shallow soils: Most likely identified sources/compounds: Tipped materials Compound MG Imported TS	Site workers (short-term/ acute exposure)	Direct contact (ingestion/dermal)	Minor	Low	Negligible	No source identified. Although unlikely to be anything other than inert, the tipped material is yet to be fully assessed. However, this material is likely to be either be removed from Site or redistributed and used within the development, which comprises a total hard surfacing thereby rendering any pathway blocked. Therefore, negligible risk is assumed. No evidence of toxic substances within the surface materials across the Site.	No	Negligible	None required.	None
		Dust inhalation	Minor	Low	Negligible					
		Vapour inhalation	Minor	Low	Negligible					
	Future site users (long-term/ chronic exposure)	Direct contact (ingestion/dermal)	Minor	Unlikely	Negligible					
		Dust inhalation	Minor	Unlikely	Negligible					
		Vapour inhalation	Minor	Unlikely	Negligible					
	Controlled water (surface)	Migration by surface run-off	Minor	Low	Negligible					
		In-ground lateral migration	Minor	Unlikely	Negligible					
	Controlled water (aquifer)	In-ground vertical migration	Minor	Unlikely	Negligible					
	Plants	Root uptake	Minor	Unlikely	Negligible					

Source (Type and location)	Receptor	Pathway	Initial Assessment from Desk Study Information			Proposed Investigation/Comments	Hazard Linkage	Revised Risk	Proposed Remediation /Management	Residual Risk
			Severity	Prob.	Risk					
Onsite: Petroleum hydrocarbon compounds (TPH) (petrol, oil, diesel), Polyaromatic Hydrocarbons (PAH) (coal, clinker, coke) and associated volatile organic compounds (VOCs) within the MG or shallow soils. Most likely identified compounds of: None identified.	Site workers (short-term/ acute exposure)	Direct contact (ingestion/dermal)	Minor	Unlikely	Negligible	No source identified.	No	Negligible	None required.	None
		Dust inhalation	Minor	Unlikely	Negligible					
		Vapour inhalation	Minor	Unlikely	Negligible					
	Future site users (long-term/ chronic exposure)	Direct contact (ingestion/dermal)	Minor	Unlikely	Negligible					
		Dust inhalation	Minor	Unlikely	Negligible					
		Vapour inhalation	Minor	Unlikely	Negligible					
	Controlled water (surface)	Migration by surface run-off	Minor	Unlikely	Negligible					
		In-ground lateral migration	Minor	Unlikely	Negligible					
	Controlled water (aquifer)	In-ground vertical migration	Minor	Unlikely	Negligible					
	Plants	Root uptake	Minor	Unlikely	Negligible					
Onsite: Polychlorinated Biphenyls (PCBs) within Made Ground or shallow soils. None identified.	Site workers (short-term/ acute exposure)	Direct contact (ingestion/dermal)			NR	No source identified.	No	Negligible	None required.	None
		Dust inhalation			NR					
		Vapour inhalation			NR					
	Future site users (long-term/ chronic exposure)	Direct contact (ingestion/dermal)			NR					
		Dust inhalation			NR					
		Vapour inhalation			NR					
	Controlled water (surface)	Migration by surface run-off			NR					
		In-ground lateral migration			NR					
	Controlled water (aquifer)	In-ground vertical migration			NR					
	Plants	Root uptake			NR					

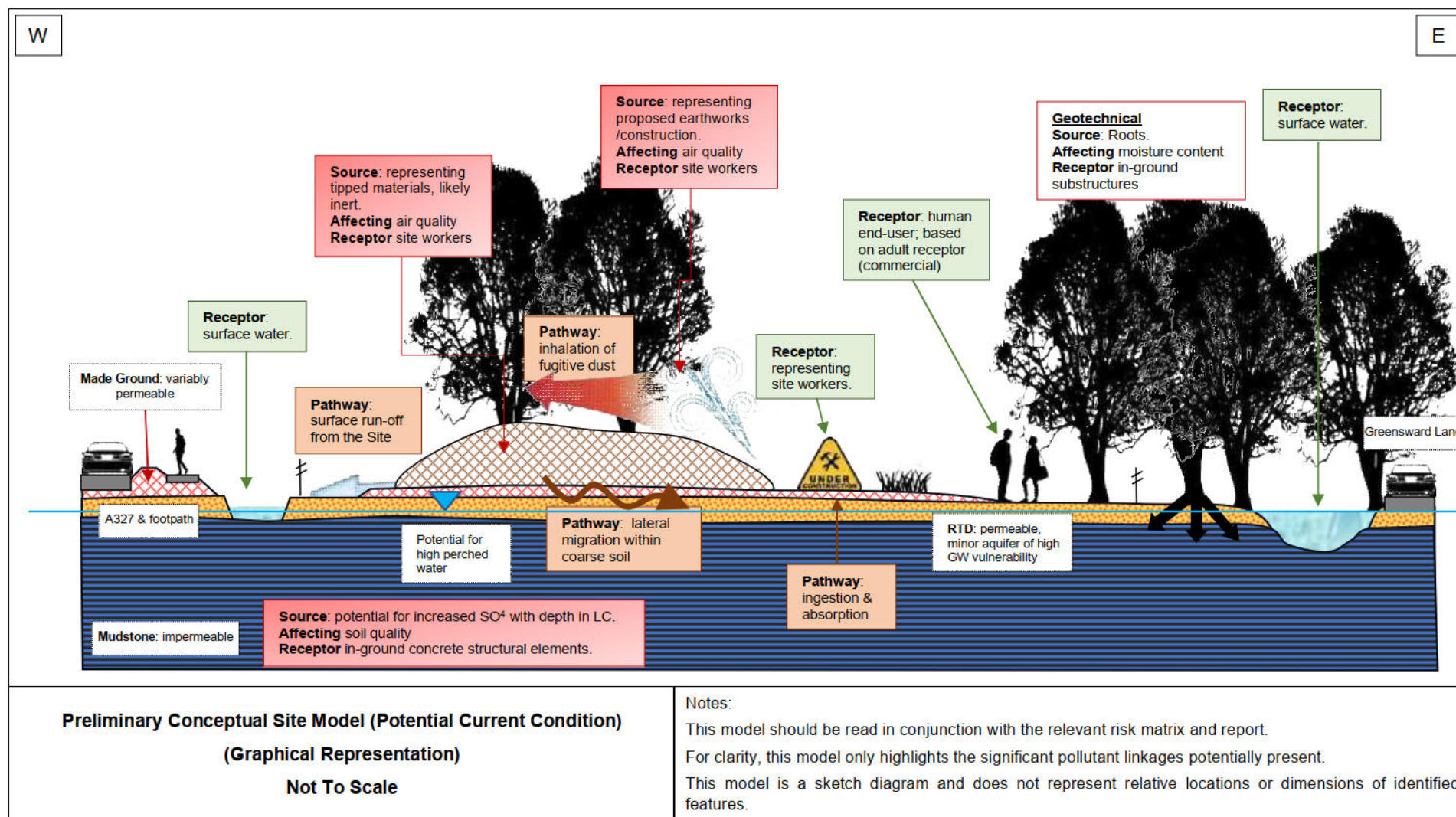
Source (Type and location)	Receptor	Pathway	Initial Assessment from Desk Study Information			Proposed Investigation/Comments	Hazard Linkage	Revised Risk	Proposed Remediation /Management	Residual Risk
			Severity	Prob.	Risk					
Onsite: Ground gas. None identified.	Site workers (short-term/ acute exposure)	Vapour inhalation	Minor	Unlikely	Negligible	No source of ground gas identified onsite that could constitute a significant risk of significant harm to any on-site receptor.	No	Negligible	None required.	None
	Future site users (long-term/ chronic exposure)	Vapour inhalation	Minor	Unlikely	Negligible					
Onsite: Residual asbestos from previous structures near or at surface. None identified.	Site workers (short-term/ acute exposure)	Inhalation of fugitive dust	Minor	Low	Negligible	No source identified.	No	Negligible	None required.	None
	Future site users (long-term/ chronic exposure)	Inhalation of fugitive dust	Minor	Unlikely	Negligible					
Onsite (Geotechnical): Aggressive substances (pH, SO₄ conditions) within <u>Made Ground</u>	In-ground utilities	Direct contact with utilities conduits.	Minor	Unlikely	Negligible	High acidity within the imported TS across the Site due to high organic content. However, material will be removed from area.	No	Negligible	None required.	None
	Building substructure	Direct contact with in- ground construction materials	Minor	Unlikely	Negligible					
Onsite (Geotechnical): Aggressive substances (pH, SO₄ conditions) <u>within natural soils</u>	In-ground utilities	Direct contact with utilities conduits.	Mild	Low	Low	Although the underlying LC was determined to be DC-1, only the top on the unit was tested. LC known to contact selenite in some beds therefore sulphate like to increase with depth. Recommend further testing or assume DC-2.	Potentially	Low	Recommend further testing or assume DC-2 as a preventative.	Negligible
	Building substructure	Direct contact with in- ground construction materials	Mild	Low	Low					

Source (Type and location)	Receptor	Pathway	Initial Assessment from Desk Study Information			Proposed Investigation/Comments	Hazard Linkage	Revised Risk	Proposed Remediation / Management	Residual Risk
			Severity	Prob.	Risk					
Offsite: Toxic & phytotoxic heavy metals and transitions migrating to Site from offsite historical /current processes. None identified.	Site workers (short-term/ acute exposure)	Direct contact (ingestion/dermal)	Minor	Unlikely	Negligible	No source identified.	No	Negligible	None required.	None
		Dust inhalation	Minor	Unlikely	Negligible					
		Vapour inhalation			NR					
	Future site users (long-term/ chronic exposure)	Direct contact (ingestion/dermal)	Minor	Unlikely	Negligible					
		Dust inhalation	Minor	Unlikely	Negligible					
		Vapour inhalation			NR					
	Controlled water (surface)	Migration by surface run-off			NR					
		In-ground lateral migration			NR					
	Controlled water (aquifer)	In-ground vertical migration	Minor	Unlikely	Negligible					
Offsite: Toxic & phytotoxic non-metals and solvents migrating to Site from offsite historical/current processes. None identified.	Site workers (short-term/ acute exposure)	Direct contact (ingestion/dermal)	Minor	Unlikely	Negligible	No source identified.	No	Negligible	None required.	None
		Dust inhalation	Minor	Unlikely	Negligible					
		Vapour inhalation	Minor	Unlikely	Negligible					
	Future site users (long-term/ chronic exposure)	Direct contact (ingestion/dermal)	Minor	Unlikely	Negligible					
		Dust inhalation	Minor	Unlikely	Negligible					
		Vapour inhalation	Minor	Unlikely	Negligible					
	Controlled water (surface)	Migration by surface run-off			NR					
		In-ground lateral migration			NR					
	Controlled water (aquifer)	In-ground vertical migration	Minor	Unlikely	Negligible					
	Plants	Root uptake	Minor	Unlikely	Negligible					



Source (Type and location)	Receptor	Pathway	Initial Assessment from Desk Study Information			Proposed Investigation/Comments	Hazard Linkage	Revised Risk	Proposed Remediation / Management	Residual Risk
			Severity	Prob.	Risk					
Offsite: Petroleum hydrocarbons (TPH) (petrol, oil, diesel), Poly Aromatic Hydrocarbons (PAHs) (coal, clinker, coke, tar) and associated volatile organic compounds (VOCs) within the Made Ground or shallow soils from offsite processes. None identified.	Site workers (short-term/ acute exposure)	Direct contact (ingestion/dermal)			NR	No source identified.	No	NR	None required.	None
		Dust inhalation			NR					
		Vapour inhalation			NR					
	Future site users (long-term/ chronic exposure)	Direct contact (ingestion/dermal)			NR					
		Dust inhalation			NR					
		Vapour inhalation			NR					
	Controlled water (surface)	Migration by surface run-off			NR					
		In-ground lateral migration			NR					
	Controlled water (aquifer)	In-ground vertical migration			NR					
Offsite: Polychlorinated Biphenyls (PCBs) from adjacent site locations within MG or shallow soils. None identified.	Site workers (short-term/ acute exposure)	Direct contact (ingestion/dermal)			NR	No source identified.	No	NR	None required.	None
		Dust inhalation			NR					
		Vapour inhalation			NR					
	Future site users (long-term/ chronic exposure)	Direct contact (ingestion/dermal)			NR					
		Dust inhalation			NR					
		Vapour inhalation			NR					
	Controlled water (surface)	Migration by surface run-off			NR					
		In-ground lateral migration			NR					
	Controlled water (aquifer)	In-ground vertical migration			NR					
	Plants	Root uptake			NR					

MG: Made Ground
TS: Topsoil
NR: No risk (missing element from S-P-R model)



8.2. Requirement for Further Assessment

During works there is potential for fugitive dust to be blown from the soil surface, particularly under dry and windy weather conditions. Although proven uncontaminated or toxic, fugitive dust can impact on general wellbeing and is at best, a nuisance. Therefore, dampening of exposed soils should be undertaken throughout all works phases as a courtesy to the surrounding land users.

Of the areas investigated and laboratory testing undertaken, neither the results nor quantified risk assessment identified significant risk of significant harm to the receptors, however, a 'negligible' risk **does not mean that contamination or the impact of such will definitely be absent from the Site** (as outlined by the risk assessment matrix presented in [Appendix F](#)), and site workers should be mindful of this.

Only the top of the London Clay was sampled and tested due to collapsed dynamic sampler holes. London Clay is known to contain selenite-bearing beds. Although the testing undertaken resulted in a concrete class DC-1, sulphate may increase with depth. It is therefore recommended that either further testing be undertaken to establish adequate concrete class or assume DC-2 as a preventative measure.

Should any soils be revealed during enabling/construction works that are in any way different to those revealed during the ground investigation outlined in this report, then excavation must cease immediately, and samples must be taken for analysis by the PRP geotechnical engineer. This applies to the type of soils as well, as it may impact the foundation design. This may result in additional remedial measures being required on site before enabling/construction works can be continued. In the event that contamination is proven, consultation with the Contaminated Land Officer of the Local Planning Authority must be sought to establish an acceptable remediation strategy for which verification may be required.

9 OVERVIEW OF RECOMMENDATIONS

Based on the findings of the ground investigation at the Site, the following is recommended:

9.1. Geotechnical Constraints

The following is a brief synopsis of [Section 5](#).

Made Ground was detected across the Site, in the form of a soft, organic-rich imported Topsoil, which contained fine demolition debris and straw mixed within, recorded to depths of between 0.2m and 0.90mbegl. In some places, a thin layer of demolition crush was encountered at the base of this soft ground, a remnant of the former construction compound.

It should be noted that the imported Topsoil across the Site has no engineered capacity and can be used only for soft landscaping areas, of which, none are presented on the proposed site plan shown in [Appendix A](#).

The natural River Terrace Deposits (RTD) were recorded as a variable gravelly, clayey SAND of substantial strength, interbedded with weaker clay or silt dominated material, which often exhibited running behaviour. This material was recorded to extend across the entire Site, which contradicts the BGS records, which indicates RTD restricted to the northwest corner, however, BGS stratal boundaries are only indicative based on the information they possess at the time of mapping.

The underlying bedrock, London Clay was recorded in three boreholes from depths of between 2.6m and 2.8mbegl as a very soft silty CLAY, however, advancement of the dynamic sampling was curtailed by hole collapse due to saturated soils in all location. As a result, dynamic probing was undertaken to depths of between 5m and 6mbegl, interpretation of which indicated the top of the London Clay from between 2.2m and 3.1mbegl also as a very soft material, however it also indicated an increase in strength with depth ([Section 5.1](#)).

LC presented with medium volume change potential with variation in moisture content. This may impact units close to the northern (hawthorn) and eastern (various deciduous) boundaries where part of the structures may be within root influence zones. However, due to the saturated nature of the soils, no dewatering process was evident, however, this may change once the Site has been drained ([Section 5.1](#)).

Additional to ground saturation, there were many areas of ponding at surface. Further water strikes were recorded at between 0.9m and 2.2mbegl, which rose to between 0.18m and 1.5mbegl on removal of casing ([Section 4.1](#)), prohibiting the use of soakaways for surface water drainage. The flora across the ponded areas indicates that near-surface or at surface water is at least a common occurrence. Swales have been constructed in the wider area and a drainage ditch is located to the northwest of the Site entrance. **It is recommended that appropriate drainage feasibility and design be undertaken** ([Section 5.3](#)).

As discussed in [Section 5.4](#), **ground improvement is recommended** for the footprint of the proposed structures, which must be compatible with the high soil water content. It is likely that the

most efficient form would be VSC to depths of around 6mbegl with deepening likely to be required for Units 4 - 6. PRP has reached out to Vibro Menard for a feasibility assessment, their extensive response is included within [Section 5.4](#), where **they recommend further investigation by CPT**, albeit that the dynamic probing proved increase in strength with depth.

[Section 5.5](#) shows that DC-1 can be adopted for in-ground concrete structures within the natural soils, however, only the surface of the London Clay was tested. It is likely that sulphate content will increase with depth due to some beds within the LC known to contain selenite crystals, **therefore either further testing should be undertaken on samples recovered from within the London Clay or assumed DC-2 as a preventative method.**

As indicated in [Section 5.4](#), ground improvement is recommended, likely by VSC. Required bearing pressures for founding the portal frame structures will be in the region of 125kPa, with FoS, a minimum of 175kPa should be sought through ground strengthening ([Section 5.6](#)). On completion of the ground improvement works, pad foundations should be founded at 1mbegl.

Once the Topsoil (Made Ground) has been stripped from the development areas, the underlying RTD sands and gravels are of adequate strength to support ground bearing slabs. Commercial ground floor slabs should be constructed as ground bearing and designed in accordance with TR34. It is **recommended that plate bearing tests be undertaken on the proof-rolled formation, post-groundworks, to determine the value for the Modulus of Sub-grade Reaction, k.** This can only be undertaken after the sub-formation has been exposed, and only once preparatory groundworks (reprofiling and ground improvement) have been completed ([Section 5.7](#)).

With regards to the natural granular RTD, approximate CBR values of 40 can be adopted once the soft overburden has been removed ([Section 5.7](#)).

Further assessment is recommended as sample assessment was undertaken only to between 2m and 3mbegl, particularly in light of the likelihood for increased sulphates with depth in the London Clay, which may determine that in-ground concrete elements require DC-2. This will also allow for installation of groundwater monitoring stand pipes. However, as indicated above, with VSC founding will likely be at 1mbegl therefore within DC-1 tolerances.

9.2. Contamination

In line with the proposed development and of the area assessed, no exceedances were proven in accordance with the LQM/CIEH S4UL and Defra C4SL criteria as outlined in [Section 7.1](#).

It should however be noted that, although likely to be inert material, the tipped material along the northern boundary was not sampled due to unsafe accessibility.

No asbestos was identified in any of the samples submitted for laboratory testing. Therefore, no significant risk of significant harm to the critical human receptor or wider environmental receptors is considered to be present due to asbestos ([Section 7.2](#)).

No radon protection measures are required for this commercial development. Ground gas monitoring was not undertaken due to lack of apparent source and a CS-1 has been assumed ([Section 7.3](#)).

For arisings due for removal from Site, WAC testing indicated the imported Topsoil/Made Ground to be non-hazardous and the natural soils to be inert. Due to the limited testing regime, it is recommended that any material to be removed from Site should be stockpiled and further tested, which can be undertaken by the groundworks contractor as and when required. The resultant WAC certificates should then be supplied to the receiving party ([Section 7.4](#)).

During works fugitive dust may be produced from the soil surface, particularly under dry and windy weather conditions. Although not necessarily contaminated or toxic, fugitive dust can impact on general wellbeing and is at best, a nuisance. Therefore, dampening of exposed soils should be undertaken throughout all works phases as a courtesy to the surrounding land users.

In addition to the recommendations outlined above, should any soils be revealed during enabling/construction works that are different in any way to those revealed during the ground investigation outlined in this report, then excavation must cease immediately, and samples must be taken for analysis by PRP. This may result in remedial measures being required on site before enabling/construction works can continue, which must be priorly agreed with the Local Planning Authority ([Section 8.2](#)).

9.3. Health & Safety/General Measures to be Adopted During Works

Dampening of exposed soils should be undertaken during dry periods.

No excavation should be entered into unless the sides are appropriately supported (battened or temporary propping of the trench sides) in accordance with current best practice and as accepted by the Health and Safety Executive which is published in "Health and Safety in Construction (HSG 150)" which is available to download from www.hse.gov.uk. It is good practice that any excavation is not entered unless absolutely necessary.

The soils across the Site were saturated at the time of investigation, with many areas of surface ponding. Surface water collecting in excavations, as demonstrated with the collapsed dynamic sampler holes, will likely destabilise the bearing strata and any excavation sides. In these circumstances, and if appropriate surface water drainage measures are yet to be installed, should water be seen to sit within the excavations, the use of a small submersible pump should be sufficient to keep water levels sufficiently low to enable concrete or services to be placed in the excavations.

Inflows are to be expected in all excavations and dewatering techniques will likely be required at all times of the year. Therefore, temporary formwork to excavations may also be required to prevent the collapse of excavation sides; this will be particularly relevant during periods of rainfall.



Karen Holton, BSc, FGS, IOSH
Senior Geotechnical Engineer

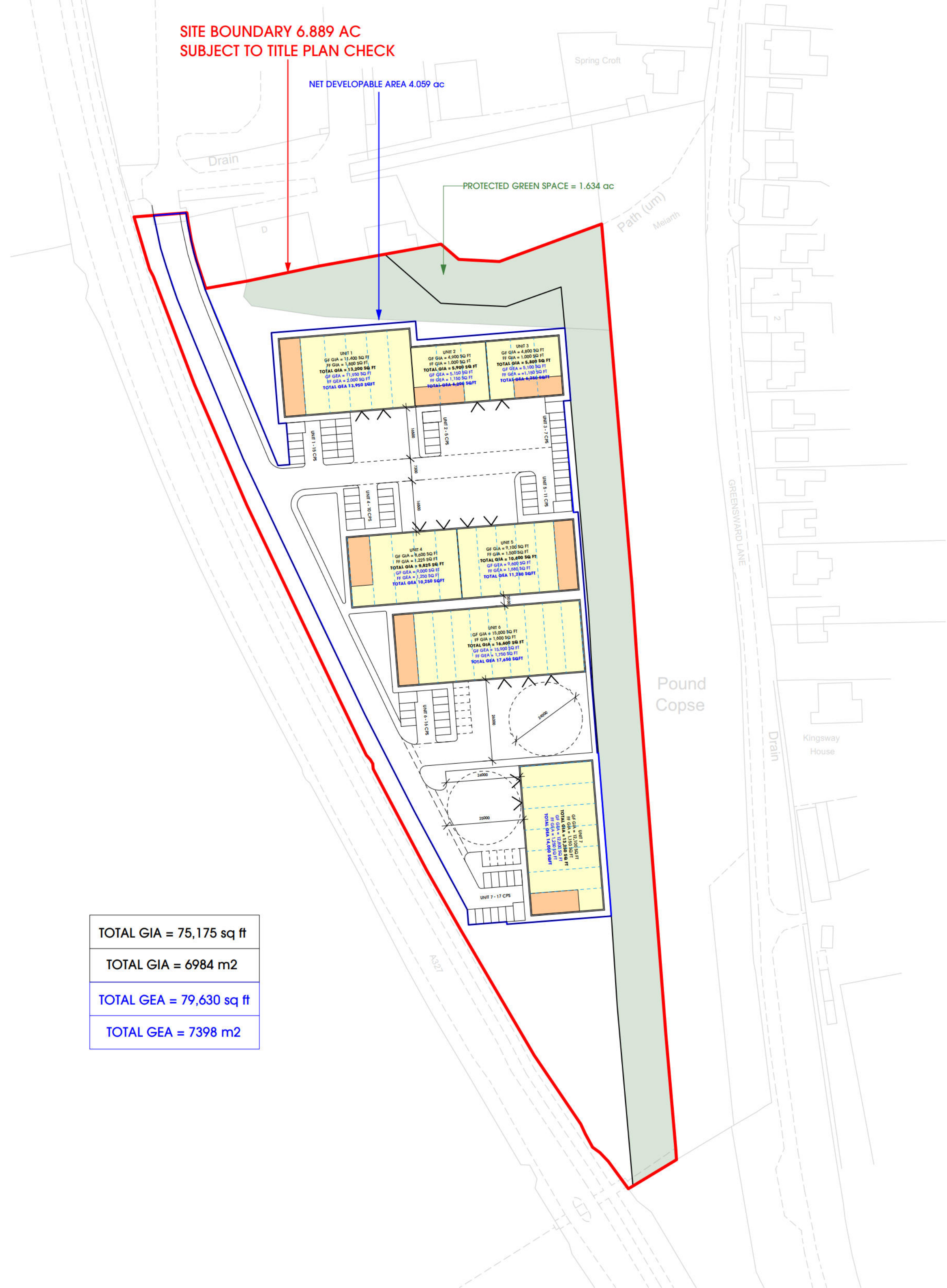


Barry Smith, B.Eng. C.Eng. M.I.Struct.E. FGS
Director

APPENDIX A

Drawings

Drawing Number:	Drawing Title:
3389 F401 A	Proposed Site Plan, HTC Architects, 14/02/2024.
64065 SK02 P1	Borehole Location Plan, PRP Engineers



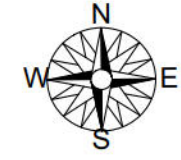
TOTAL GIA = 75,175 sq ft
TOTAL GIA = 6984 m2
TOTAL GEA = 79,630 sq ft
TOTAL GEA = 7398 m2

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HTC ARCHITECTS. IT MUST NOT BE REPRODUCED, USED,
DISCLOSED OR TRANSMITTED TO THIRD PARTIES IN ANY FORM, IN
WHOLE OR IN PART, WITHOUT PRIOR WRITTEN PERMISSION.

DO NOT SCALE!
ALL DIMENSIONS SHOULD BE CHECKED ON SITE BEFORE
WORK COMMENCES

BOUNDARY SUBJECT TO TITLE PLAN CHECK

SUBJECT TO REVIEW OF LEVELS AND FALLS



C	28/02/24	FF areas reduced	AB
B	28/02/24	GEA's added	DE
A	27/02/24	Updated to show 3m gap between Unit 4/5 and 6	DE
Rev.	Date	Description	Drawn

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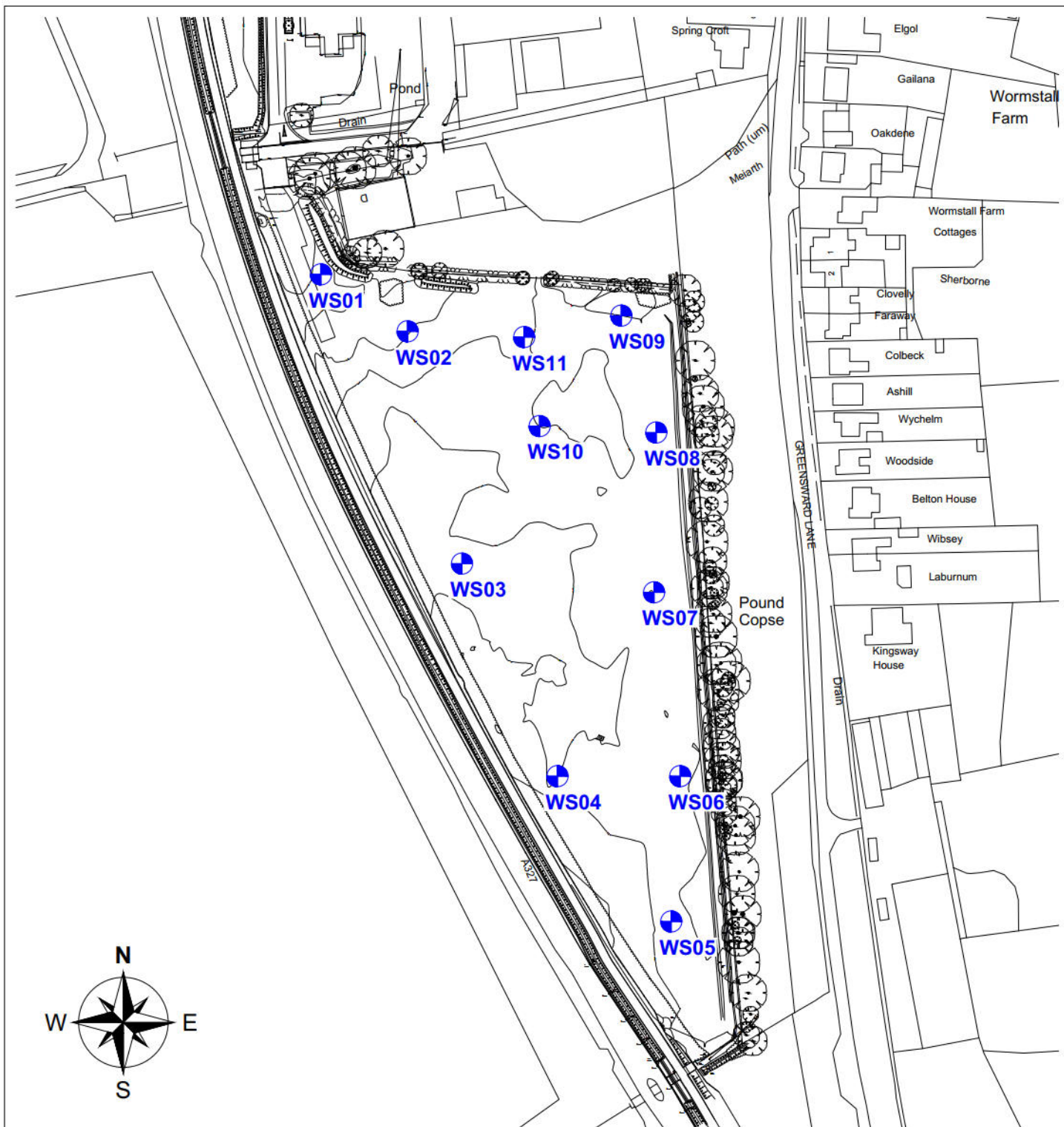
W: www.htcarchitects.co.uk
E: info@htcarchitects.co.uk

client
Tungsten Properties

project
**Observer Park, Arborfield,
Reading**

drawing title
Proposed Site Plan

date **Feb 2024**
status **Feasibility**
scale **1:1000 @ A2**
drawn **DE** checked **DW**
job no. **3389** dwg no. **F403** rev. **C**



Project:

Observer Park, Reading

Title:

Borehole Location Plan

Status:

PRELIMINARY

Engineer: KH

Date: March 2024

Drawn: GF

Scales @ A4:

Checked: BMS

1:2000

Project No: 64065

Drg No: SK02

Rev: P1



PRP

consulting engineers & surveyors

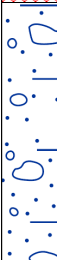
engineering excellence | creating advantage

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APPENDIX B

Engineer's Stratigraphic Logs

PROJECT NAME:		Observer Park															
SITE LOCATION:		Arborfield, Reading															
CLIENT:		Carbide Properties Ltd										JOB NO.:		64065			
START DATE:		26/03/2024				EASTING:				474934				BOREHOLE ID:		WS01	
END DATE:		26/03/2024				NORTHING:				167317				TOTAL DEPTH:		3mbgl + DP to 6m	
MEASURING POINT: Ground Level														DATUM ELEVATION (if available):			
Sample ID	Laboratory Testing	In-Situ Testing					GW	Legend	Stratum Thickness	Stratum Base	DESCRIPTION	% Recovery	Installation				
		Test Type	N Value /Blows	Hand Pen.	DP												
0	D1	WAC	SPTc	13	0.75/3/ 0.25	0	R1		0.20	0.20	Grass over firm, grey-brown clay backfill containing fragments of concrete and brick (fine to cobble) and gravel of flint and sandstone (fine to coarse, subangular to rounded), and abundant roots and rootlets. MADE GROUND of large concrete and brick fragments in clay matrix.	U1 100%					
ES1 U1	0.10								0.30								
0.5																1.40	
1																	
1.5					1/1.25/ 1.75				1.70								
2		MC/PI, SO4/pH	SPTc	5			E1		0.30	2.00	Soft, wet, olive, slightly silty, sandy CLAY (RIVER TERRACE DEPOSIT).	U3 60%					
2.5									0.60		Loose, saturated and washed out (running), orange, slightly clayey, gravelly, medium grained SAND. Gravel of fine flint and coarse sandstone (RTD).						
3	U3								0.40	3.00	Very soft, wet, dark grey, slightly silty CLAY (LONDON CLAY FORMATION).						
3.5																	
4																	
4.5																	
5																	
5.5																	
6																	
6.5																	
OTHER COMMENTS: Water encountered at 1.9m with 1m casing. At end of sampling, water at 1.6m which rose to 1.4m on removal of casing. Hole collapsed at 2.4m with dynamic probing continuation from 3m.										IN SITU KEY: SPTc (cone) SPT (spoon) FH (falling head)		EQUIPMENT/MODALITY: Archway Lite DS					
GW ENCOUNTERED:		Y		GW INFLOW RATE:		Seepage		INSTALLATION:		None		LOGGED: KLH		CHECKED: KLH			

Date	26/03/2024	Site:	Observer Park, Arborfield	Borehole Number	WS01		
Job Number	64065				Comments		
Depth (m)	N100 Blows	0	5	10	15	20	25
0.0 - 0.1		0.0 - 0.1					
0.1 - 0.2		0.1 - 0.2					
0.2 - 0.3		0.2 - 0.3					
0.3 - 0.4		0.3 - 0.4					
0.4 - 0.5		0.4 - 0.5					
0.5 - 0.6		0.5 - 0.6					
0.6 - 0.7		0.6 - 0.7					
0.7 - 0.8		0.7 - 0.8					
0.8 - 0.9		0.8 - 0.9					
0.9 - 1.0		0.9 - 1.0					
1.0 - 1.1		1.0 - 1.1					
1.1 - 1.2		1.1 - 1.2					
1.2 - 1.3		1.2 - 1.3					
1.3 - 1.4		1.3 - 1.4					
1.4 - 1.5		1.4 - 1.5					
1.5 - 1.6		1.5 - 1.6					
1.6 - 1.7		1.6 - 1.7					
1.7 - 1.8		1.7 - 1.8					
1.8 - 1.9		1.8 - 1.9					
1.9 - 2.0		1.9 - 2.0					
2.0 - 2.1		2.0 - 2.1					
2.1 - 2.2		2.1 - 2.2					
2.2 - 2.3		2.2 - 2.3					
2.3 - 2.4		2.3 - 2.4					
2.4 - 2.5		2.4 - 2.5					
2.5 - 2.6		2.5 - 2.6					
2.6 - 2.7		2.6 - 2.7					
2.7 - 2.8		2.7 - 2.8					
2.8 - 2.9		2.8 - 2.9					
2.9 - 3.0		2.9 - 3.0					
3.0 - 3.1	1	3.0 - 3.1					
3.1 - 3.2	1	3.1 - 3.2					
3.2 - 3.3	1	3.2 - 3.3					
3.3 - 3.4	1	3.3 - 3.4					
3.4 - 3.5	1	3.4 - 3.5					
3.5 - 3.6	1	3.5 - 3.6					
3.6 - 3.7	1	3.6 - 3.7					
3.7 - 3.8	1	3.7 - 3.8					
3.8 - 3.9	2	3.8 - 3.9					
3.9 - 4.0	1	3.9 - 4.0					
4.0 - 4.1	2	4.0 - 4.1					
4.1 - 4.2	2	4.1 - 4.2					
4.2 - 4.3	2	4.2 - 4.3					
4.3 - 4.4	2	4.3 - 4.4					
4.4 - 4.5	3	4.4 - 4.5					
4.5 - 4.6	4	4.5 - 4.6					
4.6 - 4.7	3	4.6 - 4.7					
4.7 - 4.8	5	4.7 - 4.8					
4.8 - 4.9	5	4.8 - 4.9					
4.9 - 5.0	5	4.9 - 5.0					
5.0 - 5.1	5	5.0 - 5.1					
5.1 - 5.2	5	5.1 - 5.2					
5.2 - 5.3	5	5.2 - 5.3					
5.3 - 5.4	6	5.3 - 5.4					
5.4 - 5.5	6	5.4 - 5.5					
5.5 - 5.6	5	5.5 - 5.6					
5.6 - 5.7	6	5.6 - 5.7					
5.7 - 5.8	6	5.7 - 5.8					
5.8 - 5.9	7	5.8 - 5.9					
5.9 - 6.0	7	5.9 - 6.0					

Water at end (casing removed)

Water strike

BH Collapsed from
London Clay transition.

Remarks

Hammer Weight 63.5 ka

PROJECT NAME:		Observer Park											
SITE LOCATION:		Arborfield, Reading											
CLIENT:		Carbide Properties Ltd								JOB NO.:		64065	
START DATE:		26/03/2024				EASTING:				474973		BOREHOLE ID: WS02	
END DATE:		26/03/2024				NORTHING:				167279		TOTAL DEPTH: 3mbgl + DP to 6m	
MEASURING POINT: Ground Level DATUM ELEVATION (if available):													
Sample ID	Laboratory Testing	In-Situ Testing					GW	Legend	Stratum Thickness	Stratum Base	DESCRIPTION	% Recovery	Installation
		Test Type	N Value /Blows	Hand Pen.	DP								
0	ES1	Soil: env, asb									Grass over saturated soft, dark brown, peaty clay backfill with occasional fine flint. Strong eutrophic (anoxic) odour and abundant roots and rootlets.		
0.5	U1	MC, SO4/pH							0.45	0.45	MADE GROUND of soft, dark brown, slightly gravelly, organic-rich clay backfill with abundant roots and rootlets. Gravel of fine to medium, subrounded and fragmented flint.	U1 90%	
									0.25	0.70			
							R1		0.20	0.90	Medium-dense, orangish brown and green, slightly clayey, medium grained SAND. Occasional fine flint (RTD).		
1			SPTc	53					0.40		Firm wet, olive and brown, slightly gravelly, sandy CLAY. Gravel of fine to coarse, rounded to subrounded flint (RTD).		
	U2	PSD							1.30			U2 90%	
1.5							E1						
2									1.70		Dense, saturated, orangish brown, clayey, slightly silty SAND and GRAVEL. Sand of fine to coarse grain. Gravel of fine to medium, subangular to rounded and fragmented flints. Flint nodules between 2.6 and 2.8m (RTD).		
2.5			SPTc	45								U3 90%	
3									3.00				
3.5													
4													
4.5													
5													
5.5													
6													
6.5													
OTHER COMMENTS:										IN SITU KEY:		EQUIPMENT/MODALITY:	
Water encountered at 1.7m with 1m casing. At end of sampling, water at 0.95m which rose to 0.8m on removal of casing. Hole collapsed at 1.9m with dynamic probing continuation from 3m.										SPTc (cone) SPT (spoon) FH (falling head)		Archway Lite DS	
GW ENCOUNTERED:		Y		GW INFLOW RATE:		Seepage		INSTALLATION:		None		LOGGED: KLH CHECKED: KLH	

Date	26/03/2024	Site:	Observer Park, Arborfield	Borehole Number	WS02
Job Number	64065				
Depth (m)	N100 Blows	0 5 10 15 20 25			
0.0 - 0.1		0.0 - 0.1			
0.1 - 0.2		0.1 - 0.2			
0.2 - 0.3		0.2 - 0.3			
0.3 - 0.4		0.3 - 0.4			
0.4 - 0.5		0.4 - 0.5			
0.5 - 0.6		0.5 - 0.6			
0.6 - 0.7		0.6 - 0.7			
0.7 - 0.8		0.7 - 0.8			
0.8 - 0.9		0.8 - 0.9			
0.9 - 1.0		0.9 - 1.0			
1.0 - 1.1		1.0 - 1.1			
1.1 - 1.2		1.1 - 1.2			
1.2 - 1.3		1.2 - 1.3			
1.3 - 1.4		1.3 - 1.4			
1.4 - 1.5		1.4 - 1.5			
1.5 - 1.6		1.5 - 1.6			
1.6 - 1.7		1.6 - 1.7			
1.7 - 1.8		1.7 - 1.8			
1.8 - 1.9		1.8 - 1.9			
1.9 - 2.0		1.9 - 2.0			
2.0 - 2.1		2.0 - 2.1			
2.1 - 2.2		2.1 - 2.2			
2.2 - 2.3		2.2 - 2.3			
2.3 - 2.4		2.3 - 2.4			
2.4 - 2.5		2.4 - 2.5			
2.5 - 2.6		2.5 - 2.6			
2.6 - 2.7		2.6 - 2.7			
2.7 - 2.8		2.7 - 2.8			
2.8 - 2.9		2.8 - 2.9			
2.9 - 3.0		2.9 - 3.0			
3.0 - 3.1	2	3.0 - 3.1			
3.1 - 3.2	1	3.1 - 3.2			
3.2 - 3.3	2	3.2 - 3.3			
3.3 - 3.4	1	3.3 - 3.4			
3.4 - 3.5	2	3.4 - 3.5			
3.5 - 3.6	1	3.5 - 3.6			
3.6 - 3.7	2	3.6 - 3.7			
3.7 - 3.8	2	3.7 - 3.8			
3.8 - 3.9	2	3.8 - 3.9			
3.9 - 4.0	3	3.9 - 4.0			
4.0 - 4.1	3	4.0 - 4.1			
4.1 - 4.2	3	4.1 - 4.2			
4.2 - 4.3	4	4.2 - 4.3			
4.3 - 4.4	4	4.3 - 4.4			
4.4 - 4.5	4	4.4 - 4.5			
4.5 - 4.6	4	4.5 - 4.6			
4.6 - 4.7	5	4.6 - 4.7			
4.7 - 4.8	6	4.7 - 4.8			
4.8 - 4.9	6	4.8 - 4.9			
4.9 - 5.0	7	4.9 - 5.0			
5.0 - 5.1	7	5.0 - 5.1			
5.1 - 5.2	7	5.1 - 5.2			
5.2 - 5.3	8	5.2 - 5.3			
5.3 - 5.4	7	5.3 - 5.4			
5.4 - 5.5	8	5.4 - 5.5			
5.5 - 5.6	8	5.5 - 5.6			
5.6 - 5.7	9	5.6 - 5.7			
5.7 - 5.8	10	5.7 - 5.8			
5.8 - 5.9	10	5.8 - 5.9			
5.9 - 6.0	11	5.9 - 6.0			
Remarks					
Hammer Weight 63.5 kg					

Water at end (casing removed)

Water strike

BH Collapsed from

Likely London Clay transition.

PROJECT NAME:		Observer Park															
SITE LOCATION:		Arborfield, Reading															
CLIENT:		Carbide Properties Ltd										JOB NO.:		64065			
START DATE:		25/03/2024				EASTING:				474997				BOREHOLE ID:		WS03	
END DATE:		25/03/2024				NORTHING:				167210				TOTAL DEPTH:		3mbgl + DP to 6m	
MEASURING POINT: Ground Level														DATUM ELEVATION (if available):			
Sample ID	Laboratory Testing	In-Situ Testing					GW	Legend	Stratum Thickness	Stratum Base	DESCRIPTION	% Recovery	Installation				
		Test Type	N Value /Blows	Hand Pen.	DP												
0																	
ES1 U1	Soil: env SO4/pH								0.20	0.20	Grass over saturated soft, dark brown, peaty clay backfill mixed with straw. Strong eutrophic (anoxic) odour and abundant roots and rootlets. MADE GROUND of large concrete and brick fragments in clay matrix. MADE GROUND of firm, dark brown, slightly sandy, slightly gravelly clay backfill mixed with straw and abundant roots and rootlets. Gravel of coarse and cobbles of subrounded and fragmented flint and occasional brick fragment. Firm, wet, orangish brown, slightly gravelly, sandy, silty CLAY. Gravel of fine to coarse, subrounded, rounded and fragmented flints (RTD). Medium-dense to dense, saturated, orangish brown, slightly clayey, slightly silty SAND and GRAVEL. Sand of fine to coarse grain. Gravel of fine to medium, subangular to rounded and fragmented flints (RTD). Very soft, wet, dark grey, slightly silty CLAY (LONDON CLAY FORMATION).	U1 90%					
									0.10	0.30							
									0.15	0.45							
									0.15	0.60							
0.5																	
D1	WAC	SPTc	27									U2 80%					
1																	
1.5												U3 70%					
2	U3	PSD, SO4/pH	SPTc	69													
2.5																	
U3	MC/PI, SO4/pH								2.80								
									0.20	3.00							
3																	
3.5																	
4																	
4.5																	
5																	
5.5																	
6																	
6.5																	
OTHER COMMENTS: Water encountered at 0.9m with 2m casing. At end of sampling, water at 1.9m which rose to 1.5m on removal of casing. Hole collapsed at 2.6m with dynamic probing continuation from 3m.										IN SITU KEY: SPTc (cone) SPT (spoon) FH (falling head)		EQUIPMENT/MODALITY: Archway Lite DS					
GW ENCOUNTERED:		Y		GW INFLOW RATE:		Seepage		INSTALLATION:		None		LOGGED: KLH		CHECKED: KLH			

Date	25/03/2024	Site:	Observer Park, Arborfield	Borehole Number	WS03				
Job Number	64065				Comments				
Depth (m)	N100 Blows	0	5	10	15	20	25		
0.0 - 0.1		0.0 - 0.1						Water strike	
0.1 - 0.2		0.1 - 0.2							
0.2 - 0.3		0.2 - 0.3							
0.3 - 0.4		0.3 - 0.4							
0.4 - 0.5		0.4 - 0.5							
0.5 - 0.6		0.5 - 0.6							
0.6 - 0.7		0.6 - 0.7							
0.7 - 0.8		0.7 - 0.8							
0.8 - 0.9		0.8 - 0.9							
0.9 - 1.0		0.9 - 1.0							
1.0 - 1.1		1.0 - 1.1							
1.1 - 1.2		1.1 - 1.2							
1.2 - 1.3		1.2 - 1.3							
1.3 - 1.4		1.3 - 1.4							
1.4 - 1.5		1.4 - 1.5							
1.5 - 1.6		1.5 - 1.6							Water at end (casing removed)
1.6 - 1.7		1.6 - 1.7							
1.7 - 1.8		1.7 - 1.8							
1.8 - 1.9		1.8 - 1.9							
1.9 - 2.0		1.9 - 2.0							
2.0 - 2.1		2.0 - 2.1							
2.1 - 2.2		2.1 - 2.2							
2.2 - 2.3		2.2 - 2.3							
2.3 - 2.4		2.3 - 2.4							
2.4 - 2.5		2.4 - 2.5							
2.5 - 2.6		2.5 - 2.6							BH Collapsed from London Clay transition.
2.6 - 2.7		2.6 - 2.7							
2.7 - 2.8		2.7 - 2.8							
2.8 - 2.9		2.8 - 2.9							
2.9 - 3.0		2.9 - 3.0							
3.0 - 3.1	1	3.0 - 3.1							
3.1 - 3.2	1	3.1 - 3.2							
3.2 - 3.3	1	3.2 - 3.3							
3.3 - 3.4	1	3.3 - 3.4							
3.4 - 3.5	2	3.4 - 3.5							
3.5 - 3.6	1	3.5 - 3.6							
3.6 - 3.7	2	3.6 - 3.7							
3.7 - 3.8	2	3.7 - 3.8							
3.8 - 3.9	2	3.8 - 3.9							
3.9 - 4.0	2	3.9 - 4.0							
4.0 - 4.1	3	4.0 - 4.1							
4.1 - 4.2	2	4.1 - 4.2							
4.2 - 4.3	3	4.2 - 4.3							
4.3 - 4.4	2	4.3 - 4.4							
4.4 - 4.5	3	4.4 - 4.5							
4.5 - 4.6	2	4.5 - 4.6							
4.6 - 4.7	5	4.6 - 4.7							
4.7 - 4.8	4	4.7 - 4.8							
4.8 - 4.9	4	4.8 - 4.9							
4.9 - 5.0	5	4.9 - 5.0							
5.0 - 5.1	5	5.0 - 5.1							
5.1 - 5.2	4	5.1 - 5.2							
5.2 - 5.3	5	5.2 - 5.3							
5.3 - 5.4	6	5.3 - 5.4							
5.4 - 5.5	5	5.4 - 5.5							
5.5 - 5.6	4	5.5 - 5.6							
5.6 - 5.7	5	5.6 - 5.7							
5.7 - 5.8	5	5.7 - 5.8							
5.8 - 5.9	4	5.8 - 5.9							
5.9 - 6.0	5	5.9 - 6.0							
Remarks									
Hammer Weight 63.5 kg									

PROJECT NAME:		Observer Park											
SITE LOCATION:		Arborfield, Reading											
CLIENT:		Carbide Properties Ltd								JOB NO.:		64065	
START DATE:		25/03/2024				EASTING:				475016		BOREHOLE ID: WS04	
END DATE:		25/03/2024				NORTHING:				167141		TOTAL DEPTH: 2mbgl + DP to 6m	
MEASURING POINT: Ground Level DATUM ELEVATION (if available):													
Sample ID	Laboratory Testing	In-Situ Testing					GW	Legend	Stratum Thickness	Stratum Base	DESCRIPTION	% Recovery	Installation
		Test Type	N Value /Blows	Hand Pen.	DP								
0													
D1	WAC								0.50		Grass over dark brown, organic-rich, peaty clay backfill with abundant roots and rootlets and occasional fine flint.		
0.5							R1		0.50			U1 80%	
ES1	Soil: BRE								0.40		Firm, wet, orangish brown, slightly gravelly, sandy CLAY. Gravel of fine to coarse, subrounded, rounded and fragmented flints (RTD).		
									0.90				
1		SPTc	54				E1		0.80		Dense, saturated, orangish brown, slightly silty, slightly clayey SAND and GRAVEL. Sand of fine to coarse grain. Gravel of fine to medium, subangular to rounded and fragmented flints (RTD).	U2 90%	
1.5									1.70				
2									0.30		Soft, wet, yellowish brown, slightly sandy CLAY (RTD).		
		SPTc	6						2.00				
2.5													
3													
3.5													
4													
4.5													
5													
5.5													
6													
6.5													
OTHER COMMENTS: Water encountered at 1.5m with 1m casing. At end of sampling, water at 0.7m which rose to 0.53m on removal of casing. Hole collapsed at 1.6m with dynamic probing continuation from 2m.										IN SITU KEY: SPTc (cone) SPT (spoon) FH (falling head)		EQUIPMENT/MODALITY: Archway Lite DS	
GW ENCOUNTERED:		Y		GW INFLOW RATE:		Seepage		INSTALLATION:		None		LOGGED: KLH CHECKED: KLH	