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1 INTRODUCTION

1.1 Commissioning

RSK Environment Limited (RSK) was commissioned by Furness Partnership Limited (the Client), to carry out a Phase 2 Geo-environmental and Geotechnical Site Investigation of the land at Gravesham Leisure Centre, Thong Lane, Gravesend, DA12 4LG. The project was carried out to an agreed brief as set out in RSK's proposal (Ref. 52511, dated 20th February 2023).

RSK's service constraints are shown in **Appendix A**.

The Site in question is being considered for development for commercial end-use.

1.2 Objectives

The objective of the work is:

- to identify any land contamination and/or geotechnical constraints to the proposed development and to support discharge of relevant planning conditions and relevant building control requirements
- to identify the need for any additional investigation or remediation works to demonstrate that the site is suitable for its proposed use

1.3 Scope of works

The scope of this assessment has been developed in accordance with relevant British Standards and authoritative technical guidance as referenced through the report. The assessment of the contamination status of the site is in line with the technical approach presented in Land Contamination Risk Management (LCRM) (Environment Agency, 2021a) and in general accordance with BS 10175: 2011 + A2 2017 (BSI, 2017). It is also compliant with relevant planning policy and guidance.

The scope of the intrusive investigation has been designed in line with the recommendations of BS5930:2015+A1:2020 Code of practice for ground investigations (BSI, 2020), which maintains compliance with BS EN 1997-1 and 1997-2 and their related standards. It has also been developed in general accordance with BS 10175: 2011 + A2 2017. Ground gas assessment has been undertaken in general accordance with BS8576: 2013 and BS 8485:2015+A1:2019.

A brief summary of relevant legislation and policy relating to land contamination is given in **Appendix B**.

The scope of works for the assessment has included the following:

Intrusive investigation

- Implementation of an intrusive investigation, in situ testing, soil sampling, laboratory geo-environmental and geotechnical testing and ground gas monitoring of installed boreholes

- interpretation of data to develop a refined conceptual site model (CSM)
- generic quantitative risk assessment (GQRA) of relevant contaminant linkages
- interpretation of ground conditions and geotechnical data to provide preliminary recommendations with respect to foundations and infrastructure design
- preliminary assessment of the potential waste classification; and,
- preparation of this factual and/or interpretative report.

1.4 Existing reports

The following reports detailing previous works at the site were made available for review:

- Albury SI Ltd - Phase 1 Desk Study, Ref: 22/12488/KFJ Rev 1, Dated: November 2022

Pertinent information from these reports has been summarised in Section 3.

1.5 Limitations

This report is subject to the RSK service constraints given in **Appendix A** and limitations that may be described through this document.

2 SITE DETAILS

2.1 Site location

Site location details are presented in **Table 1** and a site location plan is provided on **Figure 1**.

Table 1 Site location details

Site name	Gravesham Leisure Centre
Full site address and Post code	Thong Lane, Gravesend, DA12 4LG
National Grid reference (centre of site)	TQ 67056 71659

2.2 Site description

The Site boundary and current site layout are shown on **Figure 2**. The Site covers an area of c. 4.45 hectares. It is currently occupied by a Leisure centre, a playing field and associated car parking.

2.3 Surrounding land uses

The Site is located in Gravesend, within a predominantly residential setting. Immediate surrounding land uses are described in **Table 2**.

Table 2 Surrounding land uses

North	Gravesend Gold Centre
East	Southern Valley Gold Club (permanently closed)
South	Southern Valley Gold Club (permanently closed), Thong Lane and Residential properties
West	Thong Lane, Residential development

2.4 Development plans

The proposed development is to redevelop the site with a new leisure centre to the south of the existing one. The existing leisure centre will be demolished, and a new car park will be constructed in its place.

3 DESK-BASED ASSESSMENT

3.1 Phase 1 Desk Study Summary

The Phase 1 Desk Study was written by Albury SI Ltd for Gravesham Borough Council and was issued on the 22 November 2022 (ref: 22/12488/KFJ).

Key features of the historical map review largely centred around the site's location within a former WWII Airfield. More specifically the subject site was located within the eastern extents of former RAF Gravesend Airfield from 1930's by a perimeter concrete taxiway servicing the centrally located airfield further west. The airfield was later disused and subsequently demolished late 1960's/early 1970's and followed by redevelopment as a recreational sports ground and associated leisure centre. Zetica (2022), defined the subject site as being a 'high' risk from UXO.

The Geology of the area is predominantly Seaford Chalk Formation. Thanet Sand Formation overlies the Seaford Chalk and outcrops locally (south). Made Ground is anticipated throughout.

The aquifers underlying the site include Principal aquifer of high vulnerability relating to the Seaford Chalk Formation and Secondary A aquifer relating to the Thanet Sand Formation. The site is not located within a designated Source Protection Zone (SPZ) and there are no groundwater abstractions located within 1.7km of the subject site.

The site is predominantly in a lower probability radon affected area as less than 1% of properties are above the action level. An area of the southern part of the site in an area between 1-3% of properties are above the action level¹.

There is no surface water feature within 500m of the site. The site is at negligible risk from groundwater flooding. Anticipated depth to groundwater is estimated to be in excess of 20m bgl.

There are no active or inactive registered landfill sites listed within 500m of the site. No relevant trade directory information was available for the site or immediate area. An obsolete fuel station was present 357m southwest of the site.

A site walkover was undertaken on the 28th October 2022 and no obvious signs of contamination were noted.

The initial conceptual site model identified the following potentially complete pollutant linkages:

- PAH's, hydrocarbons, heavy metals, TCE/PCE from a former airfield workshop and Broadcasting House which could impact site workers and end workers through migration, ingestion and dermal contact
- Pool Chemicals (pH extremes) impacting site workers and end users through migration, ingestion, inhalation, and dermal contact; and,

¹ in December that the UK Health Security Agency (UKHSA) and British Geological Survey (BGS) updated the UK maps of Radon see www.ukradon.org/. Revised mapping data indicates the subject site is now entirely located within an area defined as 1-3% above the action threshold. In England Basic Radon Protection is recommended where more than 3% homes are above the action level. Based upon updated Radon Mapping data, there is still no requirement for Radon Protection measures as part of any future development plans.

- Ground gas from possible infilled ground to the southeast as well as made ground impacting proposed buildings through migration, ingress and accumulation.

Geotechnical risks were assigned an overall 'moderate' risk valuation owing to the potential for dissolution features (south). No natural cavities were recorded within 500m of the site.

Recommendations of further works included the commission of an intrusive site investigation to prove the underlying natural strata and characterise any made ground. It is recommended that the site investigation target historical features highlighted in the report and that the testing focus on contaminants identified within the CSM. Ground gas monitoring was also recommended due to the possible presence of made ground on site and to the southeast of site.

4 SITE RECONNAISSANCE FINDINGS

A site reconnaissance survey was completed March 2023 by RSK. The characteristics of the site observed during the walkover and from current ordnance Survey maps are summarised in **Table 3**.

A site plan is provided in **Figure 2** with photographic records included in **Appendix D** detailing the main features identified below.

Whilst the walkover summary includes consideration of current operations and housekeeping on the site as potential sources of contamination, it does not constitute a comprehensive environmental audit of the site, as covered under ISO 14001.

Table 3 Site reconnaissance findings

Feature observed	Presence Y/N	Description
Physical characteristics		
1. Are there any access constraints?	Y	The site contained barriers into different areas such as the car park and the southern field. Silver gate to eastern field from car park. Gate to eastern side of building. Western access pedestrian gate only
2. Is the site approximately level?	N	There is a bank to the south of the car park and to the east of western field. Site gently slopes towards the south with elevations approximately ranging between 68m and 70m AOD.
3. Any evidence of subsidence, landslip or slope erosion?	N	N/A
4. Any changes in level between the site and adjacent sites?	N	N/A
5. Surface cover	-	a) Approx. 40% unsurfaced
	-	b) Approx. 30% hard surfacing
	-	c) Approx. 30% buildings
Environmental characteristics		
6. Vegetation on site	Y	Many mature trees across site
7. Evidence for vegetation stress	N	N/A
8. Invasive species	N	N/A
9. Surface water features	N	N/A
10. Site drainage	Y	Surface water will run off to drains or will percolate directly into the ground.

Feature observed	Presence Y/N	Description
Structures and services		
11. Existing buildings on-site	Y	The Cascade Leisure Centre and the Regards Bar & Café.
12. Buried and overhead services present	Y	Buried
	N	Overhead
13. Underground structures	Y	Basement swimming pools
Geotechnical characteristics		
14. Evidence of damage to existing building structures on site?	N	N/A
15. Remains of building structures present on or adjacent to site?	N	N/A
16. Retaining walls and adjacent buildings on or close to site boundary?	Y	Existing basement walls act as retaining structures
17. Any abrupt changes in ground level present on or adjacent to site?	N	N/A
18. Any potentially unstable slopes/ exposed ground present on or adjacent to site?	N	N/A
19. Any mature trees on site?	Y	Boundary tree
20. Any visual evidence of infilled basements on site?	N	N/A
Potential evidence for contamination		
21. Underground/ above ground storage tanks and pipework	N	N/A
22. Potentially hazardous materials storage and use	N	N/A
23. Waste storage	Y	To the west of the building.
24. Fly-tipping	Y	To the west of the building.

Feature observed	Presence Y/N	Description
25. Electricity sub-stations/ transformers	Y	To the north of the building.
26. Asbestos-containing materials	N	N/A
27. Fire suppression	N	N/A
28. Fire history	N	N/A
29. Is there any visual evidence of potential contamination on site?	N	N/A
30. Is there any visual evidence of potential contamination on adjacent sites?	N	N/A

Potentially significant land contamination or geotechnical issues arising from the survey are summarised below:

- Electrical Substation located to the north of the Cascade Leisure Centre.

5 PRELIMINARY GEOTECHNICAL CONSTRAINTS

5.1 Preliminary geotechnical hazards assessment

A summary of commonly occurring geotechnical hazards associated with the anticipated geology outlined in Section 4.5 above is given in **Table 4** together with an assessment of whether the site may be affected by each of the stated hazards.

Table 4 Summary of preliminary geotechnical risks that may affect site

Hazard category	Hazard status based on desk study findings and proposed development		Engineering considerations if hazard affects site
	Could be present and/or affect site	Unlikely to be present and/or affect site	
Sudden lateral changes in ground conditions	☒	☐	Likely to affect ground engineering and foundation design and construction
Shrinkable clay soils	☐	☒	Design to NHBC Standards Chapter 4 or similar
Highly compressible and low bearing capacity soils, (including peat and soft clay)	☐	☒	Likely to affect ground engineering and foundation design and construction
Silt-rich soils susceptible to rapid loss of strength in wet conditions	☒	☐	Likely to affect ground engineering and foundation design and construction
Running sand at and below water table	☒	☐	Likely to affect ground engineering and foundation design and construction
Karstic dissolution features (including 'swallow holes' in Chalk terrain)	☒	☐	May affect ground engineering and foundation design and construction – refer to Section 6.2.1.
Evaporite dissolution features and/or subsidence	☒	☐	May affect ground engineering and foundation design and construction
Ground subject to or at risk from landslides	☐	☒	Likely to require special stabilisation measures
Ground subject to periglacial valley cambering with gulls possibly present	☐	☒	Likely to affect ground engineering and foundation design and construction

Hazard category	Hazard status based on desk study findings and proposed development		Engineering considerations if hazard affects site
	Could be present and/or affect site	Unlikely to be present and/or affect site	
Ground subject to or at risk from coastal or river erosion	☐	☒	Likely to require special protection/stabilisation measures
High groundwater table (including waterlogged ground)	☐	☒	May affect temporary and permanent works
Rising groundwater table due to diminishing abstraction in urban area	☐	☒	May affect deep foundations, basements and tunnels
Geological faults, fissures and break lines	☐	☒	May affect ground engineering and foundation design and construction
Underground mining including shafts and adits (e.g. coal, mineral)	☐	☒	Likely to require further assessment including potentially special stabilisation measures
Effects of extreme temperature (e.g. cold stores or brick kilns/furnaces)	☐	☒	Likely to affect ground engineering and foundation design and construction
Existing sub-structures (e.g. tunnels, foundations, basements, and adjacent sub-structures)	☒	☐	Likely to affect ground engineering and foundation design and construction
Filled and made ground (including embankments, infilled ponds and quarries)	☒	☐	Likely to affect ground engineering and foundation design and construction
Adverse ground chemistry (including expansive slags and weathering of sulphides to sulphates)	☐	☒	May affect ground engineering and foundation design and construction
Site topography	☐	☒	May affect ground engineering and foundation design and construction
Note: Seismicity is not included in the above table as this is not normally a design consideration in the UK.			

5.1.1 Natural cavity occurrence assessment

In view of the prevailing ground conditions, with Chalk at shallow depth beneath the site, it is normal practice to consider the potential risk of ground subsidence related to the presence of swallow holes and other natural chalk solution features or man-made cavities.

Based on Albury SI Ltd Phase 1 PRA report, the majority of the northern part of the site is classed as 'very low' risk of ground dissolution features, with the southern portion an area of 'moderate risk'. No natural cavities were recorded within 500m of the site.

6 SITE INVESTIGATION STRATEGY & METHODOLOGY

6.1 Introduction

RSK carried out intrusive investigation works and subsequent monitoring of boreholes between 16th March 2023 and 27th March 2023.

6.2 Objectives

The specific objectives of the investigation were as follows:

- to establish the ground conditions underlying the site including the extent and thickness of any made ground;
- to investigate specific potential sources of contamination identified in initial CSM;
- to determine groundwater depth and flow direction;
- to determine the ground gas regime underlying the site; and
- to assess geotechnical properties of soils.

6.3 Selection of investigation methods

The techniques adopted for the investigation were chosen with consideration of the objectives and site constraints, which are described below.

Window sample and cable percussive drilling was chosen based on the targeted drill depth, requirement for in-situ geotechnical data, the opportunity to collect disturbed samples and install monitoring wells. This was supplemented by mechanically excavated trial pitting to obtain a number of investigation locations, achieve greater visibility of any made ground and to run BRE 365 tests to obtain infiltration rates. Soakage tests were also undertaken in existing soakage chambers.

Prior to conducting intrusive works, utility service plans were obtained and buried service clearance undertaken in line with RSK's health and safety procedures. Copies of statutory service records were obtained by Furness Partnership Limited and can be seen in **Appendix C**.

6.4 Investigation strategy

The ground investigation was carried out using intrusive ground investigation techniques in general accordance with the recommendations of BS5930:2015+A1:2020, which maintains compliance with BS EN 1997-1 and 1997-2 and their related standards. Whilst every attempt was made to record full details of the strata encountered in the boreholes, techniques of hole formation and sampling will inevitably lead to disturbance, mixing or loss of material in some soils and rocks.

The investigation strategy involved non-targeted boreholes and trial pits. The investigation comprised an exploratory investigation.

Details of the investigation locations, installations and rationale are presented in **Table 5**. Five (5no.) machine excavated trial pits were dug to a maximum depth of 3.50m bgl before being backfilled with arisings. Three (3no.) of these excavated trial pits were used for undertaking BRE365 soakage tests. In addition, soakage tests were undertaken in the existing soakage chambers on site. Six (6no.) window sample boreholes were drilled to a maximum depth of 4.45 m bgl and three (3no.) cable percussive boreholes were drilled to a maximum of 20.45m bgl. Each borehole was installed with a combined gas and groundwater monitoring well. Furthermore, six (6no.) hand pits were undertaken up to a maximum depth of 1.20m bgl, to expose existing building foundations. An exploratory hole location plan is shown on **Figure 3**.

Table 5 Exploratory hole and monitoring well location rationale

Investigation type	Number	Designation	Monitoring well installation	Rationale examples below
Boreholes by cable percussive methods	3	BH1 to BH3	Gas/ groundwater	To prove the geological succession beneath the site and obtain geotechnical data.
Boreholes by windowless sampling methods	6	WS1 to WS6	Gas/ groundwater	To determine the contamination status of the ground beneath the site and to install additional dual-purpose groundwater and gas monitoring wells.
Trial-pits excavated by mechanical excavator	5	TP1 to TP2 and SA1-SA3	n/a	To accurately log the upper strata in non-targeted locations beneath the site, to collect samples from the shallow made ground soils and to facilitate BRE365 soakage testing.
BRE365 trial pit soakage testing	3	SA1-SA3	n/a	To obtain infiltration rates of the shallow soils in the northwestern area of site.
Hand dug pits	6	HP01-HP06	n/a	To prove the shallow geological succession beneath the site and expose existing building foundations.
Soakage tests undertaken in existing soakage chambers	3	EXSA01-EXSA03	n/a	To obtain infiltration rates within the northeastern area of site.

6.4.1 Implementation of investigation works

The site investigation works were carried out in general accordance with the UK Specification for Ground Investigation (UKSGI), third edition (AGS, 2022).

The exploratory holes were logged by an engineer in general accordance with the recommendations of BS5930:2015+A1:2020 (which incorporates the requirements of BS EN ISO 14688-1, 14688-2 and 14689-1).

The monitoring well construction and associated response zones are detailed on the exploratory hole records in **Appendix F**. The response zones were installed to target identified gas generation sources detailed in the initial preliminary CSM.

The soil sampling and analysis strategy was designed to characterise each encountered soil strata, permit an assessment of the potential contaminant linkages identified and investigate the geotechnical characteristics. In addition, samples were taken to allow for geo-environmental and geotechnical testing to be undertaken.

Soils collected for laboratory analysis were placed in a variety of containers appropriate to the anticipated testing suite required. They were dispatched to the laboratory in cool boxes under chain of custody documentation. Samples were stored in accordance with the RSK quality procedures to maintain sample integrity and preservation and to minimise the chance of cross contamination.

Selected samples were placed in polythene bags for headspace screening with a photo-ionisation detector (PID) fitted with a 10.6 eV bulb. The PID screening results are presented on the exploratory hole records.

6.5 Monitoring programme

6.5.1 Ground gas monitoring

In line with the initial CSM, response zones were installed to target the sources or pathways as detailed in the existing Phase 1 desk study report by Albury SI Ltd.

Three (3no.) monitoring rounds have been undertaken to provide data to support refining of the CSM. The number of monitoring rounds undertaken is in general accordance with the decision matrix presented as Figure 6 of BS8576 for a 'very low' to 'low' source generation potential.

A calibrated infrared gas meter was used to measure gas flow, concentrations of carbon dioxide (CO₂), methane (CH₄) and oxygen (O₂) in percentage by volume, while hydrogen sulphide (H₂S) and carbon monoxide (CO) were recorded in parts per million.

Initial and steady state concentrations were recorded. In addition, during the first monitoring round, all wells were screened with a PID to establish if there are any interferences and cross-sensitivity of other hydrocarbons with the infrared gas meter.

The atmospheric pressure before and during monitoring, together with the weather conditions, were recorded. The monitoring included periods of falling atmospheric pressures and after/during rainfall.

All ground gas monitoring results together with the temporal conditions are contained within **Appendix G**. Equipment calibration certificates are available on request.

6.5.2 Groundwater monitoring

Three (3no.) rounds of groundwater monitoring were undertaken on a weekly basis.

Depths to groundwater were recorded using an electronic dip meter on each of the return monitoring visits. The groundwater depths can be seen in the gas monitoring data found in **Appendix G**.

6.6 Laboratory testing

Laboratory testing was undertaken at a UKAS accredited laboratory with ISO17025 and MCERTS accredited test methods were specified where applicable for contamination testing and as shown in the laboratory test certificates appended.

6.6.1 Chemical analysis of soil samples

The soil sampling strategy was designed to characterise made ground and natural strata typically within the upper 1.00m of the ground profile as well as to evaluate the potential for contaminant migration from relevant sources identified within the preliminary CSM.

The programme of chemical tests undertaken on soil samples obtained from the intrusive investigation is presented in **Table 6** with the laboratory testing results contained in **Appendix H**.

Table 6 Summary of chemical testing of soil samples

Stratum	Tests undertaken	No. of tests
Made ground	Soils Suite 2 – Speciated PAH-16MS, TPHCWG (Spec. TPH), pH, As, Cd, Cr, Cu, Hg, Pb, Ni, Se, Zn, Total	10
	Hexavalent Chromium (Cr VI)	5
	ACM Screen, ID and quant %	10
	VOC Suite	1
	PCB Contained EC & WHO 12	1
	WAC-12 Single Stage	2
	Haswaste Suite	3
Natural Soils	Soils Suite 2 – Speciated PAH-16MS, TPHCWG (Spec. TPH), pH, As, Cd, Cr, Cu, Hg, Pb, Ni, Se, Zn, Total	8
	TOC	5
	ACM Screen, ID and quant %	8

6.6.2 Geotechnical analysis of soils

Where appropriate disturbed, bulk and undisturbed soil samples were taken for geotechnical classification testing with the depth and nature of samples detailed within the exploratory hole records.

Where appropriate, testing was undertaken in accordance with BS 1377:1990 Method of Tests for Soils for Civil Engineering Purposes or, where superseded, by the relevant part of BS EN ISO 17892:2014 Geotechnical investigation and testing - Laboratory Testing of

Soil. Tests carried out in order to classify the concrete class required on-site have been undertaken following the procedures within BRE SD1:2005.

The programme of geotechnical tests undertaken on samples obtained from the intrusive investigation is presented in **Table 7**. The results and UKAS accreditation of tests methods are shown in **Appendix I**.

Table 7 Summary of geotechnical testing undertaken

Strata	Tests undertaken	No. of tests
Made ground	Moisture content (%)	2
	1pt Liquid and Plastic limits (%)	2
Reworked ground	Moisture content (%)	5
	1pt Liquid and plastic limits (%)	5
	pH&WSO ₄	1
White Chalk Subgroup	Moisture content (%)	2
	1pt Liquid and plastic limits (%)	2
	Saturation moisture content (SMC) (%)	7
	pH&WSO ₄	10

6.6.3 Infiltration testing

Infiltration tests were carried out in trial pits, SA01 to SA03 to establish the infiltration rate of the near surface soils. The tests were carried out generally in accordance with the method described in BRE Digest 365 (BRE, 2016). This involved filling the pits with water from a tanker and recording the drop in water level with time as the water soaked into the ground.

The existing open soakage chambers on site were also tested in accordance with the method described in BRE Digest 365 (BRE, 2016).

Copies of the testing records are included in **Appendix F**.

7 SITE INVESTIGATION FACTUAL FINDINGS

The results of the intrusive investigation and subsequent geo-environmental and geotechnical laboratory analysis undertaken are detailed below.

7.1 Ground conditions encountered

The descriptions of the strata encountered, notes regarding visual or olfactory evidence of contamination, list of samples taken, field observations of soil and groundwater, in-situ testing and details of monitoring well installations are included on the exploratory hole records presented in **Appendix F**.

The exploratory holes revealed that the site is underlain by an initial thickness of made ground / topsoil overlying a thin veneer of what is believed to be reworked ground. Beneath this, the White Chalk Subgroup was encountered and proven to the final depth of investigation. Thanet Sand Formation was not encountered.

For the purpose of discussion, the ground conditions encountered during the fieldworks are summarised in **Table 8** with the strata discussed in subsequent subsections.

Table 3 General succession of strata encountered

Stratum	Exploratory holes encountered	Depth to top of stratum m bgl	Proven thickness (m)
Made ground	BH1 and BH3 WS5 SA1 and SA2 TP2 all HPs	G.L. to 0.30	0.30 to 1.20 (not proven in HP2, HP3 and HP5 to max 1.40m bgl)
Topsoil	BH2 and BH3 all WSs SA3 TP1 to TP2 HP3	G.L.	0.10 to 0.50
Reworked ground	all BHs all WSs SA3 TP1 to TP2 HP4 and HP6	0.30 to 1.50	0.15 to 1.30 (not proven in HP4 and HP6 to max 1.20m bgl)
White Chalk Sub-Group	all exploratory holes except HP2 to HP6	0.40 to 1.70	Proven to the full depth of the investigation (20m bgl)

7.1.1 Made Ground / Topsoil

Superficial layer of made ground / topsoil were encountered across the entire site from the surface, varying in thickness of between 0.10m and 1.20m. The made ground was encountered from the surface in areas of hardstanding only, whereas at all other locations it was recorded beneath the topsoil.

Underneath the initial bituminous bound layer tarmac, the made ground comprise granular sub-base layer (Type 1 material), while at other locations, the unit comprised, silt and clay with variable proportions of anthropogenic material.

A large proportion of the exploratory holes revealed the near surface materials to comprise topsoil, typically consisting of dark brown silty sand with variable proportions of flint, chalk and brick.

7.1.2 Reworked ground

This stratum was encountered from beneath the made ground / topsoil with thickness of between 0.15m and 1.30m, and generally comprised a firm to stiff, sandy, silty gravelly clay / sandy, gravelly, clayey silt or medium dense gravelly sand / sandy gravel.

A summary of the in-situ and laboratory test results recorded in the stratum are presented in **Table 9**.

Table 9 Summary of in-situ and laboratory test results for reworked ground

Soil parameters	Min. Value	Max. Value	Reference
Moisture content (%)	14.8	28	Appendix I
Modified moisture content (%)	17	31	-
Liquid limit (%)	33	55 (locally 80)	Appendix I
Plasticity limit (%)	17	24 (locally 40)	
Plasticity index (%)	16	31 (locally 40)	
Modified plasticity index (%)	13	29	-
Plasticity term	Low	High	Appendix I
Consistency term (based on field descriptions)	Firm	Stiff	Appendix F
Volume change potential	Low	Medium	-
SPT 'N' values	21	40	Appendix F
Undrained shear strength using shear vane (kN/m ²)	55		

7.1.3 White Chalk Sub-Group

The White Chalk was recovered as a structureless melange of off-white gravelly silt of low density, fine to coarse angular to sub-angular chalk clasts. This, however, is not considered likely to represent the in-situ condition of the chalk due to the inherently destructive nature of the drilling technique. The majority of the in-situ SPT 'N' values ranged between SPT'N'=10 to 50, suggesting the presence of a clast dominated matrix.

Locally low strength values (SPT 'N'= ≤ 10) were recorded in BH1 and BH2, which is likely to be reflective of a heavily weathered surface in the chalk.

A summary of the in-situ and laboratory test results recorded in the stratum are presented in **Table 10**.

Table 10 Summary of in-situ and laboratory test results for granular unit

Soil parameters	Min. Value	Max. Value	Reference
SPT 'N' values	11 (locally 6 to 10)	>50 (refusal)	Appendix F
Bulk Density (Mg/m ³)	1.75	1.90	Appendix I
Dry Density (Mg/m ³)	1.43	1.47	
Saturated Moisture Content %	31	33	
Estimated density based on the SMC/DD	Low		-

7.1.4 Visual/olfactory evidence of soil contamination

Other than the presence of made ground with variable anthropogenic content, there was no other forms of significant soil contamination.

7.2 Existing foundations

Six (6no.) hand excavated trial pits (HP1 to HP6) were undertaken at predetermined locations to establish the details of the existing building foundations. Details of the exposures are presented in **Appendix F**.

7.3 Groundwater

Groundwater was not encountered during the investigation works or subsequent monitoring.

7.3 Chemical laboratory results

The soil testing results are presented in **Appendix H**.

7.4 Geotechnical laboratory results

The results of the geotechnical testing are discussed in Section 11 and presented in **Appendix I**.

7.5 Ground gas monitoring

The results of the ground gas monitoring and testing carried out are given in **Appendix G** and discussed in Section 8.

8 GEO-ENVIRONMENTAL ASSESSMENT

8.1 Linkages for assessment

As described in LCRM (Environment Agency, 2021a), there are two stages of quantitative risk assessment (QRA), Tier 2 generic (GQRA) and Tier 3 detailed (DQRA). The GQRA comprises the comparison of soil, groundwater, soil gas and / or ground gas results with generic assessment criteria (GAC) that are appropriate to the linkage being assessed. This comparison can be undertaken directly against the laboratory results or following statistical analysis depending upon the sampling procedure that was adopted. This assessment relates to LCRM Stage 1, Tier 2 generic quantitative risk assessment.

Potentially complete contaminant linkages taken forward for further assessment and the methodology of assessment are presented in **Table 11**.

Note that construction workers and future maintenance workers have not been identified in the conceptual model as receptors because risks are considered to be managed through health and safety procedures according to the CDM Regulations.

Where there are potential instances that construction methods may result in short-term environmental impacts, these will need to be assessed at design stage, within a construction phase environmental management plan and where required, mitigation measures put in place.

Table 11 Linkages for GQRA

Potentially relevant contaminant linkage	Assessment method
Human health and phytotoxic-related linkages	
H1. Oral, dermal and inhalation exposure with impacted soil, soil vapour and dust by future residents	Human health GAC in Appendix J for a proposed commercial end-use.
H2. Inhalation exposure of future residents to asbestos fibres	Qualitative assessment based on the asbestos minerals present, their form, concentration, location and the nature of the proposed development.
H3. Uptake of contaminants by vegetation potentially impacting plant growth (phytotoxicity)	Comparison of soil data to GAC in Appendix K for phytotoxicity.
H4. Organic contaminants permeating potable water supply pipes	Comparison of soil data to GAC in Appendix L for plastic water supply pipes using UKWIR (2010) guidance.
Ground gas-related linkages	
G1. Concentrations of methane and carbon dioxide in ground gas entering and accumulating in enclosed spaces or small rooms	Borehole hazardous gas flow rates (Q _{hg}) have been calculated using maximum (peak) methane and carbon dioxide concentrations and steady state flow rates in accordance with BS8485. This is subject to

Potentially relevant contaminant linkage	Assessment method
in new buildings, which could affect future site users. For methane this could create a potentially explosive atmosphere, while death by asphyxiation could result from carbon dioxide.	interpretation and use of professional judgement to designate the site or zones of the site characteristic situation by comparison to a Gas Screening Value (GSV) as appropriate and in line with the CSM.

8.2 Methodology and assessment of human health and phytotoxic-related linkages

8.2.1 H1. Oral, dermal and inhalation exposure with impacted soil by future occupants/site users

As an initial assessment of each dataset, all soil results in each dataset have been directly compared against the GAC for commercial end-use.

Results indicate that all contaminants are below the relevant GAC therefore it is considered that a relevant contaminant linkage does not exist.

8.2.2 H2. Inhalation exposure of future occupants/site users to asbestos fibres

The visual inspection at the laboratory identified no materials suspected of potentially containing asbestos and the scheduled laboratory screening for asbestos found no detectable asbestos fibres within the samples of made ground and reworked natural soils submitted for subsequent analysis.

8.2.3 H3. Uptake of contaminants by vegetation potentially inhibiting plant growth (phytotoxicity)

The results have been compared with the GAC presented in **Appendix K** for this linkage. The soil screening output spreadsheet for this linkage is presented in **Appendix M**.

In summary, of the 18no. representative soil samples submitted, localised elevated concentrations of Mercury (8no.), Zinc (3no.) and Cadmium (1.no.) were recorded within the shallow made ground/reworked soils.

The results indicate that a relevant contaminant linkage may exist associated with phytotoxic effects.

8.2.4 H4. Organic contaminants permeating potable water supply pipes

For initial assessment purposes, the results of the investigation have been compared with the GAC presented in **Appendix L** for this linkage, which are reproduced from *UKWIR Report 10/WM/03/21. Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites* (UKWIR, 2010).

The results indicate that a relevant linkage may exist associated with organic contaminants and therefore pollutant polyethylene (PE) and/or polyvinyl chloride (PVC) water supply pipes are expected to be unsuitable for use on the development unless remedial measures are implemented that mitigate the risk.

It should be noted that at the time of this investigation the future routes of water supply pipes had not been established, hence the investigation and sampling strategy may not be fully compliant with UKWIR recommendations. Consequently, a targeted investigation and specific sampling/analytical strategy may be required at a later date once the route(s) of the supply pipe(s) are known. In addition, it is recommended that the relevant water supply company be contacted at an early stage to confirm its requirements for assessment, which may not necessarily be the same as those recommended by UKWIR.

8.3 G1: Methodology and assessment of ground gas-related linkages

8.3.1 Appropriate guidance

The risks to development from ground gases have been assessed in accordance with BS8485:2015+A1:2019 (BS8485), which provides guidance on ground gas (methane and carbon dioxide) characterisation and hazard assessment, as well as providing a framework for the prescription of protection measures within new buildings.

The process involves characterising the gas hazard from combining the qualitative assessment of risk (using the CSM) with ground investigation data so that a 'characteristic situation' (CS) can be derived for the site or zones within the site. Characteristic situations range from CS1 to CS6, the higher the CS, the higher the hazard potential. Gas protection measures within new buildings can be prescribed using a point scoring system, taking into consideration the CS and the proposed building type.

BS8485 indicates that the gas hazard can be characterised using the following methods:

- an empirical semi-quantitative approach using gas monitoring data to determine the 'characteristic situation' of the site (or zones of the site) and subsequent protective measures (Wilson and Card approach).
- an empirical semi-quantitative approach using TOC data to determine the 'characteristic situation' of the site (or zones of the site) and subsequent protective measures (CL:AIRE RB17 approach), or
- detailed quantitative assessment methodologies

For the purpose of this assessment, the empirical semi-quantitative approach above has been used to characterise the gas hazard and provide advice on the protective measures likely to be required within new buildings at the site.

8.3.2 Empirical semi-quantitative approach using borehole monitoring data (Wilson and Card approach, BS8485)

8.3.2.1 Background

The empirical semi quantitative approach using gas monitoring data requires the designation of a gas screening value (GSV) for the entire site or zones within the site, which informs the hazard potential and associated prescribed ground gas protection measures within new buildings (where necessary). BS8485 defines the GSV as the '*flow rate (l/hr) of a specific hazardous gas **representative of a site or zone**, derived from*

assessment of borehole concentration and flow rate measurements and taking account of all other influencing factors, in accordance with a conceptual site model'.

BS8485 Section 6.3.1 outlines the process for developing a GSV for the site or a zone as follows:

- borehole hazardous gas flow rate (Q_{hg}) is calculated for each borehole standpipe for each monitoring event. The borehole hazardous gas flow rate is defined in BS8485 as the 'flow rate of a specific hazardous gas, either methane or carbon dioxide, from a borehole standpipe'. The Q_{hg} is calculated from individual borehole measurements of total gas flow and the concentration of the specific hazardous gas. BS8485 states in Section 6.3.4 that the **maximum** gas concentration recorded during the monitoring event should be used, together with **steady-state** values of gas flows
- the reliability of the measured gas flow rates and concentrations are assessed taking into account borehole construction
- decisions are made about how to deal with any temporal or spatial shortages in the data
- judgements are made about what GSV to designate for use for design purposes taking all relevant information and the conceptual site model into account.

Once the Q_{hg} has been calculated for methane and carbon dioxide, individual borehole measurements are compared to the thresholds presented in Table 2 of BS8485 which inform the CS that directly relates to each individual measurement. Taking into account the site data (i.e. borehole gas concentration and flow rate to calculate the Q_{hg}) and all other influencing factors in accordance with the CSM, a decision can then be made regarding the GSV that is considered to be representative of the site or a zone within it.

Typical threshold concentrations of methane (1% v/v) and carbon dioxide (5% v/v), and flow rates (>70 l/h), are also considered when designating the GSV for the site or zone, which in turn dictates the hazard potential and CS. It is important to note that the site or zone characteristic GSV and maximum concentration or flow thresholds are guideline values and not absolute. The thresholds may be exceeded in certain circumstances, if the CSM indicates it is safe to do so.

8.3.2.2 Designation of a GSV for the site or zone

The results of the ground gas monitoring and testing undertaken, alongside site conditions at the time of monitoring, are given in **Appendix G**.

Consideration has been given to the presence of flooded or partially flooded response zones at the time of monitoring, with details of fully or partially flooded response zones detailed in **Appendix G**.

For the purposes of the current ground gas risk assessment, data from entirely flooded response zones has not been included in the risk assessment.

A summary of the maximum recorded concentrations per borehole (or minimum for oxygen) is presented in **Table 12** overleaf. This table also presents details of the response zone, maximum recorded initial and steady state flow rates and minimum recorded depth to water across all monitoring rounds.

The range of atmospheric pressure over the 3no.monitoring rounds completed was 978-1006 mbar.

Table 12 Summary of ground gas monitoring results – all data

Exploratory position ID	Response zone top (mbgl)	Response zone base (mbgl)	Response zone geological unit	No. of monitoring rounds	Peak CH ₄ max. (%/vol)	Steady-state CH ₄ max. (%/vol)	Peak CO ₂ max. (%/vol)	Steady-state CO ₂ max. (%/vol)	Oxygen min. (%/vol)	Peak gas flow max. (l/hr)	Steady-state gas flow max. (l/hr)	Depth to water min. (m)	Depth to water max. (m)	Atm. pressure min. (mb)	Atm. pressure max. (mb)
BH1 Shallow	0.50	1	MG & RG	3	0.1	0.1	1.7	1.2	19.3	0.1	0.1	Dry	Dry	978	1007
BH1 Deep	1	20	RG & Chalk	3	0.2	0.1	2.1	2	18.8	0.2	0.2	Dry	Dry	979	1006
BH2	0.75	20	RG & Chalk	3	0.1	0.1	0.7	0.7	19.9	0.1	0.1	Dry	Dry	979	1006
BH3	0.70	20	MG, RG & Chalk	3	0.0	0.0	2.5	2.5	18.8	0.1	0.1	Dry	Dry	979	1006
WS1	1	4	RG & Chalk	3	0.0	0.0	1.4	1.2	18.9	0.2	0.2	Dry	Dry	979	1006
WS2*	1	4	Chalk	3	0.0	0.0	0.9	0.5	20.5	0.1	0.1	Dry	Dry	979	1006
WS3	1	4	Chalk	3	0.0	0.0	1.8	1.8	16.9	0.1	0.1	Dry	Dry	979	1006
WS4	1	3	Chalk	3	0.0	0.0	1.4	1.3	19.0	0.1	0.1	Dry	Dry	979	1006
WS5	1	3	RG & Chalk	3	0.0	0.0	1.7	1.7	19.3	0.1	0.1	Dry	Dry	979	1006
WS6	1	4	RG & Chalk	3	0.0	0.0	2.3	1.9	19.0	0.1	0.1	Dry	Dry	979	1006

*Borehole vandalised between the second and third monitoring visit

8.3.2.3 Summary of borehole hazardous gas flow rates

Borehole hazardous gas flow rates (Q_{hg}) have been calculated for each borehole standpipe, for each monitoring round and are presented, alongside two 'worst case' checks in **Appendix M** comprising a probable 'worst case' and potential 'worst case' from the available monitoring data. Within this data gas concentrations exceeding the thresholds presented in Table 2 of BS8485 are identified, alongside the CS that could be associated with each individual borehole monitoring event.

8.3.2.4 Worst case check

In accordance with BS8485, a 'worst case' Q_{hg} has been calculated per borehole by multiplying the maximum recorded flow from any monitoring round for that borehole by the maximum recorded methane or carbon dioxide concentration in that borehole. A further worst-case Q_{hg} check across all data collected is presented in **Appendix M** for the entire site (or zone), which has been calculated by multiplying the maximum recorded flow by the maximum recorded methane or carbon dioxide concentration.

8.3.2.5 Designation of site gas screening value (GSV)

Considering the calculated Q_{hg} , the CSM, monitoring conditions and response zone construction, **Table 13** presents the GSVs designated for the site (or zone if applicable).

Table 13 Summary of ground gas monitoring results

Hazardous gas	GSV (l/h)	Justification for the GSV
Methane	0.00	Consistently below 1%v/v and 5%v/v (CH ₄ and CO ₂), respectively. Maximum flow rate recorded during monitoring programme 0.2/hr. Worse case AP round achieved (<1000mb).
Carbon dioxide	0.00	

Based on the Q_{hg} , the maximum concentrations and flows recorded, the CSM and the method for determining the CS presented within Table 2 of BS8485, the site has been characterised as CS1.

8.3.3 BS8485 recommended ground gas protection measures

Case 1: CS1 classification

Based on the current understanding of the conceptual site model and the assessment undertaken, the site has been classified as CS1. Considering the foregoing and in accordance with BS8485, ground gas protective measures are not considered necessary within proposed buildings.

8.4 Uncertainties and implications in refined CSM and GQRA

In accordance with good practice, data gaps and uncertainties in the refined CSM have been identified at this stage. These are summarised in **Table 14** along with the likely implications.

Table 14 Data gaps and uncertainties

Data gap/ uncertainty	Details	Implications
Asbestos not found in made ground samples tested	Although not encountered to date, asbestos containing material (ACM) could still be present in discrete locations	Vigilance should be maintained for any potential ACM or fibrous material during below ground works.
Unexploded ordnance	Zetica (2022) UXO mapping data indicates risk from UXO as 'high'. Intrusive exploratory works were facilitated via a UXO watching brief for the duration of works	A Detailed UXO Risk Assessment should be commissioned to establish risks posed to the proposed development.

9 PRELIMINARY WASTE ASSESSMENT

In accordance with the definition provided in the Waste Framework Directive (WFD), materials are only considered waste if 'they are discarded, intended to be discarded or required to be discarded, by the holder'. Naturally occurring soils are not considered waste if reused on the site of origin for the purposes of development. Soils such as made ground that are not of clean and natural origin (irrespective of whether they are contaminated or not) and other materials such as recycled aggregate, do not become waste until the criteria above are met. Further background information is provided in **Appendix E**.

Excavation arisings from the development may therefore be classified as waste if surplus to requirements or unsuitable for reuse. The following assessments assume the material tested is classified subsequently as waste (after reuse options have been excluded).

9.1 Hazardous waste assessment

Technical Guidance WM3, **Appendix E** (Environment Agency, 2022b) sets out requirements for waste sampling. It is a legal requirement to correctly assess and classify waste. The level of sampling should be proportionate to the volume of waste and its heterogeneity. The preliminary assessment provided below is based only upon the available sample results and may not be sufficient to adequately classify the waste.

9.1.1 Chemical contaminants

EnviroLab, an RSK company, has developed a waste soils characterisation assessment tool (HASWASTE), which follows the guidance within Technical Guidance WM3. The analytical results have been assessed using this tool to assess the hazardous properties to support potential off-site disposal of materials in the future. Note that it is ultimately for landfills to confirm what wastes they are able to accept within the constraints of their permit.

The results are summarised in **Table 15** and presented in full in Appendix N.

Table 15 Results of waste soils characterisation assessment (HASWASTE)

Sample ref/ depth	Hazardous properties identified
SA2 0.00-0.20m	Mutagenic HP11
SA2 0.20-0.40m	Carcinogenic HP7 and Mutagenic HP11

Both samples of shallow Made Ground from exploratory location SA2 are classified as having hazardous properties.

Properties identified (HP11 and HP7) appear synonymous with the presence of tarmac and ash deposits.

This suggests that waste soil generated from this location or within close proximity, may require disposal at a suitably permitted hazardous waste landfill or treatment facility.

9.1.2 Asbestos within waste soils

Technical Guidance WM3 requires that within a mixed waste the separately identifiable wastes be assessed separately.

For instance, where waste soil contains identifiable pieces of asbestos (visible to the naked eye) the asbestos should, where feasible, be separated from the soil and classified separately. This should be disposed of within a hazardous, stable non-reactive hazardous waste landfill or a special cell in a non-hazardous waste landfill.

Samples of potential asbestos containing material were collected from site and analysed for the presence of asbestos, the results of which are presented in **Appendix H**. Analysis confirmed that asbestos is not present within any of the soil samples submitted for analysis. Visible asbestos containing material was not identified on-site.

9.2 WAC assessment

Samples SA1 (0.20m) and SA2 (0.20-0.40m), were submitted for waste acceptance criteria (WAC) testing, the results of which are presented in **Appendix H**.

For SA1 soils - classified as not having hazardous properties:

the results of the WAC testing indicate that the total organic carbon (TOC) for a hazardous waste landfill has been exceeded and whilst soils have not been classified as having hazardous properties, may be unsuitable for disposal at inert or non-hazardous waste landfill site based on WAC alone. Furthermore, based on WAC alone, these soils may not be suitable for disposal at a hazardous waste landfill site without prior treatment to reduce TOC.

For SA2 soil – classified as having hazardous properties:

the results of the WAC testing indicate that the leaching limit values and/or the additional criteria for hazardous waste have not been exceeded and therefore the waste is suitable for disposal at an appropriately licensed landfill.

RSK recommends that a Sampling Plan be prepared to support any waste classifications and hazardous waste assessments, prior to any material being excavated. Given the level of data obtained, scale of the development and heterogeneity of the site soils, the following assessment should be considered indicative and further assessment should be undertaken following the preparation of a waste sampling plan.

10 GEOTECHNICAL ASSESSMENT

10.1 Proposed development

The precise details of the proposed development are unknown at this stage, however, it is understood the intended scheme comprises a new leisure centre with associated sports hall, fitness studios, squash courts, and car parks to the north.

10.2 Foundations

10.2.1 Foundation options

The ground conditions beneath the footprint of the proposed leisure centre have been proven to comprise an initial thickness of made ground overlying superficial deposits of reworked ground, with the White Chalk at depth. The surface of the White Chalk was recorded as highly weathered and recovered as a Grade Dm (matrix dominated) chalk, locally grading into a Grade Dc (clast dominated) chalk. No groundwater was recorded.

Depending on the magnitude of the structural loads, the adoption of conventional spread foundation may be suitable to support lightly loaded structures provided the foundations are extended into the competent chalk. Should the bearing capacity quoted below is not sufficient to accommodate for the anticipated loads, recourse to pile should be considered (Section 10.2.3).

Due to the potential (albeit low risk) for dissolution and the identified presence of initially locally highly weathered low density chalk (matrix dominated) chalk it is considered essential that all the foundations excavations be inspected by a suitably qualified geotechnical engineer.

10.2.2 Spread foundations

The recommendations for the design and construction of spread foundations in relation to the ground conditions are set out in **Table 16**.

Table 16 Design and construction of spread foundations

Design/construction considerations	Design/construction recommendations
Founding stratum	White Chalk Sub-Group
Depth	Foundations should be taken to a minimum depth of 0.75m below the final or existing ground level, whichever is lower, and at least 0.1 m into the founding stratum below any overlying made ground or to any greater depth required in respect of the special design considerations given below.
Special design considerations	Whilst no special foundation solutions are considered necessary to accommodate risks associated with ground dissolution, it is recommended that all excavation are inspected by a geotechnical engineer to confirm the suitability of the founding medium, particularly due to localised presence of low density soils in boreholes BH1 and BH2.

Design/construction considerations	Design/construction recommendations
	Where necessary foundations will need to be locally deepened to ensure foundations extend below any initially highly weathered soils.
Bearing capacity	Subject to the special design consideration given above, spread foundations (pad) constructed (up to width of 1.0m) on the White Chalk Subgroup may be designed using a net allowable bearing pressure of 125kN/m². The allowable bearing capacity includes an overall safety factor of 3 against bearing capacity failure and with total settlements associated with the bearing pressure estimated to be less than 25 mm.
Stability of excavations	In the event that excavations are to remain open for longer periods, consideration should be given to the use of trench support systems.
Dewatering	No groundwater was encountered within the maximum depth of the investigation of 20m bgl. Dewatering is therefore unlikely to be required to facilitate foundation excavations to the depths outlined above.
Construction considerations	Due to the potential risk of dissolution (albeit low), foundation excavations should be inspected, and any made ground and soft, organic or otherwise unsuitable materials removed and replaced with mass concrete. The proposed founding stratum is a silt-rich soil, hence susceptible to rapid softening once exposed. Hence all foundation excavations should immediately be blinded with concrete or the full foundation constructed.

10.2.3 Piled foundations

Recommendations for the design and construction of piled foundations in relation to the ground conditions are set out in **Table 17**.

Table 17 Design and construction of piled foundations

Design/construction considerations	Design/construction recommendations
Pile type	In the absence of any information related to the pile installation method, bored (cast in-situ) pile type has been assumed for the analysis purposes. The construction of both bored / CFA and driven piles (pre-cast concrete and driven cast in-situ) is considered technically feasible at this site.
Possible constraints on choice of pile type	Given the presence of nearby residential properties to the west, it is considered likely that the vibration associated with pile driving may not be acceptable. The use of CFA piling method usually overcomes this issue. However, it is recommended that advice should be sought from a specialist piling contractor.
Temporary casing	Groundwater was not encountered during the site investigation, therefore on that basis no temporary casing is required during the installation in the case of bored piling option.
Limitations afforded by ground	For the purpose of assessing preliminary pile capacities any made ground/superficial deposits and reworked ground encountered in the top 2m has been presumed not to contribute to the load-carrying capacity for the piles, and has been ignored in the analysis.

Design/construction considerations	Design/construction recommendations	
Man-made obstructions	The limited presence of buried sub-structures or other obstructions within the south of the site may lead to some difficulty during piling. Where buried obstructions are encountered, it will be necessary to either relocate the pile(s) or make allowance for removing the obstruction.	
Parameters (Bored)		
White Chalk Subgroup	Shaft resistance (τ_{sf})	0.45 (SPT 'N' <10) 0.80 (SPT 'N' >10)
	Base resistance	$Q_u = 200N$ – limited to: $Q_{all} = 600$ to 800 kN/m^2 (SPT $N < 25$) $Q_{all} = 1000$ to 1800 kN/m^2 (SPT $N < 25$)
General parameters	Limiting concrete stress	7.5 N/mm^2
	Limiting shaft friction	110 kN/m^2
	Global margin of safety	$2.5^{1)}$
Special precautions relating to bored pile shafts and bases	Bored pile concrete should be cast as soon after completion of boring as possible and in any event the same day as boring. Prior to casting the base of the pile bore should be clean, otherwise a reduced safe working load will be required. Similarly, if the pile bore is left open the shaft walls may relax/soften, leading to a reduced safe working load.	

¹⁾ Load factor on the base of the pile (F_b) built into the Q_{all}

A soil profile derived based upon the ground conditions encountered in BH1 to BH3, has been adopted as shown in **Table 18** below.

Table 18 Ground model adopted

Stratum	Depth to top of stratum mbgl	Thickness (m)
Made Ground / Reworked Ground (ignored)	0.00	2.0
White Chalk Sub-group – Weathered Chalk ('N' value <25)	2.0	12.00
Weathered Chalk ('N' value >25)	14.0	Proven to 20m

The design procedure for piles varies considerably, depending on the proposed type of pile. However, for illustrative purposes **Table 19** gives likely working pile loads for traditional bored, cast-in-situ concrete piles of various diameters and lengths, based on the design parameters given in **Table 17**.

Table 19 Illustration of typical pile working loads for bored cast-in-situ piles

Typical pile working loads (kN)			
Depth of pile toe (m)	Pile diameter (mm)		
	300	450	600
7	185	313	466
8	227	378	553
9	270	443	641
10	313	508	729
11	355	572	816
12	398	637	904
13	440	702	992
14	483	767	1079
15	530 ¹⁾	861	1219
Notes: Pile lengths based on a minimum penetration of 5m into chalk.			
1) Pile limiting stress			

It should be noted that behaviour of pile/pile groups under working loads should be determined as part of the detailed design work. The carrying capacity of piles depends to a large extent on the method and care taken during their installation. It is therefore recommended that the advice of a specialist piling contractor should be sought as to the most suitable type of pile in the ground conditions found at the site and also as to their lengths and diameters to support the actual working loads.

10.2.4 Foundation works risk assessment

It is anticipated that a foundation works risk assessment report will not be required for the development.

10.3 Roads and hardstanding

10.3.1 In-situ testing

In the 1.00m to 1.50m below the proposed finished ground level the exploratory holes beneath the proposed car park have revealed a soil profile comprising topsoil / made ground overlying a reworked ground.

In pavement design terms, the groundwater conditions are anticipated to comprise a low water table, i.e. at least 1.00m below the pavement formation level.

The estimated minimum, equilibrium soil-suction, California bearing ratio (CBR) value for the soils and groundwater conditions described above under a completed pavement is 2%, based upon Table C1 in TRRL (1984) Report LR1132.

The results of in-situ testing (DCP) are summarised in **Table 20**.

Table 20 Summary of CBR values derived from in-situ DCP tests

Test location	Material type	Minimum CBR value determined
BH3	Topsoil	Between 100-300mm = 3.5%
	Made ground	Between 300-600mm = 8%
SA3	Topsoil	Between 100-300mm = 4%
TP1	Reworked ground	Between 300-700mm = 3%
TP2	Reworked ground	Between 400-700mm = 4%
WS1	Reworked ground	Between 300-800mm = 3.8%
WS2	Reworked ground	Between 300-800mm = 10%
WS3	Reworked ground	Between 500-800mm = 8%
WS4	Reworked ground	Between 300-800mm = 3.4%

The recommended sub-grade soil CBR value for road pavement design is 3%. This value assumes that during construction the formation level will be carefully compacted, and any soft spots removed and replaced with well-compacted granular fill.

The sub-grade condition at the time of construction should be confirmed by testing at the final formation level by in situ CBR testing.

The sub-grade soils can be regarded as frost-susceptible based upon the criteria given in Appendix 1 of TRRL (1970) Report Road Note 29.

10.4 Chemical attack on buried concrete

The results of chemical tests carried out on soil samples indicate 2:1 water soil extract sulfate content <500mg/l with slightly alkaline pH values.

These results indicate that, in accordance with BRE Special Digest 1: 2005 Concrete in aggressive ground, the Aggressive Chemical Environment for Concrete (ACEC) Classification is AC-1 with a Design Sulphate Class for the site of DS-1. This assumes nominally mobile groundwater conditions and that no significantly disturbed clay comes into contact with concrete foundations or structures.

If significantly disturbed clay is likely to come into contact with concrete foundations or structures, it will be necessary to carry out additional tests on the soil to investigate its total potential sulphate content. This will facilitate a re-evaluation of the ACEC Classification and Design Sulphate Class for the material, to take into consideration potential oxidation of available sulphides (e.g. pyrite), as defined in Table C1 (natural ground sites) or C2 (brownfield sites) BRE Special Digest 1: 2005..

10.5 Infiltration drainage

The results of soakaway testing are summarised in **Table 21**.

Table 21 Infiltration test results

Trial pit	Geological unit	Test result (m/s)
SA1	White chalk	Test 1 = 1.20×10^{-5} Test 2 = 1.99×10^{-5} Test 3 = 2.62×10^{-5}
SA2	White chalk	Test 1 = 3.13×10^{-5} Test 2 = 2.26×10^{-5} Test 3 = 2.79×10^{-5}
SA3	White chalk	Test 1 = 3.10×10^{-5} Test 2 = 1.17×10^{-5} Test 3 = 9.04×10^{-5}

Based upon the results of the soakaway tests presented in above table, the ground conditions appear suitable from a geotechnical viewpoint for the use of pit soakaways to discharge surface run-off water into the White Chalk. The calculated infiltration rates for the weathered Margate Chalk range between 1.17×10^{-5} m/s and 9.04×10^{-5} m/s. It should be noted that the infiltration should increase with depth, as chalk becomes less weathered, so that deeper ring soakaways are also feasible, however, boreholes soakage testing would be required to confirm the infiltration at depth.

Due to the risk of soakaways triggering instability in infilled chalk dissolution features or causing new dissolution, CIRIA C574 (Engineering in Chalk) recommends that soakaways should be avoided if at all possible but, if unavoidable, should be sited at least 20m away from any foundations. However, this recommendation is generally for shallow footings. If piles are adopted for the proposed development, then this distance may potentially be reduced, and in any case, the closest part of the soakaway should be at least 5m away from any foundations for structures or roads.

The EA should be contacted at the design stage in order to obtain a 'consent to discharge'. This may not be forthcoming where soakage will be into or just above the water table, particularly within groundwater protection zones. In addition, planning approval will have to be sought for their use.

11 CONCLUSIONS AND RECOMMENDATIONS

11.1 Geo-environmental assessment

The subject site comprises an existing Leisure centre with proposed development plans to demolish and replace the existing facility.

The Phase 1 preliminary risk assessment (PRA) identifies that the site is situated within the eastern extents of former WWII RAF Gravesend Airfield. Site geology comprises Seaford Chalk and locally Thanet Sand, with variable Made Ground deposits anticipated throughout. Whilst the Seaford Chalk is a principal aquifer, groundwater abstractions within close proximity are absent, coupled with an anticipated depth to groundwater in excess of 20m, the risks to controlled waters are absent. The result of the initial conceptual model therefor focus on potential risks posed to human health and property.

Phase 2 exploratory works confirm ground conditions comprising variable Made Ground / reworked soils with variable anthropogenic deposits over a superficial Head and Bedrock Chalk. No evidence of contaminative impact was identified beyond anthropogenics. Groundwater (perched or otherwise) was absent.

Results of the GQRA indicate risk to human health (via direct contact) are absent/ 'low' when comparing soil laboratory results against adopted assessment criteria. Risk posed from hazardous ground gases are also assessed as absent/ 'low'.

Results of the phytotoxic risk assessment indicate that whilst evidence of existing vegetative distress is absent, consideration of a suitable growing medium may be required for future planting as part of the proposed development (consultation with appointed landscape consultant recommended). In addition, risks to future potable water supplies lines may exist (consultation with relevant water supply company recommended).

Whilst risks to future site users have been omitted, mindful of historical site setting (former WWII Airfield), the presence of previously unforeseen ground conditions cannot be ruled out entirely.

As such, it is recommended that future construction and maintenance workers health and safety procedures (required under CDM Regulations), include a suitably developed 'unforeseen ground conditions' procedure to be adopted. For example, although not encountered to date, asbestos containing material (ACM) could still be present in discrete locations.

Should unforeseen contamination be encountered during the development then specialist advice should be sought to determine the appropriate course of action.

It is recommended that a Detailed UXO Risk Assessment is commissioned.

The results of the preliminary waste assessment indicate the presence of localised soils with hazardous properties (SA2) believed associated with tarmac and ash deposits identified at this location. The results of the WAC assessment indicate elevated TOC greater than the threshold adopted for a hazardous waste landfill (SA1). Given the level of data obtained, scale of the development and heterogeneity of the site soils, the following assessment should be considered indicative and further assessment considered prudent.

11.2 Geotechnical assessment

Conventional strip foundations taken into the competent chalk are considered suitable for any lightly loaded structures. In the areas where foundations or other obstructions related to historical buildings are encountered, the foundations should be taken at greater depth, within a competent ground.

Should the bearing capacity quoted below is not sufficient to accommodate for the anticipated loads, recourse to pile should be considered.

It is recommended that the soils at formation levels are to be inspected to ensure that the founding soils are suitable and have not been unduly disturbed during the demolition works.

The recommended sub-grade CBR value for road pavement design is 3%, subject to further testing once the road formation level has been determined. The sub-grade soils can be regarded as frost-susceptible.

The recommended Design Sulphate Class for the site is DS-1, with an ACEC classification of AC-1.

The ground conditions appear suitable from a geotechnical viewpoint for the use of pit soakaways to discharge surface run-off water into the White Chalk, however for greater infiltration deeper soakaways (possibly even within boreholes) will be required.

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FIGURES

Figure 1 SITE LOCATION PLAN

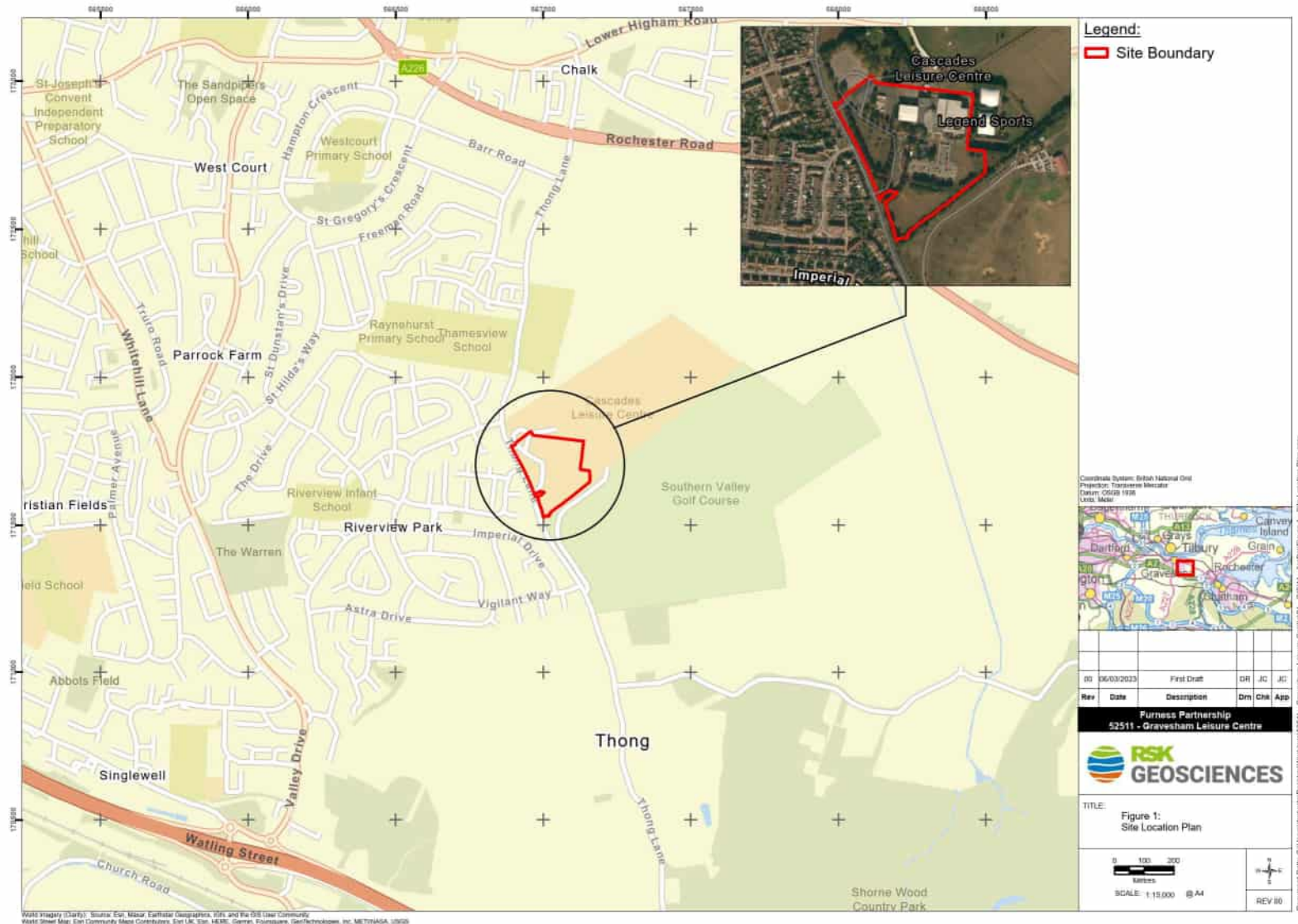


Figure 2 SITE LAYOUT PLAN

Figure 3 EXPLORATORY HOLE LOCATION PLAN



LABEL	X	Y
BH01	567025	171668
BH02	567100	171674
BH03	567108	171633
HP01	567038	171764
HP02	567069	171758
HP03	567125	171747
HP04	567087	171717
HP05	567028	171736
SA01	566972	171797
SA02	566991	171749
SA03	566929	171730
TP01	567027	171560
TP02	567068	171690
WS01	567057	171711
WS02	567119	171686
WS03	567138	171650
WS04	567047	171597
WS05	566962	171663
WS06	567013	171695
EXSA01	567091	171786
EXSA02	567132	171782
EXSA03	567113	171689
HP06	567073	171777

Legend:

- Site Boundary
- Borehole
- Existing Soakway Chambers
- Hand Pit
- Soakaways
- Trial Pits
- Window Sample

Coordinate System: British National (OS)
Projection: Transverse Mercator
Datum: OSGB 1936
Units: Metre

01	11/03/2023	Figure Number Change	TM	DR	BO
01	31/03/2023	Exploratory Hole Locations	FA	JC	JC
00	06/03/2023	First Draft	DR	JC	JC
Rev	Date	Description	Drn	Chk	App

Furness Partnership
52511 - Gravesham Leisure Centre

TITLE: Figure 3:
Exploratory Hole Location Plan

SCALE: 1:1,750 @ A4

REV 02

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Source: Esri, Maxar, Earthstar Geographics, and the IGN User Community

APPENDICES

Appendix A

SERVICE CONSTRAINTS

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) for Furness Partnership Limited (the "Client") in accordance with the terms of a contract [RSK Environment Standard Terms and Conditions] between RSK and the Client, dated 20th February 2023.. The Services were performed by RSK with the reasonable skill and care ordinarily exercised by an environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the Client.
2. Other than that, expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.
3. Unless otherwise agreed in writing, the Services were performed by RSK exclusively for the purposes of the Client. RSK is not aware of any interest of or reliance by any party other than the Client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.**
4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the Client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.
6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the Client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off site of asbestos, invasive plants, electromagnetic fields, lead paint, heavy metals, radon gas, persistent, bioaccumulative or toxic chemicals (including PFAS and related compounds) or other radioactive or hazardous materials, unless specifically identified in the Services.
7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a visual inspection of the site together with RSK's interpretation of information, including documentation, obtained from third parties and from the Client on the history and usage of the site,

unless specifically identified in the Services or accreditation system (such as UKAS ISO 17020:2012 clause 7.1.6):

- a. The Services were based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely.
- b. The Services were limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the visual inspection.
- c. The Services did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services.

RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the Client and RSK.

8. The intrusive environmental site investigation aspects of the Services are a limited sampling of the site at pre-determined locations based on the known historic / operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the properties of the materials adjacent and local conditions, together with the position of any current structures and underground utilities and facilities, and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters (as stipulated in the scope between the client and RSK, based on an understanding of the available operational and historical information) and it should not be inferred that other chemical species are not present.
9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (intrusive and sample locations etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.
10. The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater levels and ground gas concentrations and flows, may vary from those reported due to seasonal, or other, effects and the limitations stated in the data should be recognised.
11. Asbestos is often observed to be present in soils in discrete areas. Whilst asbestos-containing materials may have been locally encountered during the fieldworks or supporting laboratory analysis, the history of brownfield and demolition sites indicates that asbestos fibres may be present more widely in soils and aggregates, which could be encountered during more extensive ground works.
12. Unless stated otherwise, only preliminary geotechnical recommendations are presented in this report and these should be verified in a Geotechnical Design Report, once proposed construction and structural design proposals are confirmed.

Appendix B

SUMMARY OF LEGISLATION AND POLICY RELATING TO LAND CONTAMINATION

Part IIA of the Environmental Protection Act 1990

Part IIA of the Environmental Protection Act 1990 (Part IIA) and its associated Contaminated Land Regulations 2000 (SI 2000/227), which came into force in England on 1 April 2000, formed the basis for the current regulatory framework and the statutory regime for the identification and remediation of contaminated land. Part IIA of the EPA 1990 defines contaminated land as 'any land which appears to the Local Authority in whose area it is situated to be in such a condition by reason of substances in, on or under the land, that significant harm is being caused, or that there is significant possibility of significant harm being caused, or that pollution of controlled waters is being or is likely to be caused'. Controlled waters are considered to include all groundwater, inland waters and estuaries.

In August 2006, the Contaminated Land (England) Regulations 2006 (SI 2006/1380) were implemented, which extended the statutory regime to include Part IIA of the EPA as originally introduced on 1 April 2000, together with changes intended chiefly to address land that is contaminated by virtue of radioactivity. These have been replaced subsequently by the Contaminated Land (England) (Amendment) Regulations 2012, which now exclude land that is contaminated by virtue of radioactivity.

The intention of Part IIA is to deal with contaminated land issues that are considered to cause significant harm on land that is not undergoing development (see Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance, April 2012). This document replaces Annex III of Defra Circular 01/2006, published in September 2006 (the remainder of this document is now obsolete).

Planning Policy

Land contamination is often addressed via the planning process during redevelopment of sites. This approach was documented in Planning Policy Statement: Planning and Pollution Control PPS23, which states that it remains the responsibility of the landowner and developer to identify land affected by contamination and carry out sufficient remediation to render the land suitable for use. PPS23 was withdrawn early in 2012 and has been replaced by much reduced guidance within the National Planning Policy Framework (NPPF), reference ISBN: 978-1-5286-1033-9, July 2021. For sites in Wales, reference should be made to Planning Policy Wales (Welsh Government. Edition 11, February 2021).

The new framework has limited guidance on contaminated land, as follows:

Chapter 11. Making effective use of land

- 117 Planning policies and decisions should promote an effective use of land in meeting the need for homes and other uses, while safeguarding and improving the environment and ensuring safe and healthy living conditions. Strategic policies should set out a clear strategy for accommodating objectively assessed needs, in a way that makes as much use as possible of previously-developed or 'brownfield' land.
- 118. Planning policies and decisions should:

c) give substantial weight to the value of using suitable brownfield land within settlements for homes and other identified needs, and support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land.

Chapter 15. Conserving and enhancing the natural environment

170. Planning policies and decisions should contribute to and enhance the natural and local environment by:

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and

f) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.

Ground conditions and pollution

178. Planning policies and decisions should ensure that:

a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);

b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990; and

c) adequate site investigation information, prepared by a competent person, is available to inform these assessments.

179. Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.

Water Resources Act (WRA)

The Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009 updated the Water Resources Act 1991, which introduced the offence of causing or knowingly permitting pollution of controlled waters. The Act provides the Environment Agency with powers to implement remediation necessary to protect controlled waters and recover all reasonable costs of doing so.

Water Framework Directive (WFD)

The Water Framework Directive 2000/60/EC is designed to:

- enhance the status and prevent further deterioration of aquatic ecosystems and associated wetlands that depend on the aquatic ecosystems
- promote the sustainable use of water
- reduce pollution of water, especially by 'priority' and 'priority hazardous' substances
- ensure progressive reduction of groundwater pollution.

The WFD requires a management plan for each river basin be developed every six years.

Groundwater Directive (GWD)

The 1980 Groundwater Directive 80/68/EEC and the 2006 Groundwater Daughter Directive 2006/118/EC of the WFD are the main European legislation in place to protect groundwater. The 1980 Directive is due to be repealed in December 2013. The European legislation has been transposed into national legislation by regulations and directions to the Environment Agency.

Priority Substances Directive (PSD)

The Priority Substances Directive 2008/105/EC is a 'Daughter' Directive of the WFD, which sets out a priority list of substances posing a threat to or via the aquatic environment. The PSD establishes environmental quality standards for priority substances, which have been set at concentrations that are safe for the aquatic environment and for human health. In addition, there is a further aim of reducing (or eliminating) pollution of surface water (rivers, lakes, estuaries and coastal waters) by pollutants on the list. The WFD requires that countries establish a list of dangerous substances that are being discharged and EQS for them. In England and Wales, this list is provided in the River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010. In order to achieve the objectives of the WFD, classification schemes are used to describe where the water environment is of good quality and where it may require improvement.

Environmental Permitting Regulations (EPR)

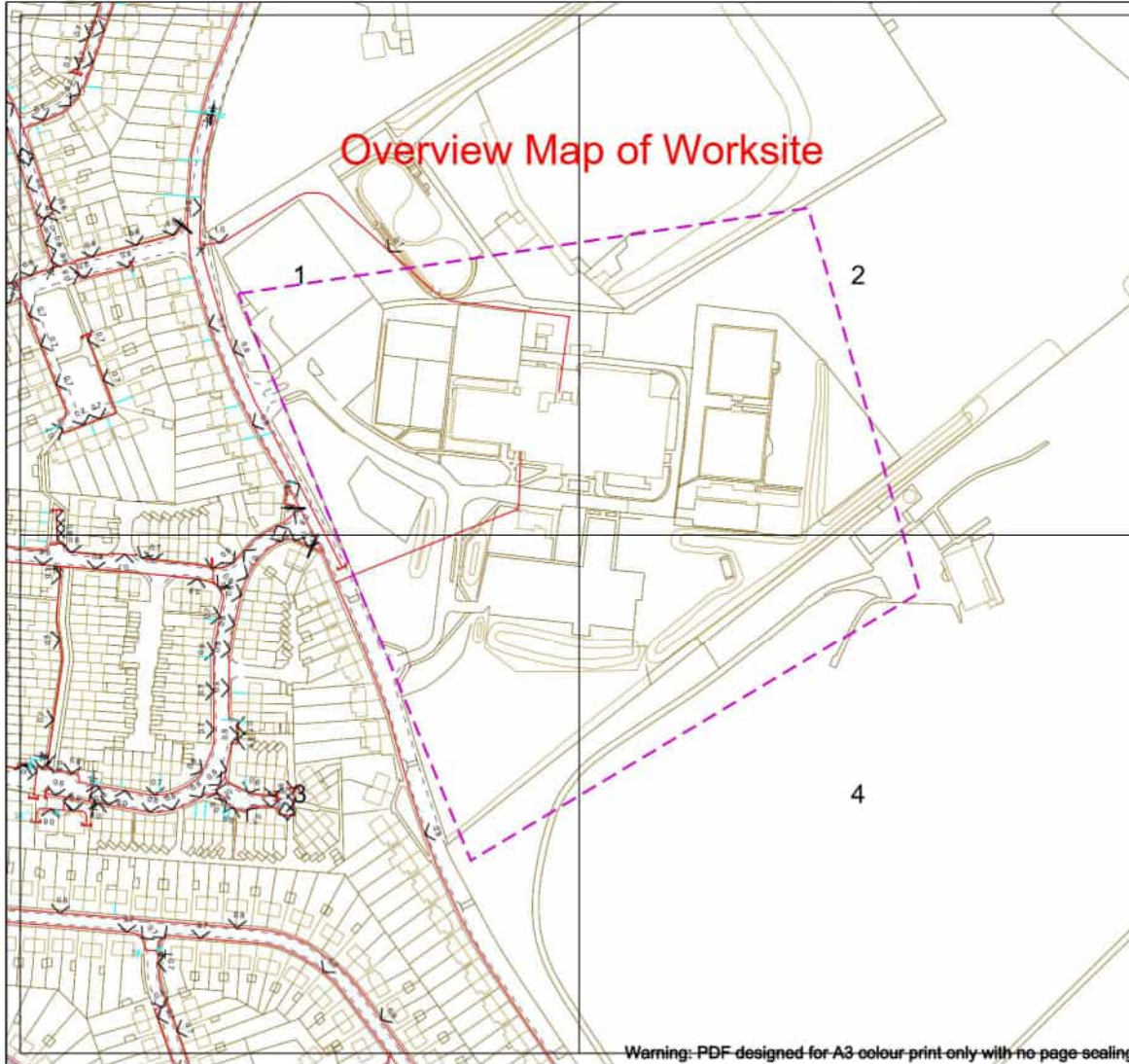
The Environmental Permitting (England and Wales) Regulations 2016 (as amended) provide a single regulatory framework that streamlines and integrates waste management licensing, pollution prevention and control, water discharge consenting, groundwater authorisations, and radioactive substances regulation. Schedule 22, paragraph 6 of EPR 2016 states: 'the regulator must, in exercising its relevant functions, take all necessary measures - (a) to prevent the input of any hazardous substance to groundwater; and (b) to limit the input of non-hazardous pollutants to groundwater so as to ensure that such inputs do not cause pollution of groundwater.'

Notes:

1. *The above information is provided for background but does not constitute site-specific advice*
2. *The above summary applies to England only. Variations exist within other countries of the United Kingdom*

Appendix C

UTILITY SERVICE PLANS



Contact Us
SGN Safety Admin Team:
0800 912 1722
Email:
plantlocation@sgn.co.uk

Date Requested: 17/03/2023
Job Reference: 28875118
Site Location: 567077 171735
Requested by: Mr Simon Larkin
Your Scheme/Reference: Cascades New Build

Scale: 1:2000 (When plotted at A3)

This plan shows the location of those pipes owned by Scotia Gas Networks (SGN) by virtue of being a licensed Gas Transporter (GT). Gas pipes owned by other GTs or third parties may also be present in this area but are not shown on this plan. Information with regard to such pipes should be obtained from the relevant owners. No warranties are given with regard to the accuracy of the information shown on this plan. Service pipes, valves, siphons, sub-connections etc. are not shown but their presence should be anticipated. You should be aware that a small percentage of our pipes/assets may be undergoing review and will temporarily be highlighted in yellow. If your proposed works are close to one of these pipes, you should contact the SGN Safety Admin Team on 0800 912 1722 for advice. No liability of any kind whatsoever is accepted by SGN or its agents, servants or sub-contractors for any error or omission contained herein. Safe digging practices, in accordance with HS (0)47, must be used to verify and establish the actual position of mains, pipes, services and other apparatus on site before any mechanical plant is used. It is your responsibility to ensure that plant location information is provided to all persons (whether direct labour or sub-contractors) working for you on or near gas apparatus. Information included on this plan should not be referred to beyond a period of 28 days from the date of issue.

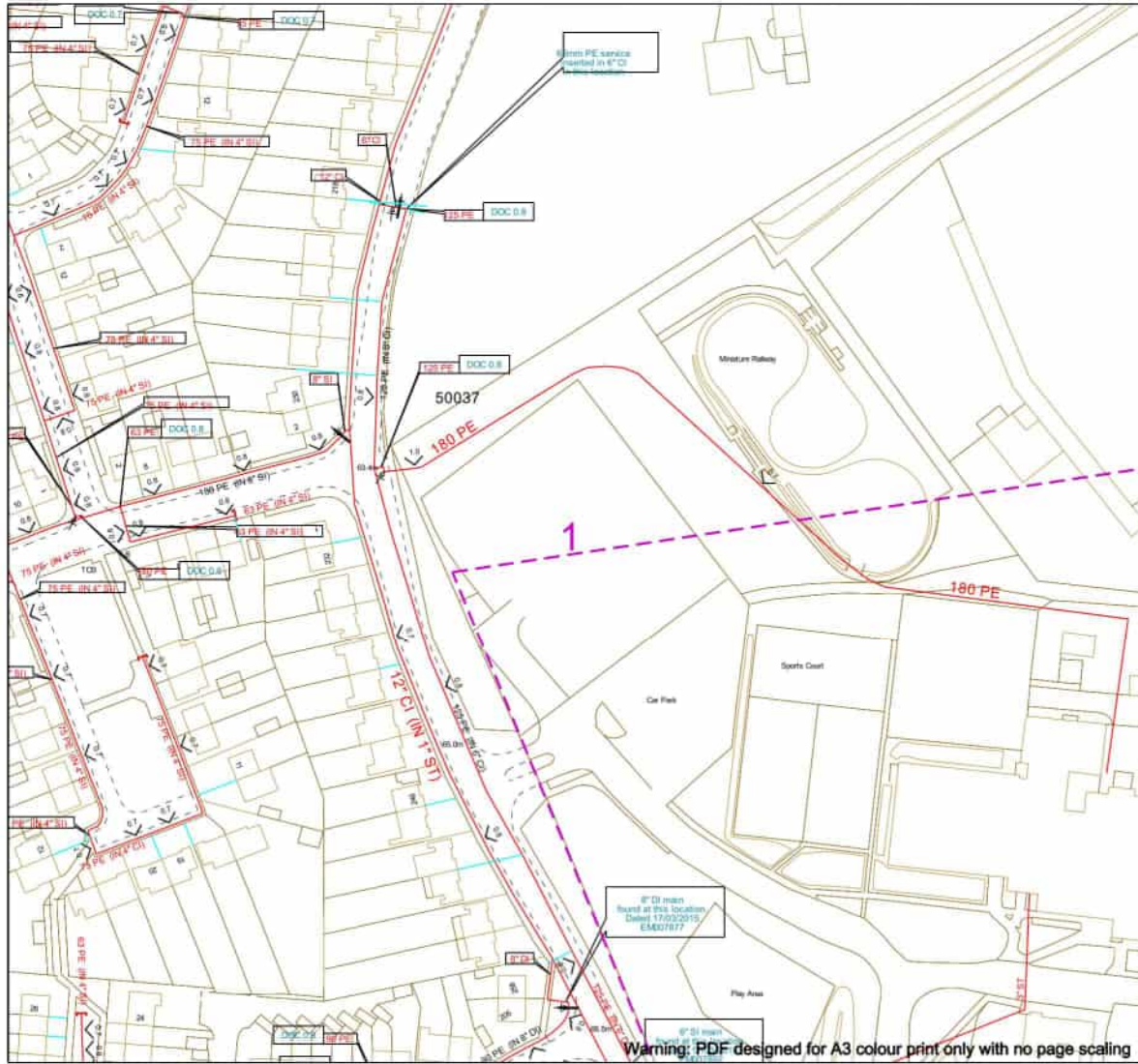
Report damage immediately – KEEP EVERYONE AWAY FROM THE AREA
0800 111 999

Low Pressure Mains
Medium Pressure Mains
Intermediate Pressure Mains
High Pressure Mains
LAs
GTs
SSSIs
Some Examples Of Plant Items
Valve
Siphon
Depth of Cover
Diameter Change
Material Change
Digsite: Line: Area:



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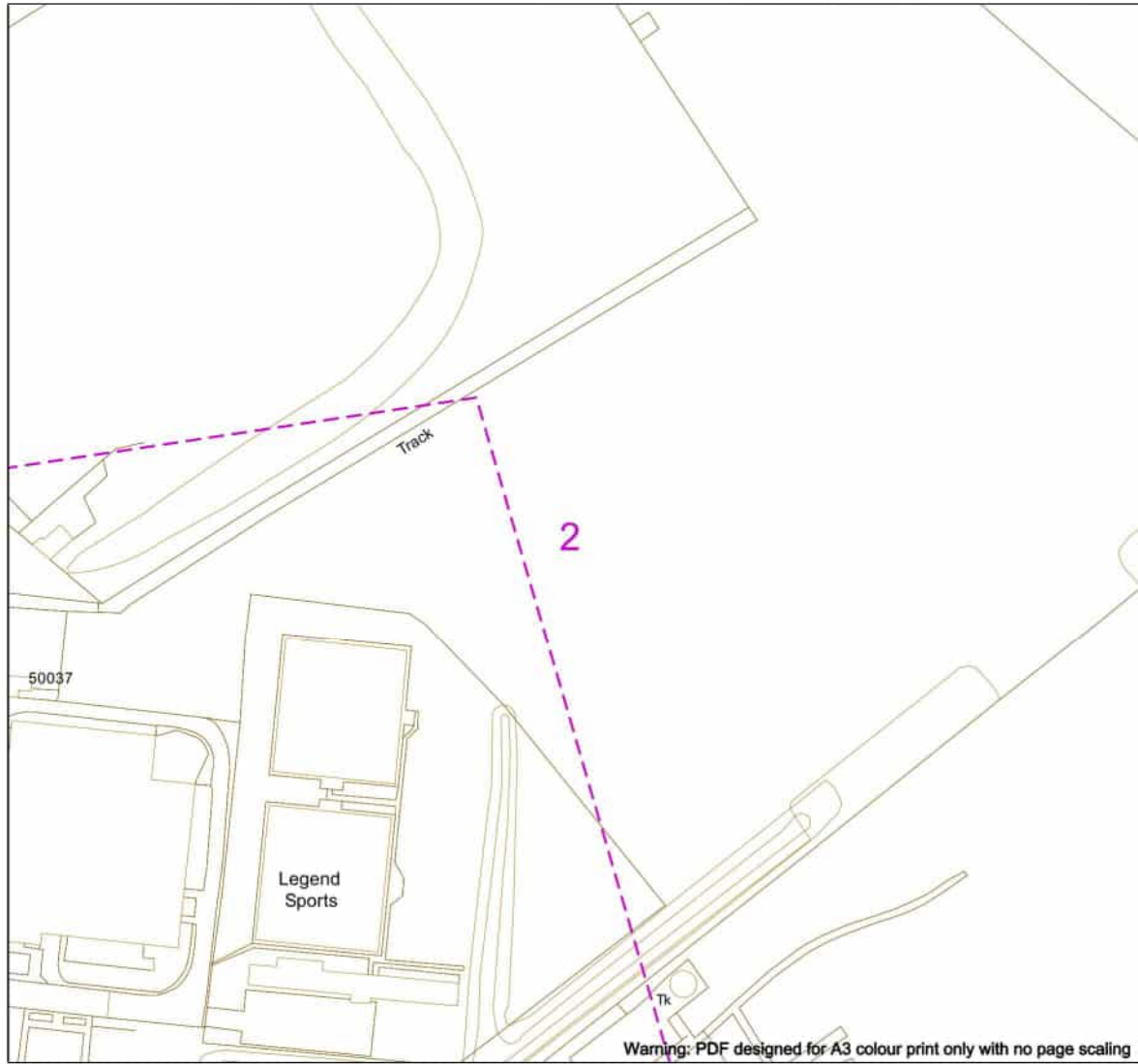
Digsite: Line:

Area:



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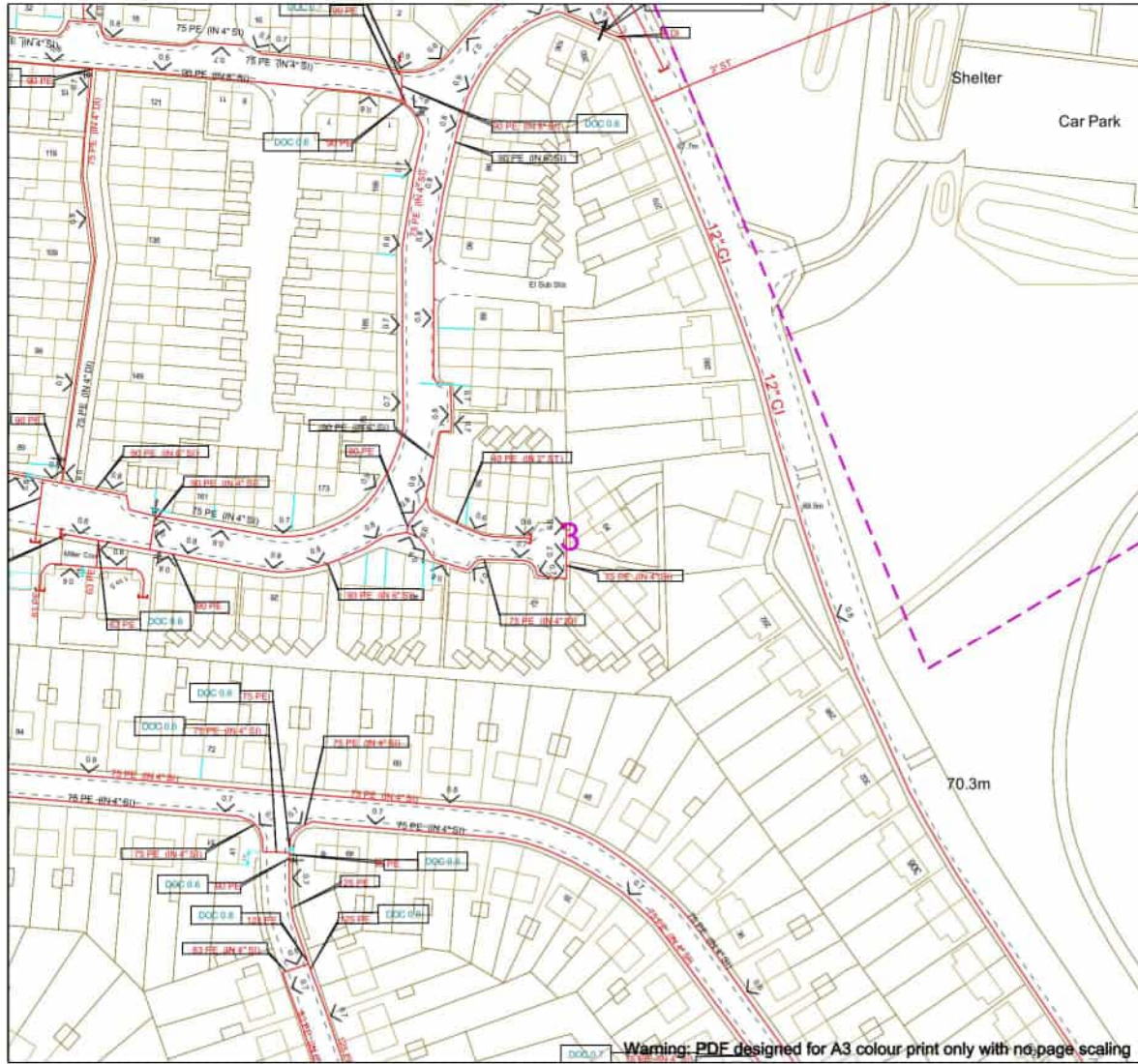
Material Change

Digsite: Line:

Area:



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Your Scheme/Reference: Cascades New Build

Scale: 1:1000 (When plotted at A3)

This plan shows the location of those pipes owned by Scotia Gas Networks (SGN) by virtue of being a licensed Gas Transporter (GT). Gas pipes owned by other GTs or third parties may also be present in this area but are not shown on this plan. Information with regard to such pipes should be obtained from the relevant owners. No warranties are given with regard to the accuracy of the information shown on this plan. Service pipes, valves, siphons, sub-connections etc. are not shown but their presence should be anticipated. You should be aware that a small percentage of our pipes/assets may be undergoing review and will temporarily be highlighted in yellow. If your proposed works are close to one of these pipes, you should contact the SGN Safety Admin Team on 0800 912 1722 for advice. No liability of any kind whatsoever is accepted by SGN or its agents, servants or sub-contractors for any error or omission contained herein. Safe digging practices, in accordance with H5 (0)47, must be used to verify and establish the actual position of mains, pipes, services and other apparatus on site before any mechanical plant is used. It is your responsibility to ensure that plant location information is provided to all persons (whether direct labour or sub-contractors) working for you on or near gas apparatus. Information included on this plan should not be referred to beyond a period of 28 days from the date of issue.

Report damage immediately – KEEP EVERYONE AWAY FROM THE AREA
0800 111 999

Low Pressure Mains
Medium Pressure Mains
Intermediate Pressure Mains
High Pressure Mains

LAs
GTs

Some Examples Of Plant Items
Valve
Siphon
Depth of Cover
Diameter Change
Material Change

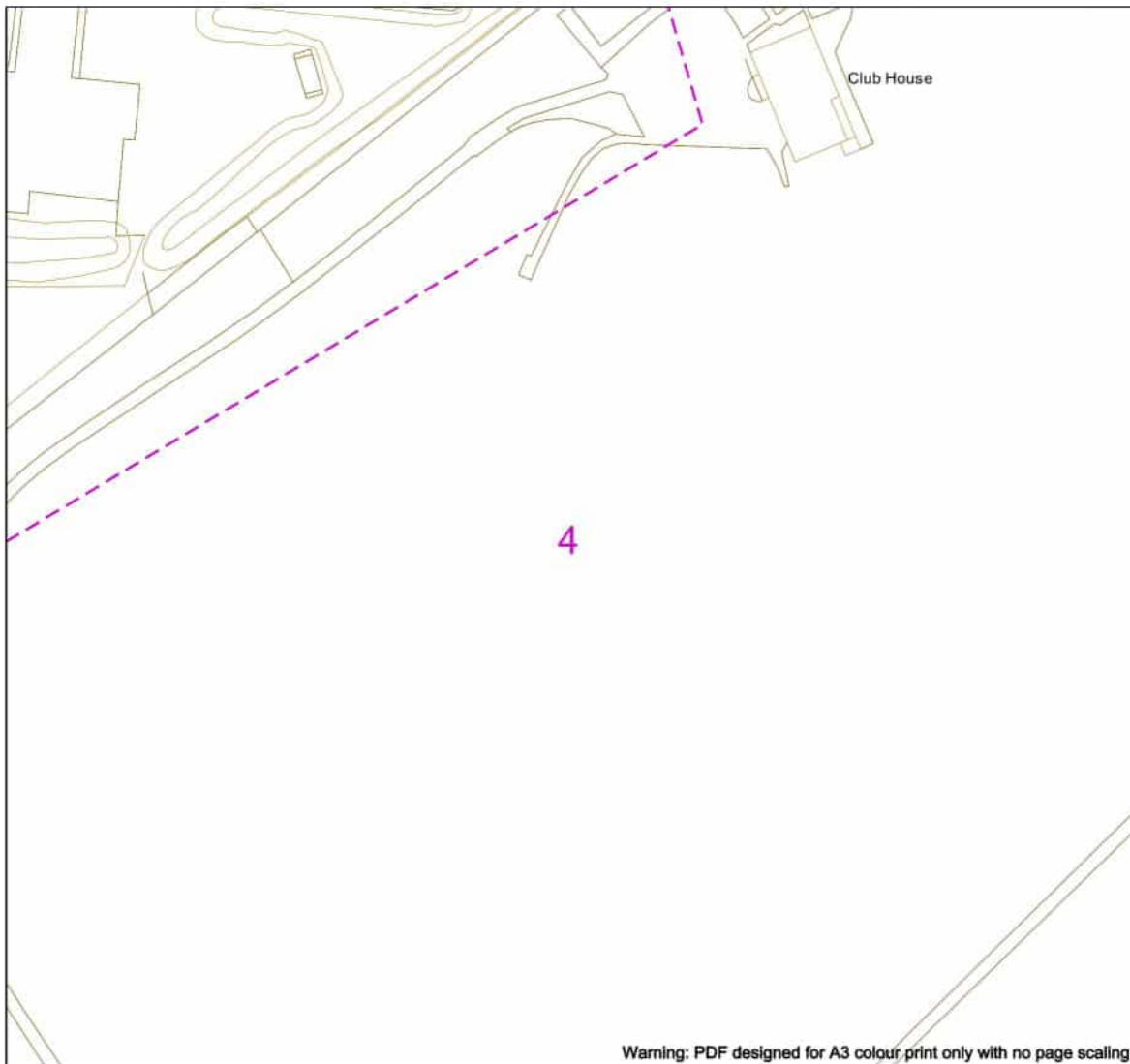
SSSIs

Digsite: Line: Area:



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Warning: PDF designed for A3 colour print only with no page scaling





Contact Us
SGN Safety Admin Team:
0800 912 1722
Email:
plantlocation@sgn.co.uk

Date Requested: 17/03/2023
Job Reference: 28675118
Site Location: S67077 171735
Requested by: Mr Simon Larkin
Your Scheme/Reference: Cascades New Build

Scale: 1:1000 (When plotted at A3)

This plan shows the location of those pipes owned by Scotia Gas Networks (SGN) by virtue of being a licensed Gas Transporter (GT). Gas pipes owned by other GTs or third parties may also be present in this area but are not shown on this plan. Information with regard to such pipes should be obtained from the relevant owners. No warranties are given with regard to the accuracy of the information shown on this plan. Service pipes, valves, siphons, sub-connections etc. are not shown but their presence should be anticipated. You should be aware that a small percentage of our pipes/assets may be undergoing review and will temporarily be highlighted in yellow. If your proposed works are close to one of these pipes, you should contact the SGN Safety Admin Team on 0800 912 1722 for advice. No liability of any kind whatsoever is accepted by SGN or its agents, servants or sub-contractors for any error or omission contained herein. Safe digging practices, in accordance with HS 0047, must be used to verify and establish the actual position of mains, pipes, services and other apparatus on site before any mechanical plant is used. It is your responsibility to ensure that plant location information is provided to all persons (whether direct labour or sub-contractors) working for you on or near gas apparatus. Information included on this plan should not be referred to beyond a period of 28 days from the date of issue.

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0800 111 999

Low Pressure Mains
Medium Pressure Mains
Intermediate Pressure Mains
High Pressure Mains

LAs
GTs
SSSIs

Some Examples of Plant Items

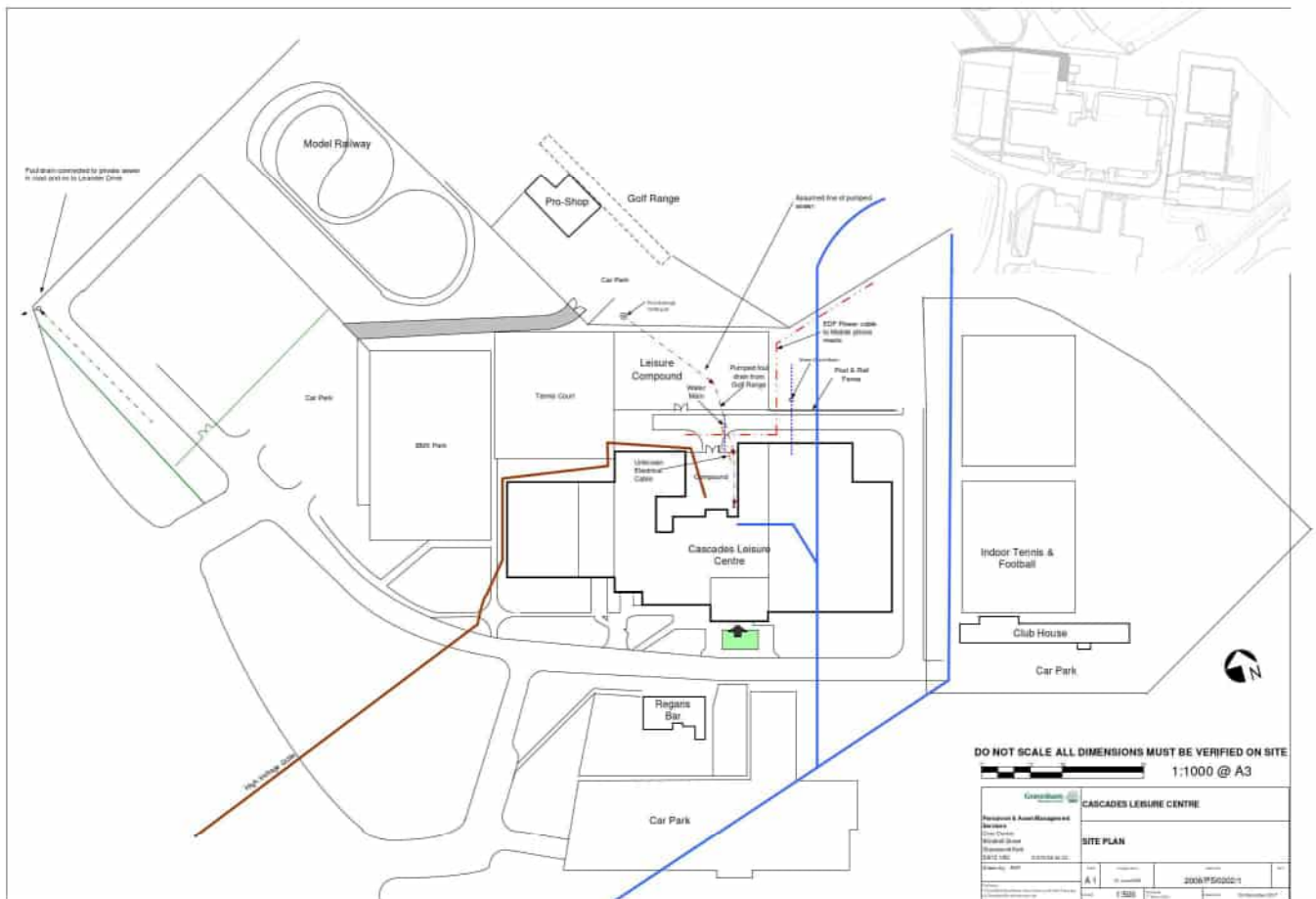
Main	Siphon	Depth of Cover	Diameter Change	Material Change

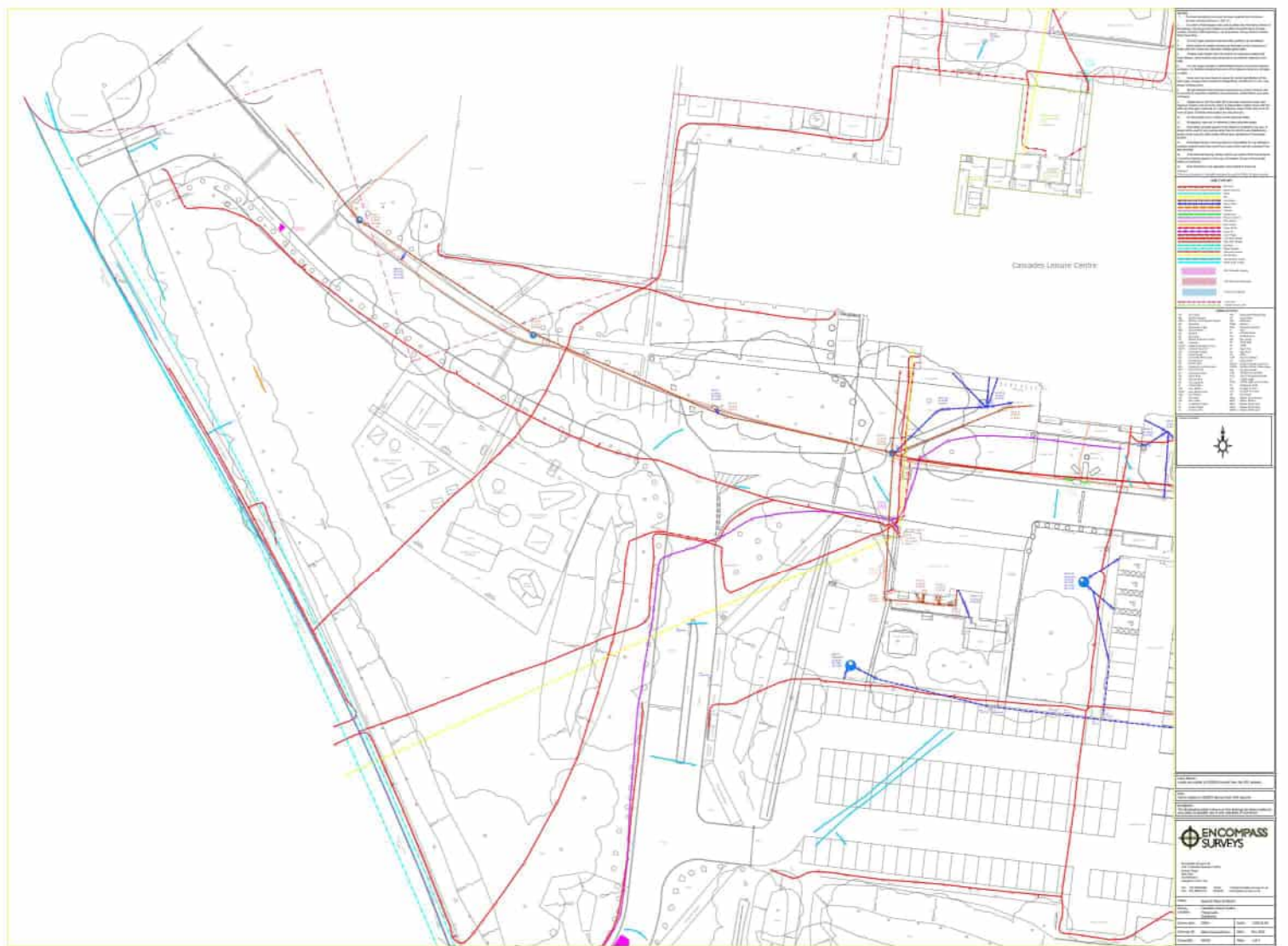
Digsite: Line: Area:



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Warning: PDF designed for A3 colour print only with no page scaling







Legend

Property Lines (Red)

Building Footprints (Black)

Parking Spaces (Blue)

Landscaping (Green)

Other Features (Purple)

North Arrow

ENCOMPASS SURVEYS

Surveyed by: [Name]
Reviewed by: [Name]
Date: [Date]

Area	Area (sq. ft.)	Area (sq. yd.)
Building Footprints	10,000	111.11
Parking Spaces	5,000	55.56
Landscaping	2,000	22.22
Other Features	1,000	11.11
Total	18,000	201.11



Legend

Color	Description
Red	Property Boundary
Blue	Survey Boundary
Green	Vegetation Boundary
Yellow	Other Boundary

North Arrow

ENCOMPASS SURVEYS

Project Information

Field	Value
Project Name	...
Client	...
Surveyor	...
Date	...
Scale	...



Legend

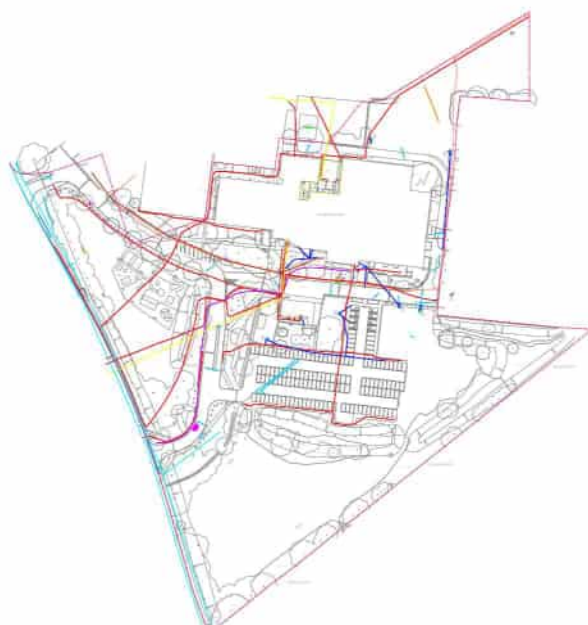
Symbol	Description
Red line	Water Supply
Blue line	Sewerage
Yellow line	Gas
Green line	Electricity
Black line	Other

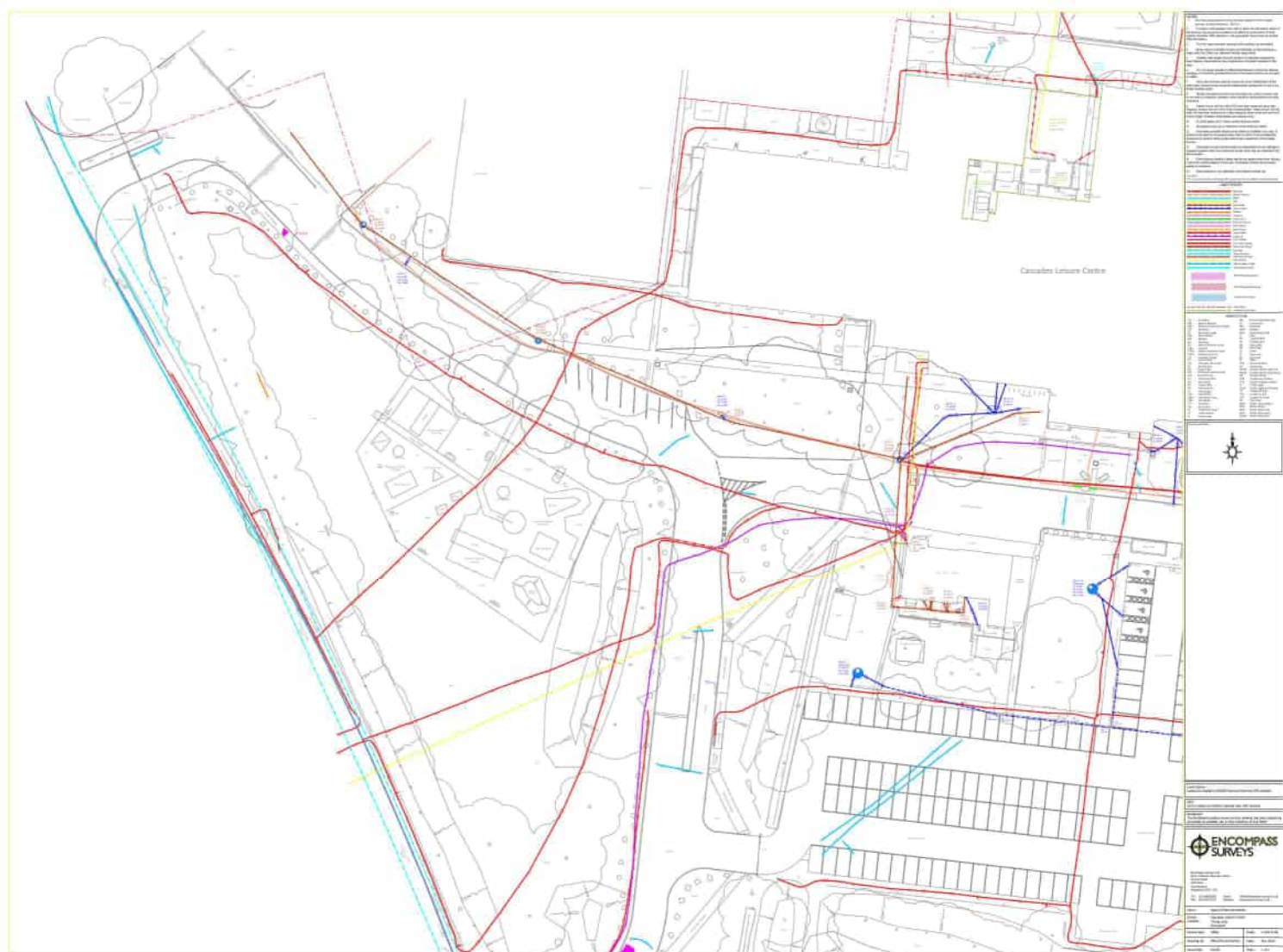
North Arrow

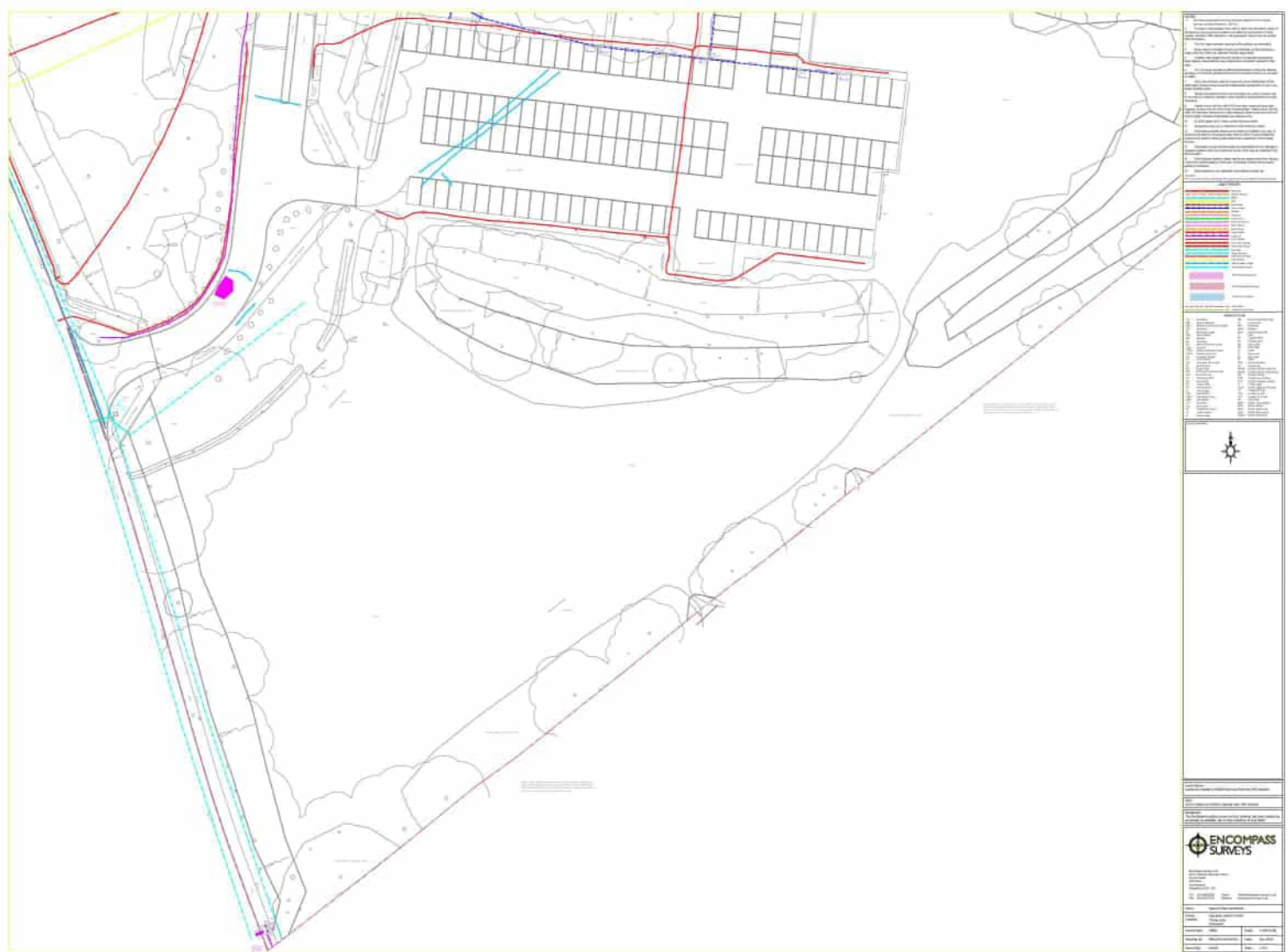
ENCOMPASS SURVEYS

Project Information

Field	Value
Project Name	Caswell Leisure Centre
Client	...
Surveyor	...
Date	...









Legend

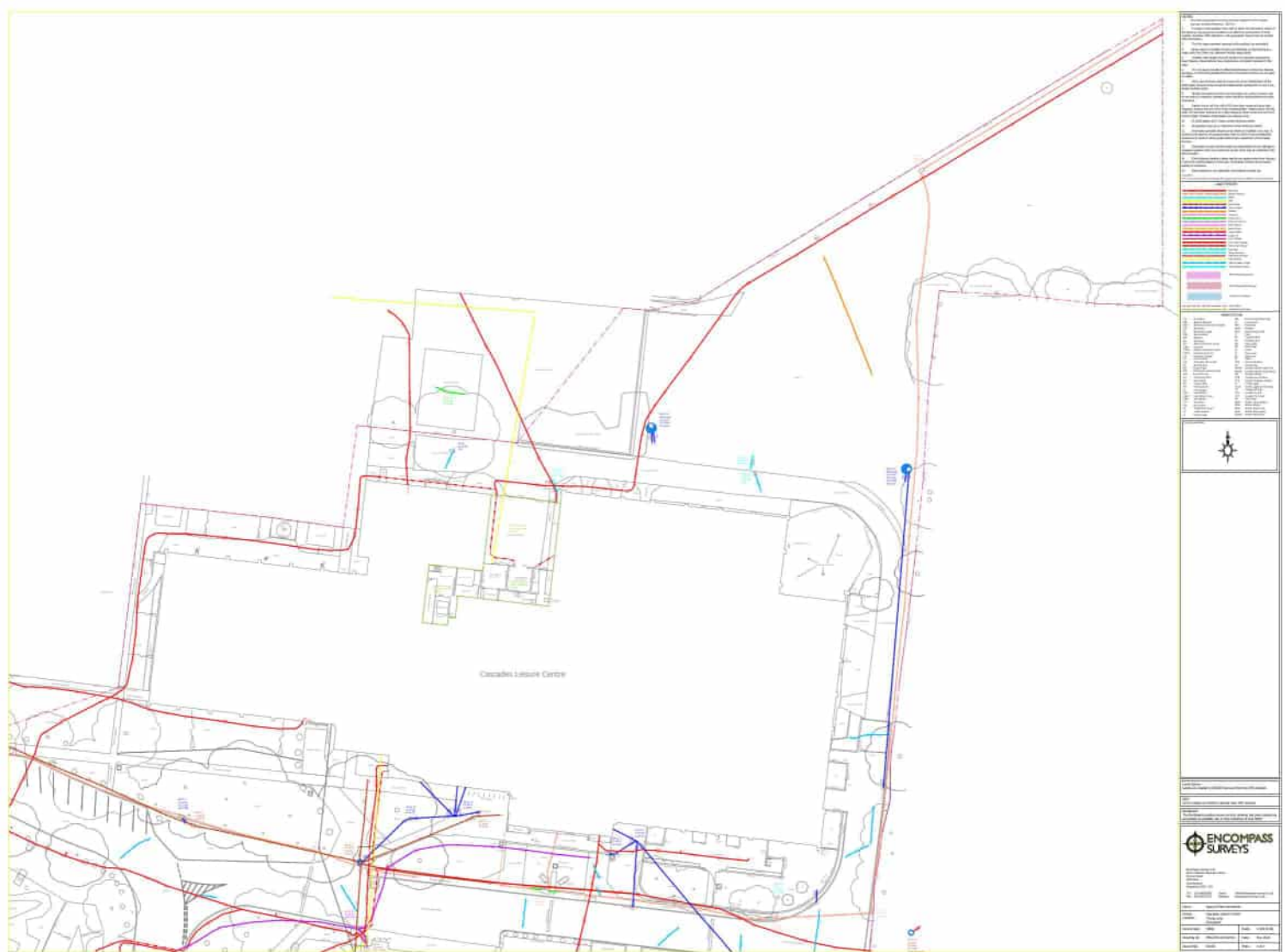
Color	Description
Red	Property Line
Blue	Survey Line
Green	Utility Line
Yellow	Boundary Line
Purple	Survey Point
Black	Building Footprint
Grey	Parking Lot
White	Open Area

North Arrow

ENCOMPASS SURVEYS

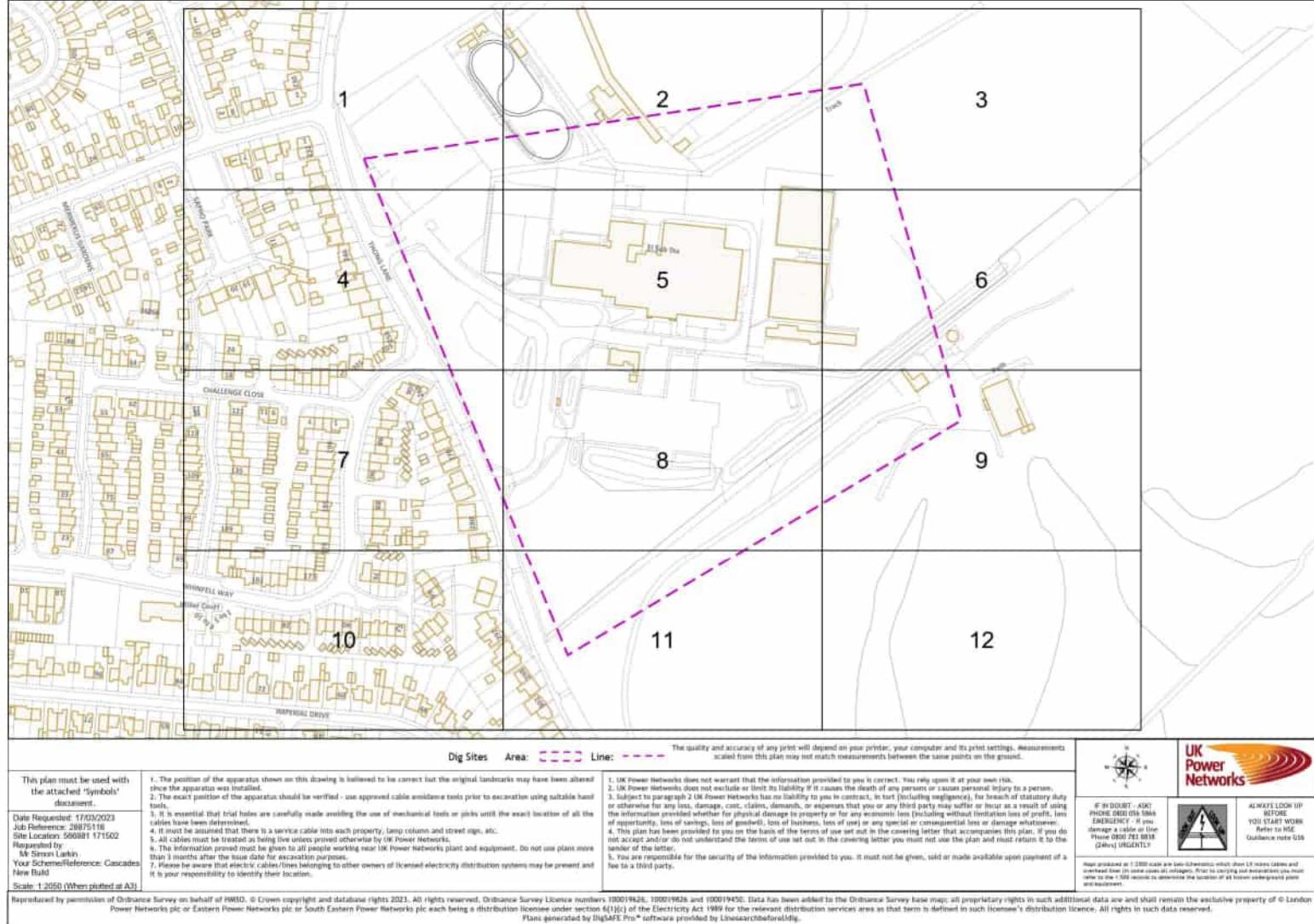
Project Information

Field	Value
Project Name	Site Plan for Loma Verde
Client	ABC Development
Surveyor	John Doe
Date	10/26/2023
Scale	1" = 100'



Map Symbols

						
VALVE OPEN	VALVE CLOSED	GOVERNOR	END CLOSURE	SYPHON	REDUCER	TEE
						
TEST POINT	CATHODIC PROTECTION	GENERAL REFERENCE	FLOW MEASURE	DIP POINT	MONO ETHYLENE GLYCOL	OILING POINT
						
FLOW STOP	PRESSURE MEASUREMENT	STAND PIPE	OFFICIAL MINISTRY RECORD	PURGE POINT	GAS CONDITIONER	DRAIN POINT
				 LP MAINS  MP MAINS  IP MAINS  LHP MAINS  HISTORY DATA		
SKETCH BUBBLE	DEPTH OF COVER	METER	MATERIAL CHANGE			
						
PIG TRAP	CROSSOVER CONNECTION	CHANGE OF DIAMETER	PIPE JOINT	SSSI	GTs	
						CONTACT ZONE LTS



This plan must be used with the attached 'Symbols' document.

Date Requested: 17/03/2023
Job Reference: 28875116
Site Location: 506881 171502
Requested by: M Simon Larkin
Your Scheme/Reference: Cascades New Build
Scale: 1:2500 (When plotted at A3)

1. The position of the apparatus shown on this drawing is believed to be correct but the original landmarks may have been altered since the apparatus was installed.
2. The exact position of the apparatus should be verified - use approved cable avoidance tools prior to excavation using suitable hand tools.
3. It is essential that trial holes are carefully made avoiding the use of mechanical tools or jacks until the exact location of all the cables have been determined.
4. It must be assumed that there is a service cable into each property, lamp column and street sign, etc.
5. All cables must be treated as being live unless proved otherwise by UK Power Networks.
6. The information provided must be given to all people working near UK Power Networks plant and equipment. Do not use plans more than 3 months after the issue date for excavation purposes.
7. Please be aware that electric cables/lines belonging to other owners of licensed electricity distribution systems may be present and it is your responsibility to identify their location.

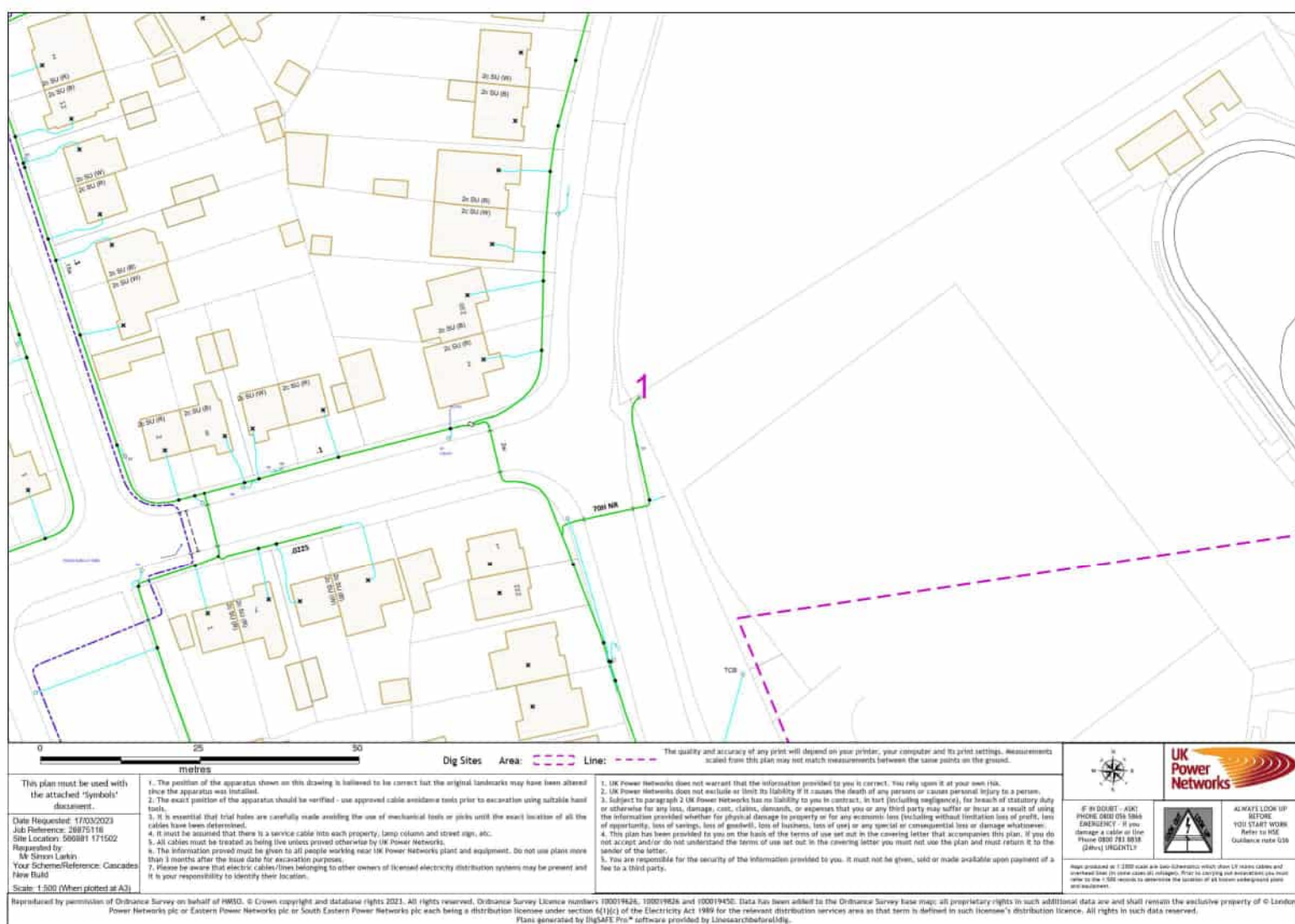
1. UK Power Networks does not warrant that the information provided to you is correct. You rely upon it at your own risk.
2. UK Power Networks does not exclude or limit its liability if it causes the death of any persons or causes personal injury to a person.
3. Subject to paragraph 2 UK Power Networks has no liability to you in contract, in tort (including negligence), for breach of statutory duty or otherwise for any loss, damage, cost, claims, demands, or expenses that you or any third party may suffer or incur as a result of using the information provided whether for physical damage to property or for any economic loss (including without limitation loss of profit, loss of opportunity, loss of savings, loss of goodwill, loss of business, loss of use) or any special or consequential loss or damage whatsoever.
4. This plan has been provided to you on the basis of the terms of use set out in the covering letter that accompanies this plan. If you do not accept and/or do not understand the terms of use set out in the covering letter you must not use the plan and must return it to the sender of the letter.
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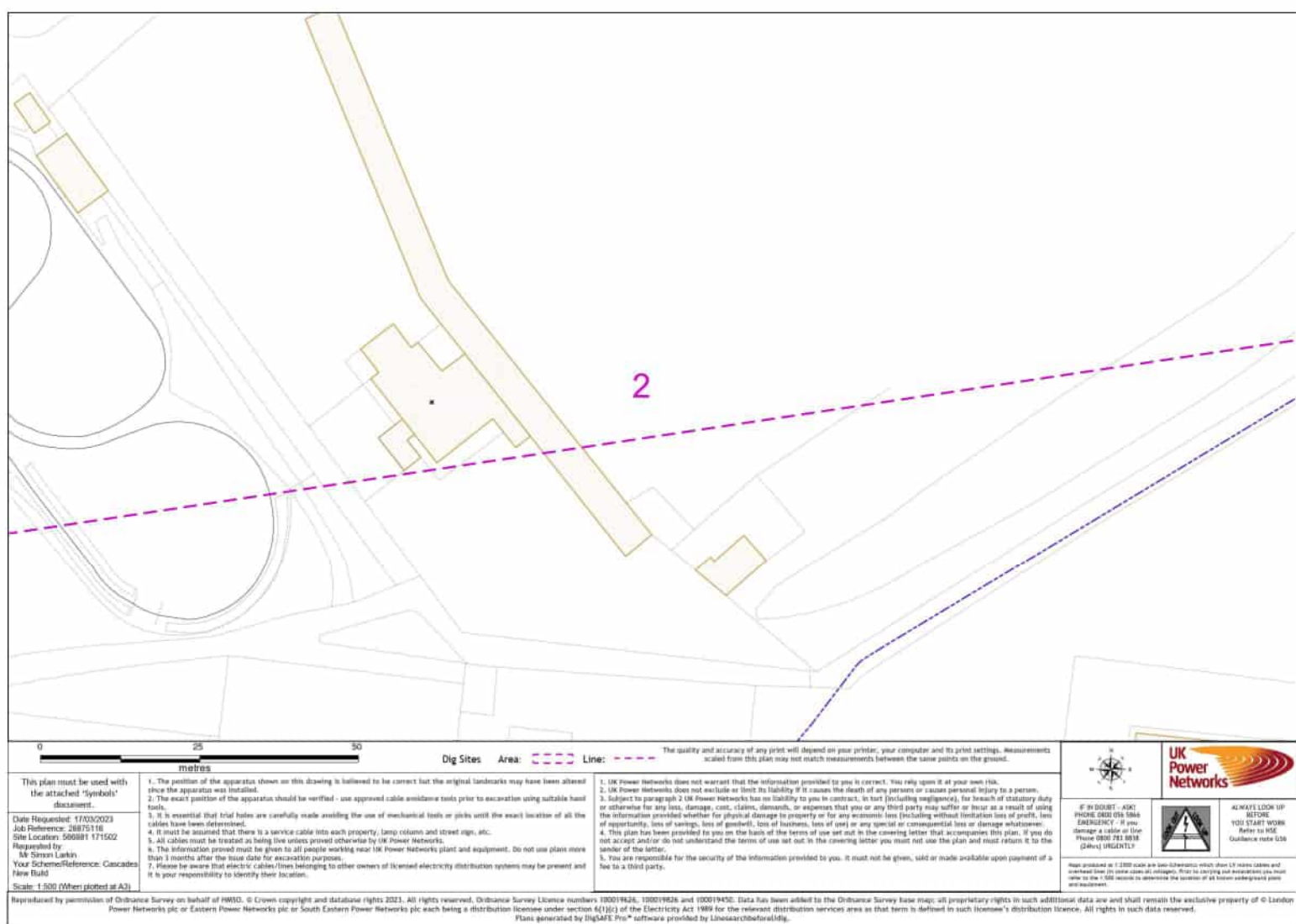


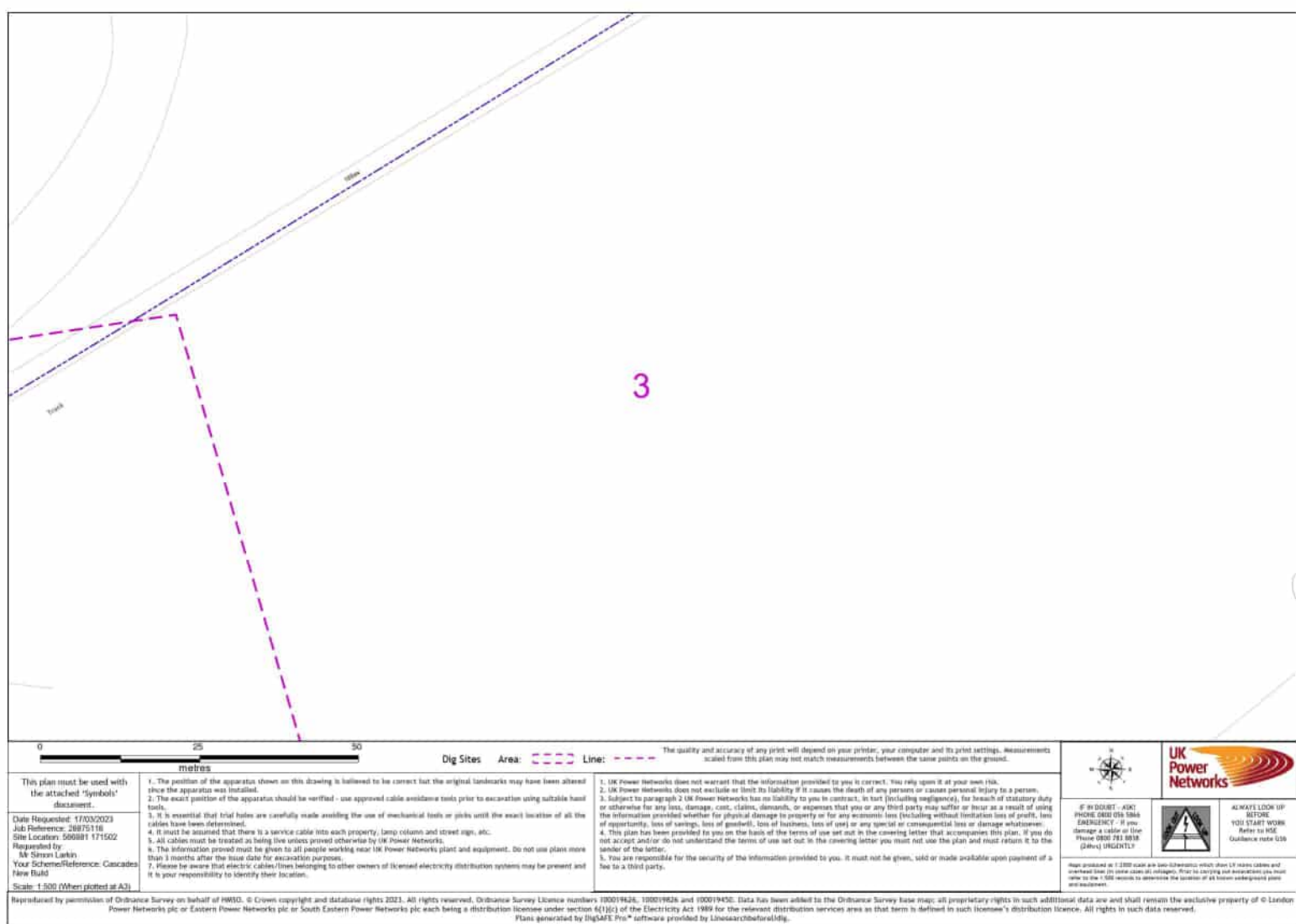
IF IN DOUBT - ASK
PHONE 0800 056 5866
EMERGENCY - If you
damage a cable or line
Phone 0800 785 8958
(Always Urgently)

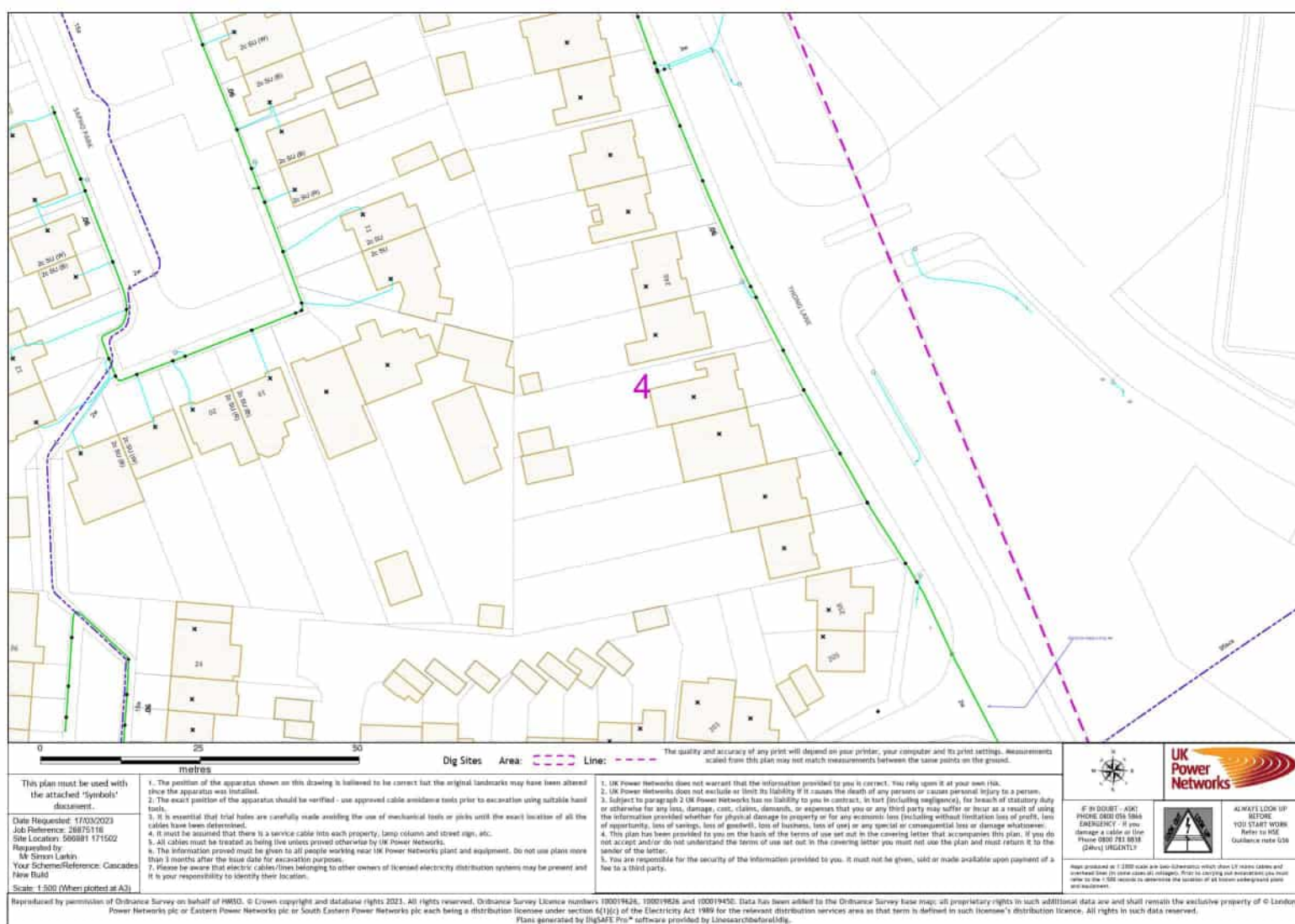


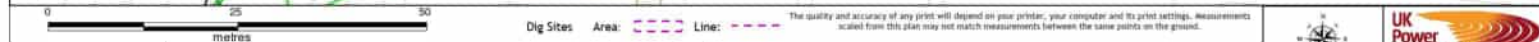
ALWAYS LOOK UP
BEFORE
YOU START WORK
Refer to NSE
Guidance note G26



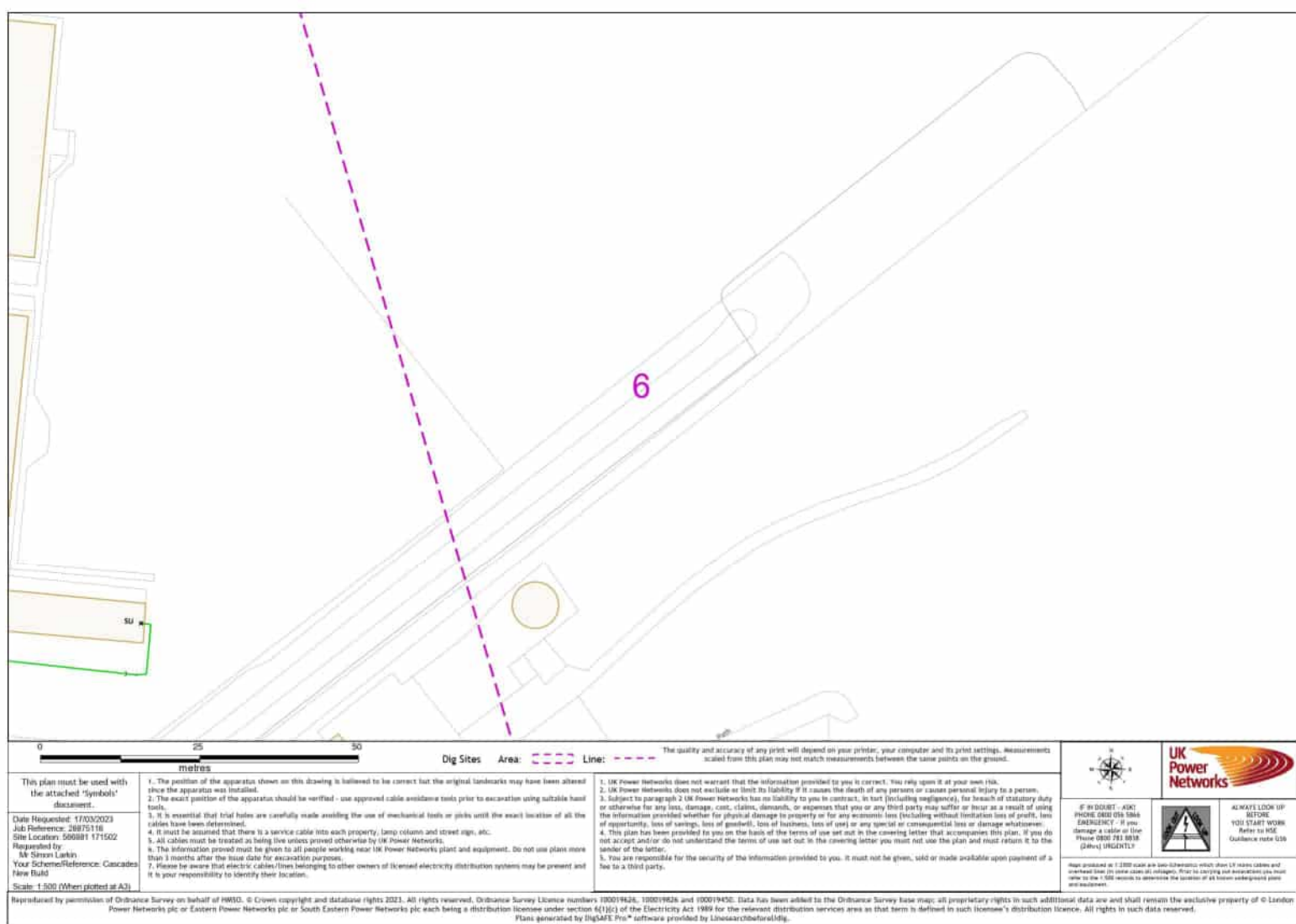






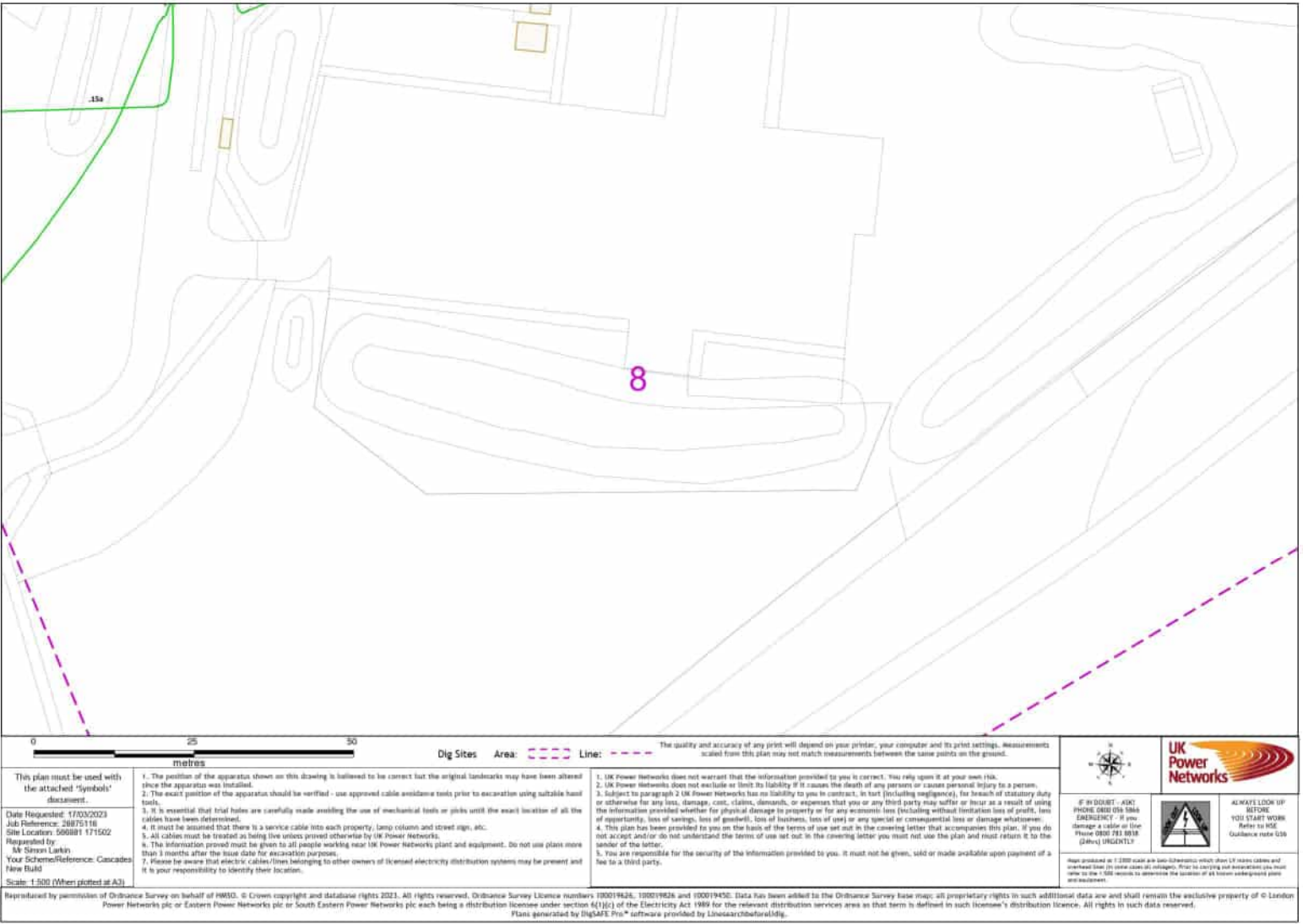


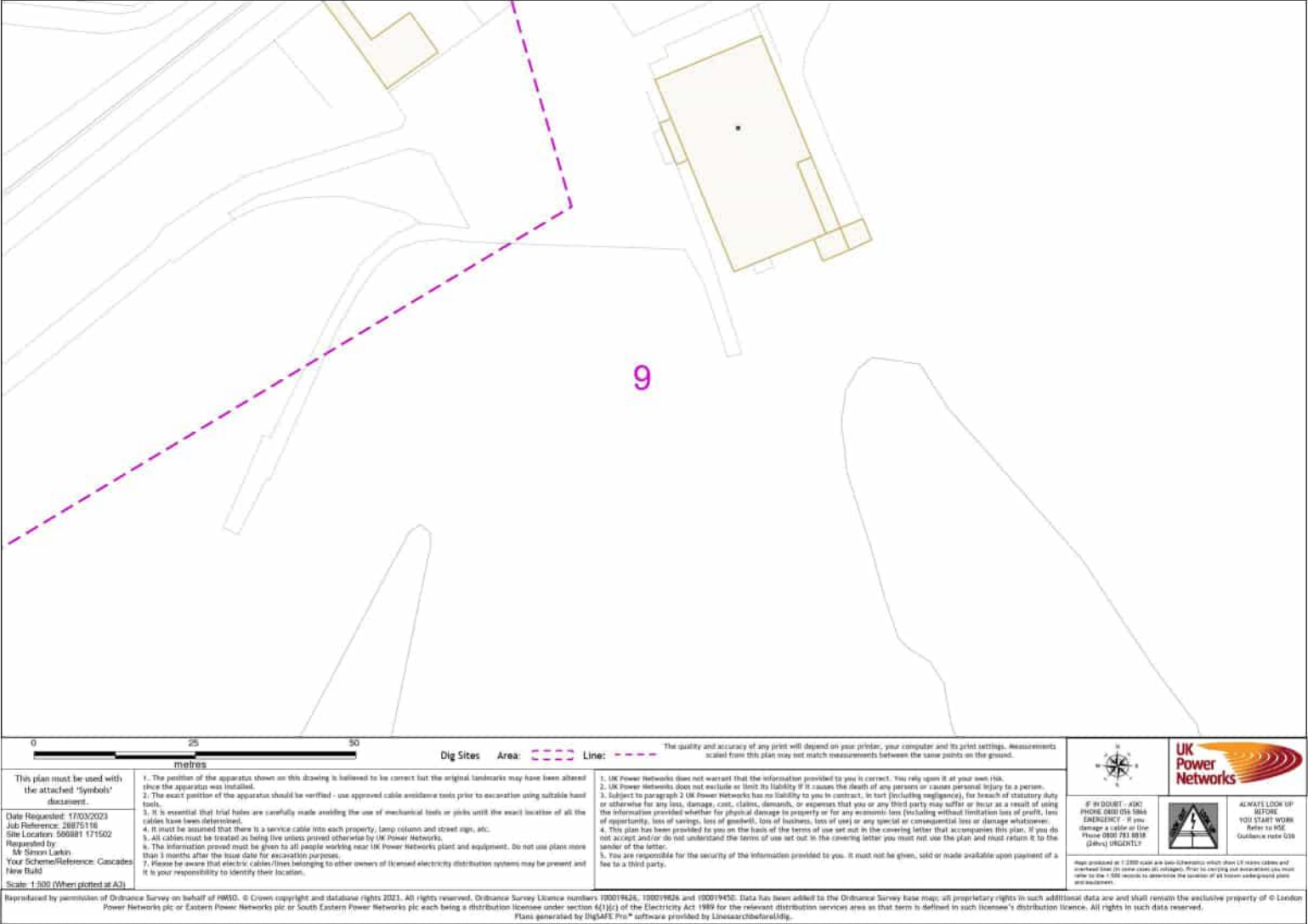
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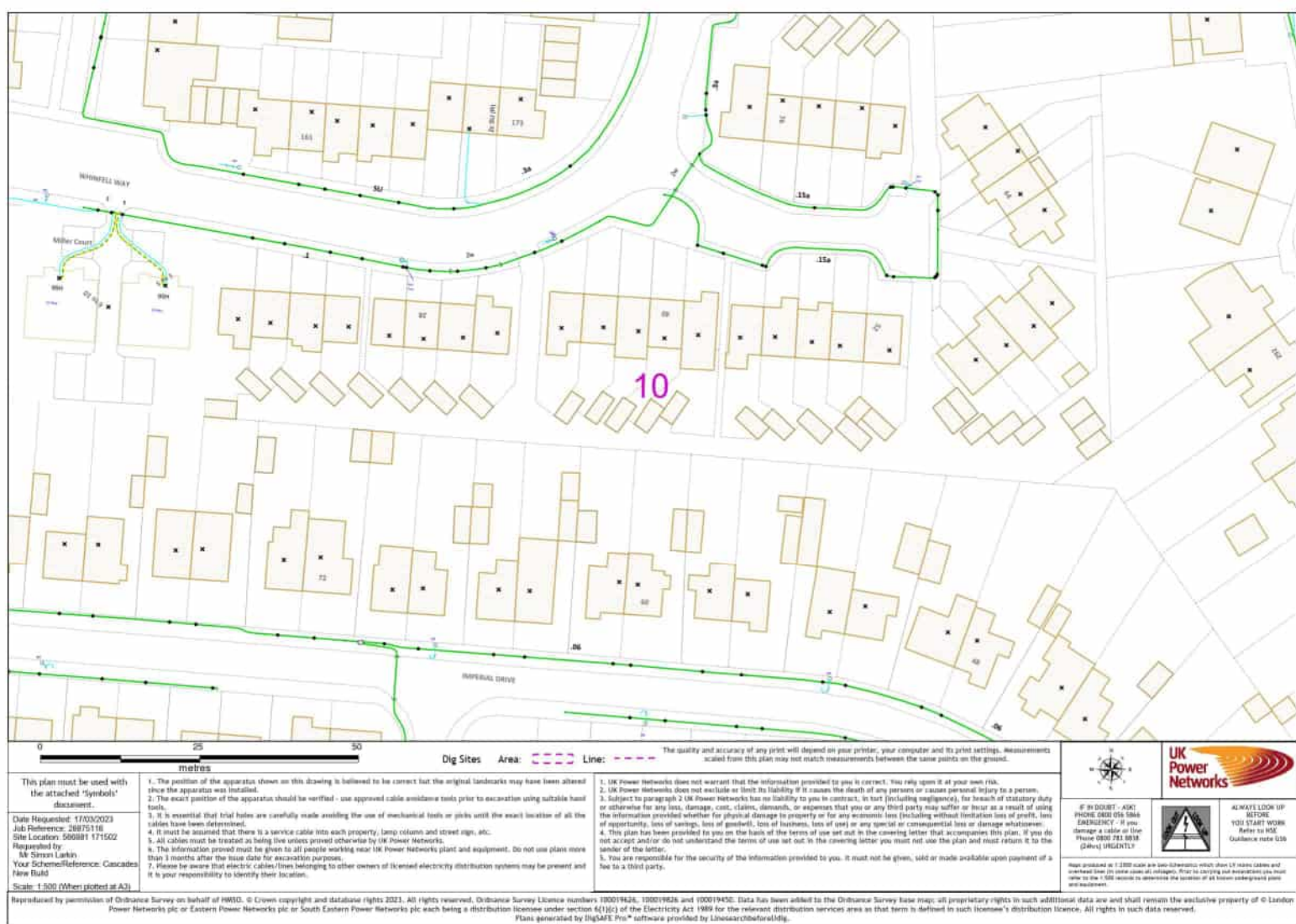


This plan must be used with the attached 'Symbols' document. Date Requested: 17/03/2023 Job Reference: 26875118 Site Location: 506881 171502 Requested by: M Simon Larkin Your Scheme/Reference: Cascades New Build Scale: 1:500 (When plotted at A3)	1. The position of the apparatus shown on this drawing is believed to be correct but the original landmarks may have been altered since the apparatus was installed. 2. The exact position of the apparatus should be verified - use approved cable avoidance tools prior to excavation using suitable hand tools. 3. It is essential that trial holes are carefully made avoiding the use of mechanical tools or jacks until the exact location of all the cables have been determined. 4. It must be assumed that there is a service cable into each property, lamp column and street signs, etc. 5. All cables must be treated as being live unless proved otherwise by UK Power Networks. 6. The information provided must be given to all people working near UK Power Networks plant and equipment. Do not use plans more than 3 months after the issue date for excavation purposes. 7. Please be aware that electric cables/lines belonging to other owners of licensed electricity distribution systems may be present and it is your responsibility to identify their location.	 IF IN DUBT - ASK PHONE 0800 056 1866 EMERGENCY - If you damage a cable or line Phone 0800 781 8018 (dialing 999/112) ALWAYS LOOK UP BEFORE YOU START WORK Refer to HSE Guidance note G56 Maps produced at 1:500 scale are two-dimensional which show LFT meters cables and overhead lines (OHL) cables (if relevant). Prior to digging and installation you must refer to the 1:500 records to determine the location of all known underground pipes and manholes.
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Date Requested: 17/03/2023
Job Reference: 26875116
Site Location: 506881 171502
Requested by: Mr Simon Larkin
Your Scheme/Reference: Cascades New Build
Scale: 1:500 (When plotted at A3)

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7. Please be aware that electric cables/lines belonging to other owners of licensed electricity distribution systems may be present and it is your responsibility to identify their location.

1. UK Power Networks does not warrant that the information provided to you is correct. You rely upon it at your own risk.
2. UK Power Networks does not exclude or limit its liability if it causes the death of any person or causes personal injury to a person.
3. Subject to paragraph 2 UK Power Networks has no liability to you in contract, in tort (including negligence), for breach of statutory duty or otherwise for any loss, damage, cost, claims, demands, or expenses that you or any third party may suffer or incur as a result of using the information provided whether for physical damage to property or for any economic loss (including without limitation loss of profit, loss of opportunity, loss of savings, loss of goodwill, loss of business, loss of use) or any special or consequential loss or damage whatsoever.
4. This plan has been provided to you on the basis of the terms of use set out in the covering letter that accompanies this plan. If you do not accept and/or do not understand the terms of use set out in the covering letter you must not use the plan and must return it to the sender of the letter.
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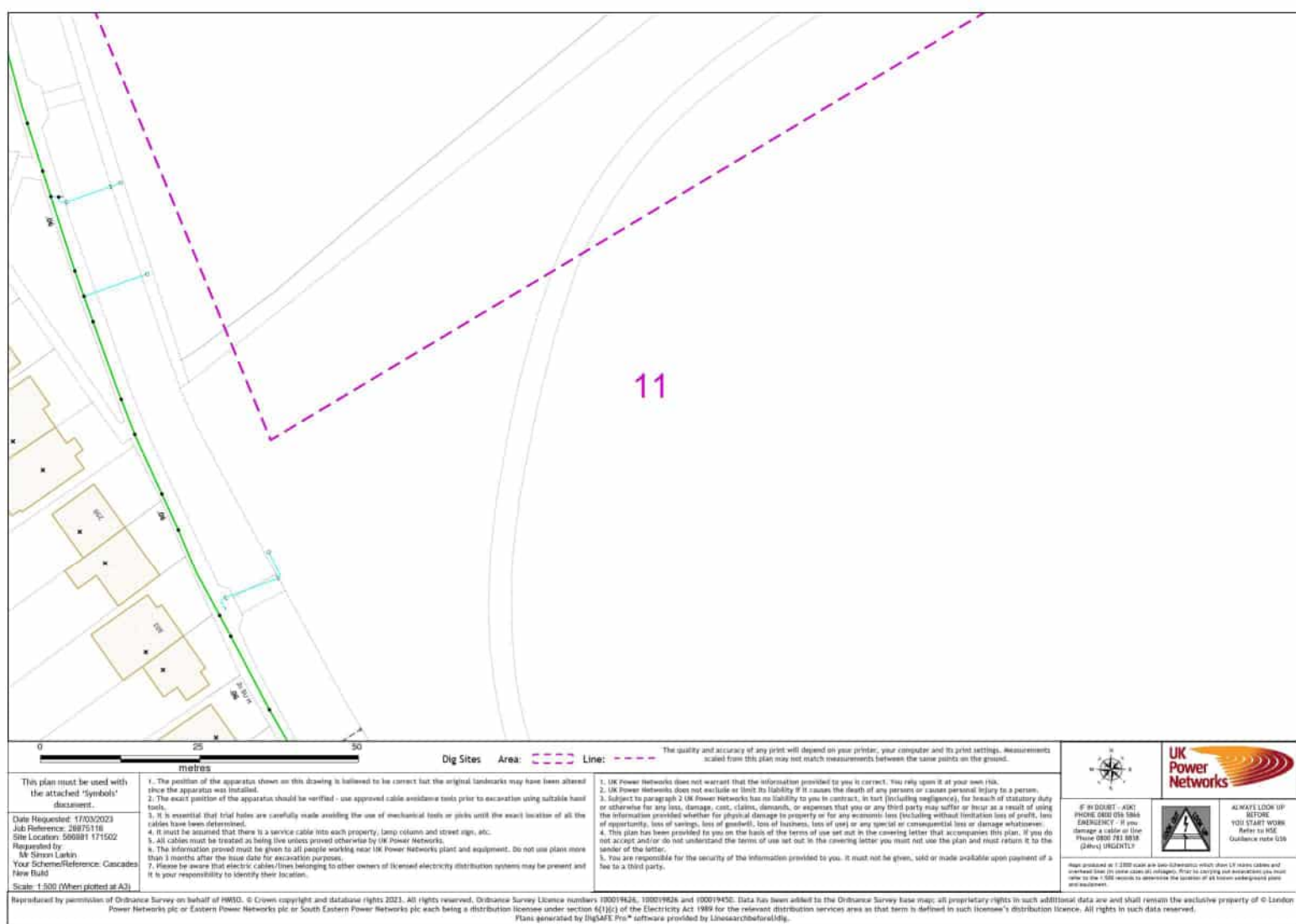


IF IN DOUBT - ASK!
PHONE: 0800 056 5866
EMERGENCY - If you damage a cable or line Phone 0800 785 8058 (dialling 999/112)



ALWAYS LOOK UP BEFORE YOU START WORK
Refer to NSE Guidance note G26

Maps produced at 1:2500 scale are two-dimensional which show LFT meters cables and overhead lines (OHL) under ideal conditions. Prior to carrying out excavation you must refer to the 1:500 section to determine the location of all known underground pipes and boundaries.



This plan must be used with the attached 'Symbols' document. Date Requested: 17/03/2023 Job Reference: 26875118 Site Location: 506881 171502 Requested by: M Simon Larkin Your Scheme/Reference: Cascades New Build Scale: 1:500 (When plotted at A3)	1. The position of the apparatus shown on this drawing is believed to be correct but the original landmarks may have been altered since the apparatus was installed. 2. The exact position of the apparatus should be verified - use approved cable avoidance tools prior to excavation using suitable hand tools. 3. It is essential that trial holes are carefully made avoiding the use of mechanical tools or picks until the exact location of all the cables have been determined. 4. It must be assumed that there is a service cable into each property, lamp column and street sign, etc. 5. All cables must be treated as being live unless proved otherwise by UK Power Networks. 6. The information provided must be given to all people working near UK Power Networks plant and equipment. Do not use plans more than 3 months after the issue date for excavation purposes. 7. Please be aware that electric cables/lines belonging to other owners of licensed electricity distribution systems may be present and it is your responsibility to identify their location.	1. UK Power Networks does not warrant that the information provided to you is correct. You rely upon it at your own risk. 2. UK Power Networks does not exclude or limit its liability if it causes the death of any persons or causes personal injury to a person. 3. Subject to paragraph 2 UK Power Networks has no liability to you in contract, in tort (including negligence), for breach of statutory duty or otherwise for any loss, damage - cost, claims, demands, or expenses that you or any third party may suffer or incur as a result of using the information provided whether for physical damage to property or for any economic loss (including without limitation loss of profit, loss of opportunity, loss of savings, loss of goodwill, loss of business, loss of use) or any special or consequential loss or damage whatsoever. 4. This plan has been provided to you on the basis of the terms of use set out in the covering letter that accompanies this plan. If you do not accept and/or do not understand the terms of use set out in the covering letter you must not use the plan and must return it to the sender of the letter. 5. You are responsible for the security of the information provided to you. It must not be given, sold or made available upon payment of a fee to a third party.	 IF IN DUBT - ASK PHONE 0800 056 1866 EMERGENCY - If you damage a cable or line Phone 0800 781 8018 (dialing 111/92511) ALWAYS LOOK UP BEFORE YOU START WORK Refer to MSE Guidance note G16
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Dig Sites Area: Line:

The quality and accuracy of any print will depend on your printer, your computer and its print settings. Measurements scaled from this plan may not match measurements between the same points on the ground.

This plan must be used with the attached 'Symbols' document.

Date Requested: 17/03/2023
Job Reference: 26875118
Site Location: 506881 171502
Requested by:
Mr Simon Larkin
Your Scheme/Reference: Cascades New Build
Scale: 1:500 (When plotted at A3)

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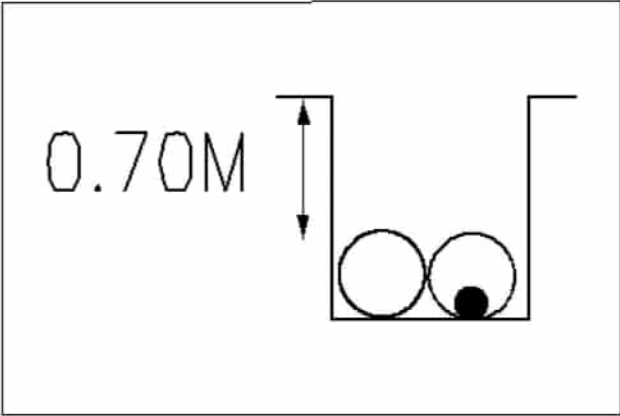
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3. Subject to paragraph 2 UK Power Networks has no liability to you in contract, in tort (including negligence), for breach of statutory duty or otherwise for any loss, damage - cost, claims, demands, or expenses that you or any third party may suffer or incur as a result of using the information provided whether for physical damage to property or for any economic loss (including without limitation loss of profit, loss of opportunity, loss of savings, loss of goodwill, loss of business, loss of use) or any special or consequential loss or damage whatsoever.
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ALWAYS LOOK UP BEFORE YOU START WORK
Refer to RSE Guidance note G16

If in DUBLET - 4507
PHONE 0800 056 1066
EMERGENCY - If you
damage a cable or line
Phone 0800 781 8016
(dialing 999/112)

Plans produced at 1:500 scale are two-dimensional which show 2D views of cables and overhead lines (OHL) and do not show 3D views. Plans are for guidance only and do not show the location of all known underground pipes and manholes.



Cross Section B

1. The position of the apparatus shown on this drawing is believed to be correct but the original landmarks may have been altered since the apparatus was installed. 2. The exact position of the apparatus should be verified - use approved cable avoidance tools prior to excavation using suitable hand tools. 3. It is essential that trial holes are carefully made avoiding the use of mechanical tools or picks until the exact location of all the cables have been determined. 4. It must be assumed that there is a service cable into each property, lamp column and street sign, etc. 5. All cables must be treated as being live unless proved otherwise by UK Power Networks. 6. The information provided must be given to all people working near UK Power Networks plant and equipment. Do not use plans more than 3 months after the issue date for excavation purposes. 7. Please be aware that electric cables/lines belonging to other owners of licensed electricity distribution systems may be present and it is your responsibility to identify their location.	1. UK Power Networks does not warrant that the information provided to you is correct. You rely upon it at your own risk. 2. UK Power Networks does not exclude or limit its liability if it causes the death of any persons or causes personal injury to a person. 3. Subject to paragraph 2 UK Power Networks has no liability to you in contract, in tort (including negligence), for breach of statutory duty or otherwise for any loss, damage, cost, claims, demands, or expenses that you or any third party may suffer or incur as a result of using the information provided whether for physical damage to property or for any economic loss (including without limitation loss of profit, loss of opportunity, loss of savings, loss of goodwill, loss of business, loss of use) or any special or consequential loss or damage whatsoever. 4. This plan has been provided to you on the basis of the terms of use set out in the covering letter that accompanies this plan. If you do not accept and/or do not understand the terms of use set out in the covering letter you must not use the plan and must return it to the sender of the letter. 5. You are responsible for the security of the information provided to you. It must not be given, sold or made available upon payment of a fee to a third party.	IF IN DOUBT - ASK! PHONE 0800 936 5664 EMERGENCY - If you damage a cable or line Phone 0800 753 88 88 (24 hrs) URGENTLY	 UK Power Networks  ALWAYS LOOK UP BEFORE YOU START WORK Refer to HSE Guidance note GS6 Maps produced at 1:2500 scale are Geo-Schematics which show LV main cables and overhead lines (in some cases all voltages). Prior to carrying out excavations you must refer to the 1:500 records to determine the location of all known underground plant and equipment.
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UK Power Networks Feedback Tool

Please help UK Power Networks improve the accuracy of their network records and help make it safer for all those working around them in future.

All you need to do is:

1. Use your phone camera to scan the QR code:
2. Provide feedback on what you have found on site (good or bad)
3. Upload a photo if needed



Thank you for making the area a safer place to dig.

UK Power Networks, working with LSBUD