

GROUND INVESTIGATION REPORT



FOR FACTORY UNITS, 23 WOOD STREET, HINCKLEY, LEICESTERSHIRE LE10 1JQ

Report No. 5435

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EXECUTIVE SUMMARY

- The site appears to have comprised commercial/industrial buildings since the earliest available mapping of 1887, undergoing various stages of redevelopment culminating in the current layout in c2008, thereafter remaining more-or-less unchanged up until the present day
- A Phase 2 intrusive ground investigation was conducted comprising boreholes, manually-excavated trial pits and one concrete core-hole supplemented by in-situ plus detailed geotechnical and contamination lab testing
- Ground profile proved generally commensurate with recorded geological mapping and expectation, recording a variable surface mantle of made ground underlain by predominantly cohesive superficial deposits to terminal depths. The MMG bedrock was only locally identified in WS3 and WS4
- The bedrock MMG is of “Secondary B” aquifer status and the superficial D of “Secondary A” aquifer status. Groundwater was only encountered in WS3 at 4.0m depth
- Detailed quantitative contamination risk assessment undertaken in accordance with BS10175:2011 “Code of Practice for the Investigation of Potentially Contaminated Sites” and Environment Agency (EA) document LCRM “Land Contamination Risk Management” (2020) would infer that the site is for the most part uncontaminated, with only a single lead elevation which can easily be remediated with the application of either a clean cover system or permanent hardstand. There is no perceived risk to controlled waters
- Trenchfill foundations bearing onto the superficial deposits at minimum 1.5m depth should be acceptable throughout, where an allowable bearing resistance of at least 133kN/m² ought to be achievable
- All exploratory holes remained stable during the short time they were left open and the short-term stability of side walls within open excavations is unlikely to be an issue during construction
- Suspended ground floor slabs will be required owing to the thickness of made ground exceeding 600mm however heave protection ought not be necessary
- Buried concrete in open excavations up to 3.5m depth can adopt DS/AC-1 mix
- Near surface plasticity results suggest CBR values of 3-6% for preliminary road and pavement design, reduced to 2% where made ground is exposed at the formation level
- Percolation testing confirms the ground to be unsuitable for a conventional SUDs-type drainage system
- There is not currently considered to be a requirement for landfill gas or radon gas protection measures in the proposed residential buildings

GROUND INVESTIGATION REPORT FOR FACTORY UNITS,
23 WOOD STREET, HINCKLEY, LEICESTERSHIRE LE10 1JQ
PREPARED FOR ANSLEY VILLAGE FARM LIMITED

1 INTRODUCTION

- 1.1** It is proposed to re-develop the above site with apartments. It is understood that whilst the Local Planning Authority (LPA) has granted planning permission, given the 'high sensitivity' of the proposed development a Condition has been placed requiring an assessment of the current contamination status in order to determine any potential risks to both human health and controlled waters. A contamination risk assessment has therefore been undertaken to part address Condition 25 of the planning permission (**Hinckley and Bosworth Borough Council Planning Reference: 22/00695/HYB**). A ground investigation to ascertain the ground conditions for appropriate foundation and ground floor slab design along with soakaway drainage feasibility has also been undertaken.
- 1.2** The geotechnical investigation has been carried out in general accordance with Eurocode 7 'Geotechnical Design', in particular BS EN 1997-1:2004 and 1997-2:2007 and BS EN ISO 14688-1:2002 and 14688-2:2004. The proposed development is considered to fall into the Geotechnical Category 2 classification, thus routine field and laboratory testing methods have been adopted. Reference has also been made to BS5930:2015 Code of Practice for Ground Investigations, and National House Building Council (NHBC) Standards Chapter 4.2 – 'Building Near Trees'.
- 1.3** The Geo-environmental assessment comprising Phase 1 desk study followed by Phase 2 testing and quantitative contamination risk assessment has been carried out in accordance with BS10175:2011 "Code of Practice for the Investigation of Potentially Contaminated Sites" and Environment Agency (EA) document LCRM "Land Contamination Risk Management" (2020).
- 1.4** This report has been prepared in accordance with quotation reference Q24310, dated 1st November 2024 with instruction confirmed 12th November 2024 by Ansley Village Farm Limited, to whom reliance on this report is presently restricted.

2 SITE LOCATION AND DESCRIPTION

- 2.1** Centred on National Grid Reference 443028, 294031 the irregularly shaped 0.19ha site is located in Hinckley, Leicestershire some 700m south-east of the town centre as shown on drawing 5435/1.
- 2.2** A walkover survey was undertaken on 20th November 2024 and a selection of representative photos is presented in Appendix 1, with their positions and orientations shown on existing site layout drawing 5435/2. This identified the site to comprise an operational label printing works with two large factory buildings (Unit 1 & 2) connected by an archway and set within a mixed concrete/tarmac hardstand and gravel hardcore yard used for parking plus some limited soft landscaping. The site is enclosed on all sides by a mixture of dwellings and commercial premises.
- 2.3** **Unit 1** (to be demolished) is a derelict two-storey building of conventional brick-built construction with a pitched tiled roof and plastic rainwater goods, accessed via either a pedestrian entrance or roller-shutter door. The building has been used for generic storage of filing cabinets, empty paint cans, white goods and other miscellaneous items and the floor comprises brick setts which where visible appeared to be unbroken and devoid of hydrocarbon/paint staining.
- 2.4** **Unit 2** (to be converted) is a two-storey building of conventional brick-built construction with a flat roof and plastic rainwater goods, accessed via both a pedestrian door and roller-shutter door and is currently occupied by Colour Flex Labels, a commercial printing works. Internally the ground floor consists of four distinct rooms; the main printing area in the eastern half, the entrance hall and amenity room in the centre and a storage area in the west. The internal surface in the west comprises brick setts whilst the rest of the building comprises a concrete floor slab which appeared to be in reasonably good unbroken condition and devoid of significant ink staining.
- 2.5** Externally the yard area is predominantly tarmac hardstand parking with concrete around the entrance bays of Unit 2 and two small areas of soft landscaping. An empty and disused above ground fuel tank was noted however there was no evidence of hydrocarbon staining on the floor around it. There are a number of perimeter semi-mature to mature trees and hedgerows including ash, Leyland cypress and maple.
- 2.6** Topographic mapping data derived from the Google Earth mapping suite indicates the site to be essentially flat at an elevation of 134m above Ordnance Datum (AOD).

3 DESK STUDY RESEARCHES

Recorded Geology

- 3.1** The geology of the site is shown on the British Geological Survey (BGS) 1:10,000 scale mapping sheet SP 49 SW and online, which indicates it to be entirely underlain by bedrock of the Mercia Mudstone Group (MMG) which usually comprises predominantly red, occasionally greenish-grey mudstones and subordinate siltstones with thin beds of gypsum/anhydrite and sandstone. This is entirely overlain by superficial deposits of the Dunsmore Gravel (D) which is typically characterised as red, brown and yellow flinty gravel with lenses of coarse sand. There are no areas of mapped made ground or geological faulting shown either inside or within likely influencing distance of the site although the former is anticipated given the developed setting.
- 3.2** Whilst this Practice has no record of previous investigations of immediate use to the site, the BGS archive records a borehole c70m to the north-west which confirmed ground conditions to be commensurate with geological mapping.

Hydrogeology and Hydrology

- 3.3** The MAGIC website confirms the MMG as a “Secondary B” aquifer, meaning that it comprises low permeability strata with a limited ability to store and yield groundwater by virtue of localised features such as fissures, thin permeable horizons and weathering. The overlying superficial D is classified as a ‘Secondary A’ aquifer, meaning that it comprises permeable strata capable of supporting water supplies at a local rather than strategic level, and in some cases forming an important source of baseflow to rivers. There are no EA-recorded groundwater abstractors listed within influencing distance (the nearest being some 945m to the south-west as per drawing 5435/5) and the site is not located within a groundwater Source Protection Zone (SPZ). The site surface predominantly comprises building cover and tarmac/concrete hardstand with limited gravel hardcore/soft landscaping suggesting that rainwater infiltration is likely to be low/negligible for the former and high for the latter, dependent on either the existing drainage infrastructure (roof runoff drains via guttering and downpipes but ultimate discharge point unknown) or natural permeability.

- 3.4** Based upon the above information the site is considered to be within an area of low to moderate sensitivity in terms of groundwater resources by virtue of the “Secondary A” superficial aquifer designation.
- 3.5** The site itself contains no ponds or water courses and the nearest significant off-site surface water feature appears to be a pond some 150m to the south-west. The EA does not consider the site to be at risk of flooding from rivers or seas.
- 3.6** Based upon the above information the site is considered to be within an area of low sensitivity in terms of controlled surface waters.

Site History

- 3.7** The history of the site has been deduced by inspection of historical Ordnance Survey maps dating back to 1887 (Appendix 4) together with historical aerial imagery provided as part of the online Google Earth mapping service, and a selection of relevant extracts is presented as drawing 5435/3. Any on and/or off-site points of interest that may affect or be affected by the proposed development are summarised in Table 1 below.

TABLE 1: SUMMARY OF SITE HISTORY

Date (Source Map Scale)	On-Site	Off-Site	Potential Contaminants that may affect Site	Likelihood of Site Impact
1887 - 1889 (1:10,560 and 1:2,500)	Hosiery Manufactory and several other presumed commercial units	Generally surrounded by clothing/hosiery manufactories and residential dwellings 30m NE – St Peters Priory 39m NE – St Peters Church 58m and 196m SE – St Peters RC School and Old Gravel Pit 6m N – disused burial ground	Toxic and phytotoxic metals	Low - Moderate
1903 - 1904 (1:10,560 and 1:2,500)	No significant change	196m SE – Old Gravel Pit no longer recorded, potentially infilled	As above plus landfill-type gas emissions	Low - Moderate
1924 - 1955 (1:10,560, 1:10,000 and 1:2,500)	Layout change	No significant change	As above plus Petroleum/ polyaromatic hydrocarbons (TPH/PAH), volatile organic compounds (SVOC and VOC) and asbestos containing materials (ACM)	Low - Moderate

Date (Source Map Scale)	On-Site	Off-Site	Potential Contaminants that may affect Site	Likelihood of Site Impact
1960 - 1969 (1:10,000 and 1:2,500)	Present day Unit 1 and 2 established with outbuildings and labelled 'factory'	Hosieries now labelled 'factories'	As above	Moderate
1977 - 1987 (1:10,000 and 1:2,500)	No significant change	Commercial units to north replaced with dwellings 6m N – burial ground no longer recorded	As above	Moderate
1993 (1:2,500)	Some outbuildings demolished	No significant change	As above	Moderate
1999 - 2006 (1:10,000, 1:2,500 and Google Earth historical mapping suite)	No significant change	6m N – dwellings constructed	As above	Moderate
2008 – present day (1:10,000, 1:2,500 and Google Earth historical mapping suite)	All outbuildings demolished	No significant change	As above	Moderate

- 3.8** Please note that Ordnance Survey plans only represent periodic snapshots in time, and do not provide a continuous record of previous site usage, there is therefore a risk that the site may contain buried remnant foundations of former buildings or waste products associated with unrecorded previous site usage, which may not be evident from the site walkover inspection and desk study researches.

Landfill Gas and Radon Gas

- 3.9** Consistent with the site history researches the EA landfill register shows no record of either active or historical landfills within potential influencing distance of the site; with the nearest authorized landfill being "F E Downes Limited" c850m to the south-east, and the nearest historical landfill being "Bute Close Landfill Site" c850m to the north-west, as per drawing 5435/5. OS historical 1887 mapping edition shows an old gravel pit some 196m to the south-east of the site which ceases to be recorded by 1903 and in the absence of intrusive investigation has to be assumed to have been infilled with methanogenic waste. Despite this, given its size, age (>100 years), distance from site and the likely permeability of the intervening superficial geology (thereby permitting passive venting at source) between the source and receptor site, the potential risk of

landfill gas migration from this gravel pit is considered negligible. Landfill gas protection measures are therefore considered unnecessary in the proposed re-development at this site.

- 3.10** Consultation of the UK Health Security Agency/BGS “UK maps of radon” online resource indicates a 0-1% probability for radon to be above the actionable level, suggesting that radon protection measures are not required in new development at this site. This should as usual be confirmed with the relevant Building Control Officer.

Unexploded Ordnance Risk

- 3.11** An online review of regional unexploded bomb data on the Zetica website indicates this area of Leicestershire to constitute a low risk (less than fifteen bombs per thousand acres), for which a more detailed unexploded ordnance (UXO) assessment is considered unnecessary.

Surrounding Land Use

- 3.12** As shown on drawing 5435/5 there are no environmentally sensitive areas such as nature reserves, special protection areas (SPA), special areas of conservation (SAC) or sites of special scientific interest (SSSI) either on or within likely influencing distance of the site, with the nearest SSSI (“Burbage Wood & Aston Firs”) being 1.7km east.

4 PROPOSED DEVELOPMENT

- 4.1** It is proposed to re-develop the site into residential usage by converting the operational printworks (Unit 2) into a three-storey apartment building, and demolishing Unit 1 to be replaced by two three-storey apartment buildings, complete with communal parking and peripheral soft landscaping. The proposed development layout (based upon Hayward Architects Limited Job No. 19/28 Drawing No. 05h dated March 2019) has been reproduced as drawing 5435/4.

5 PRELIMINARY RISK ASSESSMENT AND CONCEPTUAL SITE MODEL

5.1 The site and its immediate surroundings have been assessed in terms of current and historical land use and the environmental, geological and hydrogeological setting; the methodology of which is described in Appendix 3. In view of the proposed residential end use, for risk assessment purposes the **critical receptor** would be a female child (age class 1-6) and our assessment has been progressed on this basis.

5.2 Review of historical mapping suggests that the site appears to have comprised commercial/industrial buildings since the earliest available mapping of 1887, undergoing various stages of redevelopment culminating in the current layout in c2008, thereafter remaining more-or-less unchanged until the present day.

5.3 In view of the foregoing the potential sources and the **principal contaminants of concern** are presented in Table 2 below.

TABLE 2: POTENTIAL SOURCES AND PRINCIPAL CONTAMINANTS OF CONCERN

Potential Sources		Principal Contaminants of Concern
ON-SITE	Unrecorded made ground/topsoil	Toxic and phytotoxic metals PAH TPH ACM VOCs SVOCs
	Above ground fuel tank (disused)	TPH
OFF-SITE	None	None

5.4 The above information is converted into the preliminary Conceptual Site Model shown in Figure 1 below, and the **potential pollutant linkages** involving future residents, proposed services and local environmental receptors are discussed in Table 3, with appropriate risk levels.

- 5.5** The findings of the Phase 1 desk study suggest a generally moderate risk that the site may contain contaminants at elevations sufficient to pose a significant risk to human health or environmental receptors; given the high-sensitivity of a proposed residential development it was considered prudent to include routine contamination assessment within the planned 'geotechnical' ground investigation, the results of which are reported below. All test results have been incorporated into an appropriate quantitative risk assessment to determine risk levels to the obvious receptors in the form of future site users and groundwater quality, as well as those less obvious such as the proposed buildings and infrastructure, such that any necessary remedial measures can be identified and recommended to ensure that the developed site will be "fit for purpose".

6 GROUND INVESTIGATION REPORT

Site Works

- 6.1** The Phase 2 intrusive investigation took place on 28th November 2024 by way of borehole drilling, hand pitting and concrete coring. The number and location of all exploratory holes were selected by this Practice at the locations indicated on drawing 5435/4. A CAT electrical service scanner was deployed at surface prior to all intrusive works and as an added precaution all boreholes were preceded by manually excavated inspection pits up to 1.2m depth. No services (recorded or unrecorded) were physically encountered during the intrusive works.
- 6.2** Four windowless sampling (small diameter) boreholes (WS1-4) were drilled up to 5m depth using a Terrier 2002 window-sampling rig. In-situ standard penetration tests (SPT) were undertaken at 1.0m depth intervals in accordance with BS EN ISO 22476-3:2005 to assess the relative density of the material penetrated and these results are indicated on the respective logs in Appendix 2. All arisings were logged in accordance with Eurocode 7 (BS EN ISO 14688-1:2002 and 14688-2:2004) by a suitably qualified engineer from this Practice, and representative disturbed samples taken for geotechnical and contamination testing as appropriate.
- 6.3** In-situ percolation testing to establish the infiltration potential of the natural ground was undertaken by way of 'falling head' percolation tests in WS1. Results are presented graphically with the logs in Appendix 2 and soakaway drainage feasibility is discussed in Section 6.18-6.19 of this report.

6.4 Boreholes were supplemented by five manually-excavated hand pits (TP1-5) targeting areas of proposed soft landscaping, plus a single concrete core (C1) and hand pit (C2) in the main print works building, to obtain samples for laboratory contamination testing. A detailed description of all strata encountered, positions and types of samples taken and any groundwater observations are included on the exploratory hole logs given in Appendix 2.

6.5 Upon completion of the works all holes were backfilled with arisings, and either reinstated at surface with concrete cores/brick setts or compacted by hand.

Laboratory Testing - Geotechnical

6.6 Routine geotechnical classification testing comprised moisture content and plasticity determinations, plus acidity and sulphate analysis to BRE Special Digest 1 requirements. Results are tabulated below.

TABLE 4: INDEX TEST RESULTS AND CLASSIFICATION

WS No	Depth (m)	Material	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	USCS	Consistency Index	<425um (%)	Modified PI	Volume Change Potential (NHBC)
2	1.0	D	9.9	26	14	12	CIL	1.34	74	9	None
2	2.0	D	10.9	37	17	20	CIM	1.31	72	14	Low
2	3.0	D	11.1	45	20	25	CIM	1.36	67	17	Low
2	4.0	D	20.4	46	20	26	CIM	0.98	49	13	Low
3	2.5	D	13.9	40	17	23	CIM	1.13	59	14	Low
3	3.5	D	26.6	46	20	26	CIM	0.75	81	21	Medium
4	0.5	MG	14.5	39	20	19	CIM	1.29	80	15	Low
4	1.0	MG	26.6	40	17	23	CIM	1.02	83	19	Low

MG = Made Ground

D = Dunsmore Gravel

TABLE 5: CHEMICAL TEST RESULTS AND CLASSIFICATION

WS No.	Depth (m)	Material	Total sulphate SO ₄ (%)	Total sulphur (%)	Total potential sulphate SO ₄ (%)	pH	Water soluble sulphate SO ₄ (mg/l)	BRE SD1 classification	
								Design Sulphate Class	Aggressive Chemical Concrete Class
1	0.50	D	0.041	0.017	0.051	7.7	25.0	1	1
2	2.00	D	0.076	0.022	0.066	6.6	236.0	1	1
3	1.50	D	0.026	0.009	0.027	6.4	84.8	1	1
3	3.50	D	0.032	0.011	0.033	7.7	54.1	1	1
4	1.00	MG	0.079	0.026	0.078	6.3	217.0	1	1
4	2.50	D	0.048	0.015	0.045	6.8	140.0	1	1

MG = Made Ground D = Dunsmore Gravel

Laboratory Testing - Contamination

6.8 The contamination sampling scheme was conducted in accordance with BS10175:2011 with sampling aimed to achieve overall site coverage and to target areas of proposed soft landscaping plus features of concern such as the disused above ground fuel tank. All test results have been incorporated into an appropriate risk assessment to determine risk levels to the receptors, such that any necessary remedial measures can be identified and recommended to ensure that the proposed development site is 'fit for use'.

6.9 Representative samples of made ground and natural subsoil were taken from the upper 1.0m of extracted ground. Those soils to be scheduled for organic analysis were sealed within opaque amber glass jars to prevent loss of any volatiles during transit, whilst those for inorganic testing were placed in plastic tubs, all with chain of custody labelling. All soils were sent to UKAS accredited i2 Analytical Ltd where (based upon the principal contaminants of concern in Table 2) analysis selectively comprised the following:

- Toxic and phytotoxic metals
- Asbestos Screen and ID
- Speciated Polyaromatic Hydrocarbons (PAH)
- Banded Total Petroleum Hydrocarbons - Carbon Range C6-40 (TPH)
- Soil organic matter

- Semi-Volatile and Volatile Organic Compounds (SVOC/VOC)

6.10 Risk to controlled waters was determined by leachate analysis on two representative samples of made ground and subsoil, tested to determine leachable content of toxic and phytotoxic metals plus PAH.

6.11 The certified laboratory test results are presented as Appendix 3 and for convenience have also been summarised to facilitate comparison against assessment criteria. All results and their implications upon the preliminary CSM are further discussed in Sections 8 and 9.

Discussion on Ground Conditions

6.12 Ground conditions appear commensurate with geological mapping and expectation. Beneath a variable surface mantle of made ground virtually all exploratory holes encountered predominantly cohesive deposits of the recorded superficial D to terminal depths. The MMG bedrock was locally identified in WS3 and WS4. A summary of the observed strata is presented in Table 6 below, although for specific descriptions of ground conditions, reference should be made to the logs presented in Appendix 2.

TABLE 6: SUMMARY OF OBSERVED STRATA

Stratum	Base Depth (m)	Notes / Occurrences
MADE GROUND: variably comprising hardstand and mixture of granular and cohesive soils (see Appendix 2 for specific details)	0.19 – 1.20	Encountered in all exploratory holes
SAND: variably loose to dense, orangish-brown and brown, slightly gravelly, clayey. Gravel is fine to medium quartzite and chert (DUNSMORE GRAVEL)	2.70 - >4.00	Encountered in WS2-4
CLAY: variably soft to stiff, orangish-brown, brown and brownish-grey, slightly sandy, slightly gravelly, variably friable and plastic. Gravel is fine to medium quartzite and chert (DUNSMORE GRAVEL)	>0.60 – 4.75	Encountered in WS1, 3, 4, TP4 and 5
CLAY: stiff to very stiff, blueish-grey and brownish-grey, plastic with rare chert gravel. (MERCIA MUDSTONE GROUP)	>4.45 - >5.00	Encountered in WS3 and WS4
Perched / Groundwater	WS3 groundwater at 4.0m depth	
Roots	None visually identified	
Desiccation	None visually identified	

- 6.13** Based upon on-site visual and olfactory examination of the subsoil there was nothing to suggest the presence of obviously significantly contaminated subsoil.
- 6.14** Index testing performed upon the made ground classifies it as predominantly intermediate plasticity inorganic clay of low volume change potential in accordance with NHBC Standards. CI values of 1.02 and 1.29 were recorded, and whilst those values >1.1 are normally suggestive of desiccation, given the observed granular content (supported by the <425 μ m results) this is instead likely a function of a naturally lower moisture content/liquid limit).
- 6.15** Similar testing on undisturbed material of the superficial D classifies it as predominantly intermediate plasticity inorganic clay of low volume change potential in accordance with NHBC Standards. CI values were recorded between 0.75 and 1.36, and whilst those values >1.1 are normally suggestive of desiccation, given the observed granular content (supported by the <425 μ m results) this is likely a function of a naturally lower moisture content/liquid limit). Any trees and even long grass/weed cover can desiccate the soil throughout summer months with worst-case conditions expected at the end of a summer season, so depending upon the time of year of development the foregoing may change from that reported.
- 6.16** All exploratory holes except for WS3 remained dry and stable during the limited time they were left open and in the short-term groundwater is unlikely to be encountered within newly excavated foundation or service trenches within the superficial D. Note that groundwater levels are of course subject to seasonal fluctuation according to prevailing weather conditions, and the situation encountered and described above could potentially change in the future, especially in a period of seemingly ever-apparent but unpredictable climate change.

Percolation Testing - Soakaway Feasibility

- 6.17** A single falling head percolation test was undertaken within borehole WS1 with a test zone depth of c0.1-3.0m (test records shown on log in Appendix 2). Only a single test was possible within the single day of sitework. The tests took place into predominantly undisturbed clay of the recorded superficial D and as expected due to the dominantly cohesive soil profile very low/negligible infiltration was recorded, meaning that it has not been possible to calculate a soil infiltration rate.

- 6.18** The soil profile and infiltration results are in our opinion representative of the soils beneath the site hence the ground is considered unsuitable for the adoption of a conventional SUDS-type drainage system. It is therefore recommended that an alternative drainage option be considered such as transmission of storm water run-off to the existing drainage network. It will be necessary to provide evidence to the local drainage authority that the adoption of soakaways within the site is not practical given the impermeable nature of the underlying geology, and the results in Appendix 2 of this report should suffice.

7 GEOTECHNICAL DESIGN REPORT

- 7.1** The site investigation works have proven ground conditions beneath the site to be in accordance with recorded mapping and expectation. Beneath a variable surface mantle of made ground virtually all exploratory holes encountered predominantly cohesive deposits of the recorded superficial D to terminal depths. The MMG bedrock was locally identified in WS3 and WS4.
- 7.2** In the absence of definitive information pertaining to structure and/or anticipated design loads etc, foundation recommendations at this stage are relatively generic, based upon assumed/envisaged methods of construction in light of the ground conditions encountered.

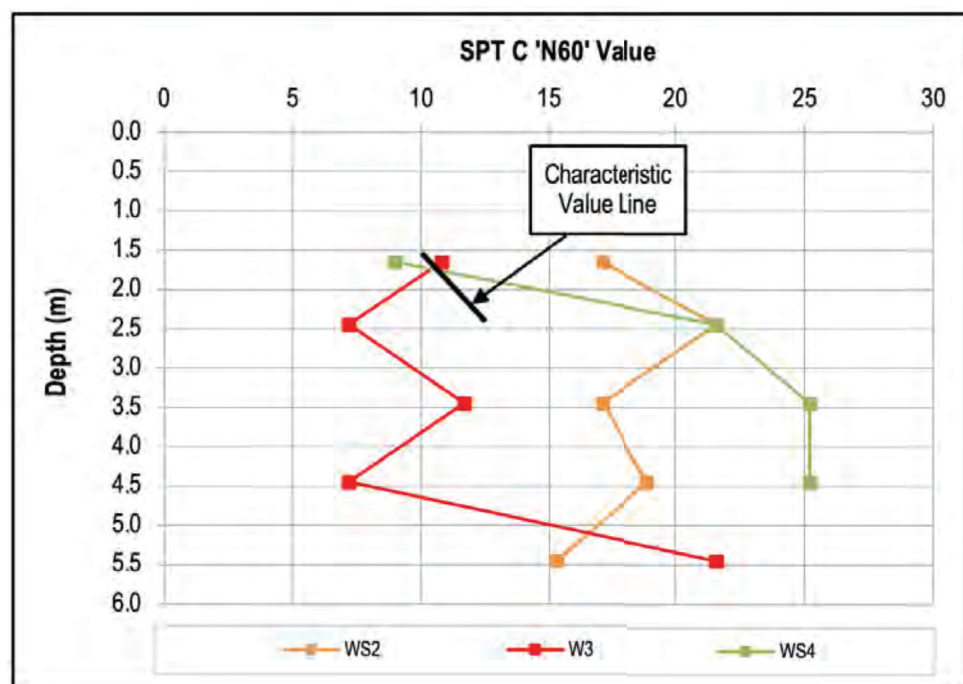
Foundation Design

- 7.3** The natural weathered cohesive deposits of the superficial D classify as predominantly intermediate plasticity and low volume change potential; therefore (following NHBC Standards) a minimum founding depth of 0.75m is required, or greater within the radius of influence of trees and obviously subject to those foundations also penetrating through rooted and/or desiccated soils and any localised softer, infilled or disturbed deposits to found in competent undisturbed normally hydrated material.
- 7.4** Based upon the foregoing requirements, a minimum founding depth of 1.5m will be needed to ensure adequate penetration into undisturbed natural soils beneath the near surface made ground deposits. Whilst one of the proposed buildings is within the zone of influence of a (suspected*) maple tree, any required additional foundation deepening due to tree root influence as per NHBC guidance is mitigated by the

proposed minimum founding depth of 1.5m (*subject to correct identification by an arboriculturist and accurate distances to the buildings measured to confirm required minimum founding depths).

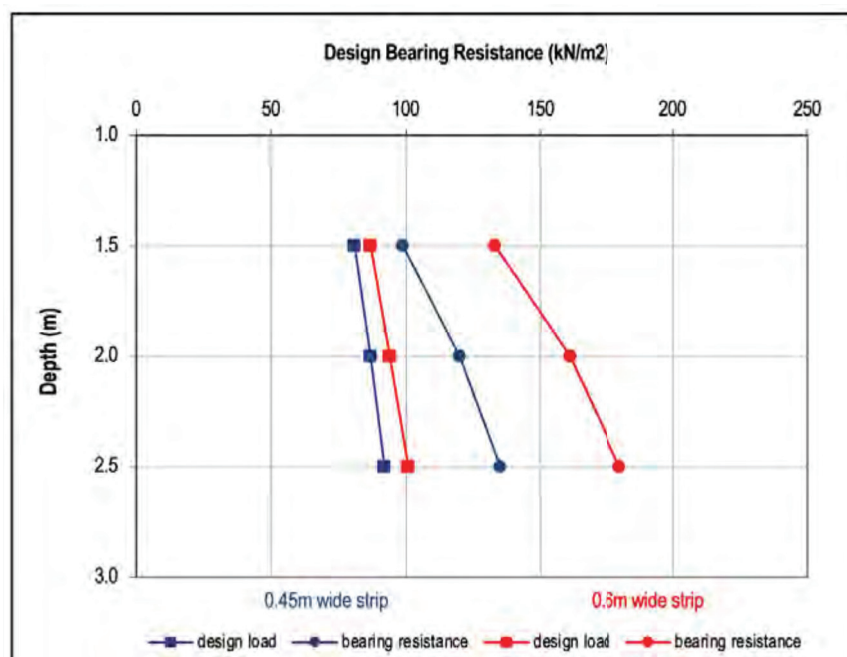
- 7.5** Given the low volume change potential soils and absence of trees heave protection ought not to be required. Owing to the thickness of made ground exceeding 600mm suspended ground floor slabs will be required for all buildings, and should incorporate a subfloor void of 100mm for in-situ concrete or 250mm for pre-cast concrete and timber floors.
- 7.6** Geotechnical design calculations have been undertaken following the requirements of Design Approach 1, Combination 2 within Eurocode 7 (BS EN 1997-1), which require the establishment of design values for actions, ground properties and ground resistances, and definition of the limits that must not be exceeded (usually a serviceability limit state). Characteristic values of undrained shear strength used for determination of ground bearing resistance have been generated using 'normalised' insitu SPT/SPT-C results (in accordance with BS EN ISO 22476-9:2009).
- 7.7** Uncorrected CPT N-values are shown on the borehole logs and normalised N-values shown are also presented as N_{60} versus depth in Figure 2.

FIGURE 2: PLOT OF SPT C (N_{60}) VALUES -v- DEPTH



7.8 With reference to Figure 2, by adopting an SPT-C N_{60} value of 10 at 1.5m depth, and based on a conventional three-storey residential line load of 65kN/m, the design bearing resistance (bearing capacity) for a standard 0.6m wide strip/trench-fill foundation is estimated to be approximately 133kN/m², which exceeds the likely bearing pressure of 87kN/m² and confirms suitability. Whilst similar calculations also suggest suitability for 0.45m wide foundations at this depth (bearing capacity of 99kN/m² versus likely bearing pressure of 81kN/m²) the factor of safety is less so 0.6m wide is recommended. The design bearing resistance continues to increase with increasing depth so greater founding depths will also be sufficient for the proposed development. The design bearing resistance is plotted in Figure 3 below, so that values can be assigned to any other depths as necessary.

FIGURE 3: DESIGN BEARING RESISTANCE -v- DEPTH



7.9 Perched/groundwater was not encountered in any of the exploratory holes. Perched/groundwater levels vary seasonally thus depending on the timing of construction water could be encountered at levels in variance to those recorded by this investigation. As always it is recommended that any excavations are not left open and unsupported for any longer than necessary.

Buried Concrete Protection

- 7.10** The results of acidity and sulphate testing presented in Table 5 show that buried concrete associated with foundations (constructed up to 3.50m depth) and floor slabs can be designed to Design Sulphate Class DS-1 and Aggressive Chemical Environment for Concrete Class ACEC-1 in accordance with BRE Special Digest 1 (2005), i.e. no special measures required.

Road / Pavement Design

- 7.11** With regard to road / pavement design, laboratory index analysis, compared to Highways Agency Interim Advice Note 73/06, Rev 1 (2009) indicates a CBR value of 3-6% can be achieved. Where made ground is encountered at formation level a value of 2% is more commonly adopted as a precaution. It is recommended that in-situ testing be carried out closer to the time of construction to obtain a more accurate bearing ratio, since CBR value will vary seasonally. The sand soil may locally have the potential to be frost-susceptible, however the Local Authority should be able to advise based upon their previous experience in the area.

Recommendations for Monitoring of Ground Conditions During Construction

- 7.12** In view of the importance of founding on natural ground, a careful watch must be maintained during all foundation excavations to ensure that this requirement has been satisfied.
- 7.13** Consideration should be given to access into/around the site since the surface soils have the potential to be subject to softening during periods of sustained wet weather.
- 7.154** Due to the potential for cohesive soils to shrink and swell, inspection during foundation excavations should ensure that no live roots or evidence of desiccation is visible at the founding horizon.
- 7.15** In the event of any doubt in the above matters, this Practice would be pleased to attend site as instructed.

8 CONTAMINATION RISK ASSESSMENT

Human Health

8.1 The contamination risk assessment has been carried out in general accordance with the methodology described within Appendix 3. Testing has included samples of the near-surface made ground and natural subsoil to assess their suitability for retention within a proposed development. Tier 1 risk modelling has adopted the '**Residential without Plant Uptake**' land use scenario, including the pathway of direct dermal contact, and the 'critical receptor' is taken as a female child of age class 1-6. All results are then compared against published 'Suitable For Use threshold Levels' (S4UL), as per Table 7 below.

TABLE 7: COMPARISON OF SOIL CHEMICAL TEST RESULTS WITH GUIDELINE VALUES

Determinant	Maximum Measured Concentration (mg/kg)	LQM/CIEH S4UL Residential without plant uptake (mg/kg) \$	Tests Undertaken (No.)	Exceedances (No.)	Notes
Arsenic	28	40	11	0	
Cadmium	4.5	85	11	0	
Chromium (III)	29	910	11	0	
Chromium (VI)	<1.2	6	11	0	
Lead	1000	310*	11	1	TP1/0.40-0.60m
Mercury	0.6	56	11	0	
Selenium	<1.0	430	11	0	
Nickel	36	180	11	0	
Copper	350	7,100	11	0	
Zinc	4100	40,000	11	0	
PAH compounds	5.38	Various	11	0	
TPH compounds (C6-C40)	260	Various	11	0	
Semi-Volatile Organic Compounds	<LOD	Various	2	0	
Volatile Organic Compounds	<LOD	Various	2	0	
Asbestos Screen, ID and Quantification	<0.001% - chrysotile asbestos loose fibre(s)	<0.001%	11	0	

Determinant	Maximum Measured Concentration (mg/kg)	LQM/CIEH S4UL Residential without plant uptake (mg/kg) \$	Tests Undertaken (No.)	Exceedances (No.)	Notes
Notes:					
ND = None Detected					
* provisional C4SL					
\$ based on soil organic matter = 1%					

8.2 It will be seen above that there are no elevations of phytotoxic metals, PAH or TPH compounds, SVOC or VOC. Whilst it is noted that loose fibre(s) of chrysotile asbestos were locally encountered in near surface made ground (C1/0.13-0.30m) its concentration does not exceed the human health threshold. A single mild elevation of the toxic metal lead was however locally identified (TP1/0.30-0.60m made ground) which may pose a risk to the future health of site users, so has been considered in more detail below.

8.3 Tier 1 risk assessment identified 1000mg/kg of lead in a single sample of made ground (TP1/0.30-0.60m) which exceeds the respective 'residential' C4SL threshold of 310mg/kg. Statistical analysis using the CIEH Statistical Calculator determines that the lead elevation is an outlier to the main population of results suggesting a localised "hot-spot" of contamination, so either further investigation or more likely remedial action is required which is discussed in more detail below.

8.4 It is an inherent requirement of LCRM 2020 for any land contamination assessment to include an **options appraisal** of possible remedial measures, which are advised as follows (mindful of the scale of development and localised extent of contamination):

- Given the mild elevation and relatively low volume of contaminated material likely to be generated during remedial works, one provisionally recommended remedial option would be to selectively remove the offending material from within affected soft landscaping area in the vicinity of TP1. Such arisings can potentially be retained on site as site-won material (as long as it is placed beneath hardstand or buildings), alternatively such arisings can be disposed of off-site at a suitable licensed landfill. Replacement soil will need to be uncontaminated and suitable for a residential development and (if imported) ideally come with pre-certification confirming its uncontaminated status and suitability for use within a residential end use.

- An alternative to the foregoing would be the simple application of a clean cover system across the localised soft landscaping area below TP1 to break the potential exposure pathway. Using the BRE BR465 “Clean Cover System” software, based upon the aforementioned elevations in paragraph 8.4 a provisional minimum thickness of 490mm has been calculated to remove the risk to human health. A reduced thickness may be possible subject to assessment of contamination data for the proposed import soils. Clearly if it is necessary to maintain existing ground levels, prior removal of the offending material may be necessary. Any imported topsoil (and subsoil) should be certified (ideally pre-import) as uncontaminated to ensure that it is suitable for a residential end use and records of compliance will need to be provided to the LPA.
- Where hardstanding or building cover is proposed, this should act as a barrier between contaminants and future site users effectively breaking the potential pollutant linkages and exposure pathways thus negating any possible health risks.

Water Supply Pipework

- 8.5** In addition to the above, consideration has been given to the potential effects of recorded concentrations on new water utility pipework. Despite the presence of made ground given the general absence of organic contaminants there ought to be no requirement for upgraded barrier pipework and the results of the contamination testing undertaken as part of this investigation would seem to support this, although of course this is subject to the proposed actual route of pipework through the site. As always it is recommended that advice be sought from the local regulatory authority prior to ordering, since it is possible that their specific in-house thresholds may differ markedly from those within the most recent guidance by UK Water Industry Research (UKWIR) report “Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites” (2010).

Landfill Gas and Radon Gas

- 8.6** It was previously established in the desk study researches that the site is unlikely to be affected by either natural radon gas or landfill gases. The exploratory holes have since found no evidence of methanogenic materials beneath the site thus gas protection measures are not considered necessary within the proposed development.

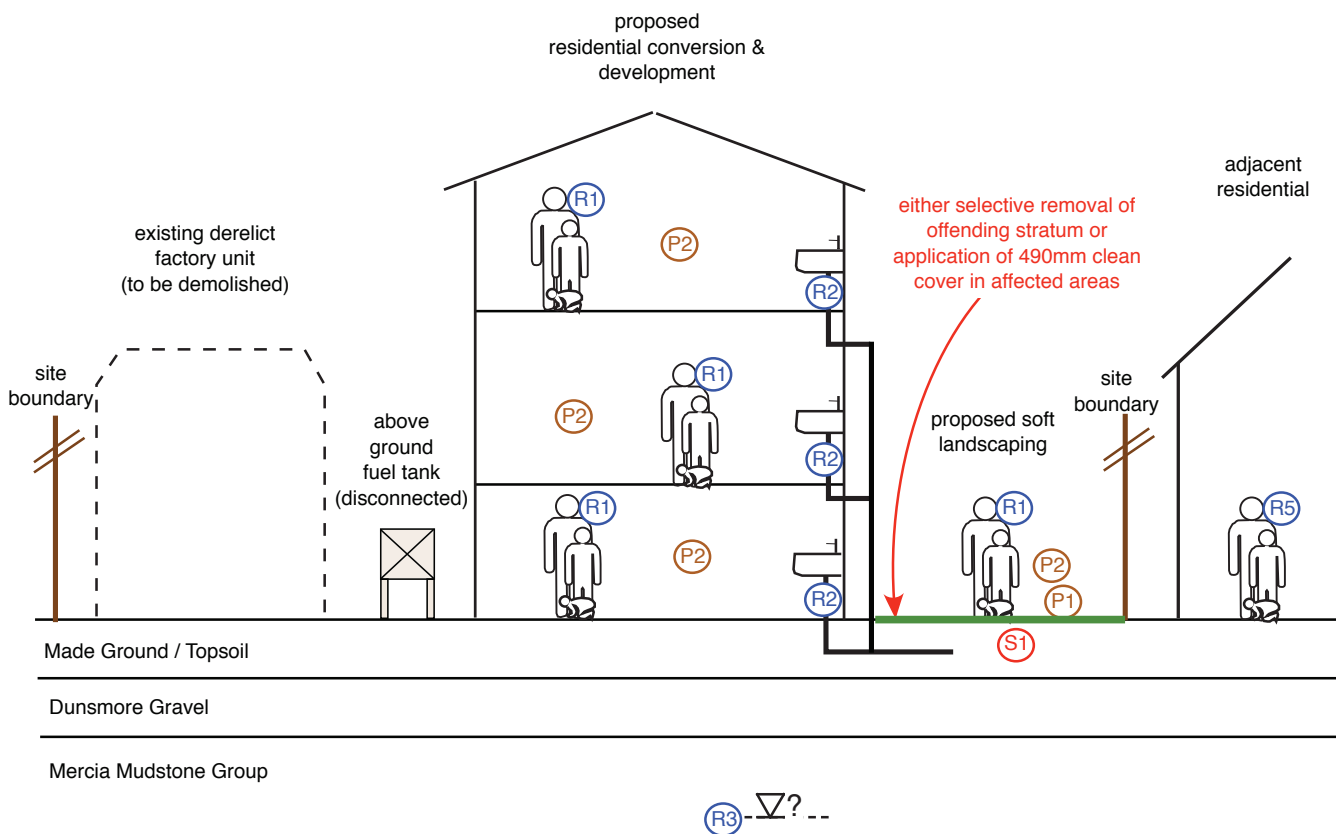
Controlled Waters

- 8.7** With respect to controlled waters, whilst most of the leachate results are acceptable a single nominal elevation of Fluoranthene in WS1/0.08-0.42m ($0.03\mu\text{g/l}$) plus elevated Napthalene in WS1/0.08-0.42m and TP4/0.20-0.60m ($0.08\mu\text{g/l}$ and $2.4\mu\text{g/l}$ respectively) were recorded which exceed their respective WFD groundwater thresholds (both $0.075\mu\text{g/l}$). Despite these minor exceedances, given that there are no SPZs or groundwater abstractors within influencing distance, and that in all likelihood this stratum will either be removed during a standard site-strip or covered by buildings or hardstand, there is considered to be no viable pollution risk to controlled waters/groundwater resources, hence no remedial action is considered necessary.

Caveats

- 8.8** In line with best industry practice the scope of contamination testing has been based upon the site history, current land usage and actual findings, with reference where necessary to DoE Industry Profiles and DEFRA/EA guidance. To the best of our knowledge information concerning the land quality assessment is accurate at the date of issue, however subsurface conditions including ground contamination may vary spatially and with time. There may be conditions pertaining to the site not disclosed by the above sources of information, which might have a bearing upon the recommendations made, were such conditions known. We have however used our professional judgement in order to limit this during the investigation.
- 8.9** The conclusions and recommendations made in respect of land quality do not address any potential risks to site operatives or ground workers during the construction stage. These issues should be addressed by the Principal Contractor in accordance with the relevant statutory procedures and regulations (CDM Regulations 2015).
- 8.10** It is important that these limitations be clearly recognised when the findings and recommendations of this report are being interpreted. Additional assessment may be necessary should a significant delay occur between report date and implementation of the proposed scheme to which it relates.

RE 4: REFINED CONCEPTUAL SITE MODEL (NTS)



RE 8: SUMMARY OF POTENTIAL / IDENTIFIED POLLUTANT LINKAGES

Pathways	Receptors					Comments	Refined Risk Rating	Remedial/Mitigation Requirements
	R1	R2	R3	R4	R5			
P1	X					Localised elevation of toxic metal lead	Low - Moderate	Either removal of offending stratum or application of minimum 490mm thickness of clean cover (Topsoil/Subsoil) within soft landscaping proximal to hot-spots
P2	X							
P3								
P4								
P5								
P6								
S1	Localised elevation of toxic metal lead in near surface made ground							
P1	Direct dermal contact or ingestion of soil							
P2	Inhalation of dust and vapours							
P3	Permeation into new water supply pipework							
P4	Vertical leaching of leachable contaminants in unsaturated zone and lateral migration in saturated zone							
P5	Landfill gas migration through unsaturated zone and accumulation within confined spaces							
P6	Radon gas migration through unsaturated zone and accumulation within confined spaces							
R1	Future site users (critical residential receptor is female child of age class 1-6)							

10 CONCLUSIONS AND RECOMMENDATIONS

- 10.1** The foregoing discussions and recommendations are based upon the results of a geo-environmental desk study, followed by intrusive ground investigation comprising boreholes plus laboratory geotechnical and contamination testing. The exploratory holes appear to present a consistent pattern of subsoil conditions but as always a careful watch should be maintained for any anomalous conditions during site stripping and excavation, which should be reported back to this Practice for further investigation and assessment.
- 10.2** Phase 1 researches indicate that the site appears to have comprised commercial/industrial buildings since the earliest available mapping of 1887, undergoing various stages of redevelopment culminating in the current layout in c2008, thereafter remaining more-or-less unchanged up until the present day.
- 10.3** The intrusive investigation has proven a variable surface mantle of made ground virtually all exploratory holes encountered predominantly cohesive deposits of the recorded superficial D to terminal depths. The MMG bedrock was locally identified in WS3 and WS4. Most of the exploratory holes (with the exception of ws3) remained dry and stable during the time that they were left open, suggesting that short-term stability of side walls within open excavations is unlikely to be a significant issue during construction. Perched/groundwater levels do vary seasonally and care should be taken if development is proposed during traditionally wetter winter months as a potentially higher water table may then result in an adverse effect upon short-term side wall stability. As always it is recommended that any excavations are not left open and unsupported for any longer than necessary.
- 10.4** Foundations will need to penetrate any near surface disturbed or softer ground to found at minimum 1.5m depth within normally hydrated soils of the superficial D (see section 7 for specific details). Plot-specific foundation depths will need to be calculated once the proposed development layout is finalised. Suspended ground floor slabs will be required however heave protection ought not to be.
- 10.5** Buried concrete in open excavations up to 3.5m depth can adopt DS-1/AC-1 mix i.e. special sulphate resistance measures are unnecessary.
- 10.6** Proposed external road / pavement design where the formation level is natural can be based upon a CBR value of 3-6%; where made ground is the formation level a value

of 2% is more commonly adopted. Such material may locally have the potential to be frost-susceptible but as always we recommend that in-situ tests be undertaken closer to the time of construction.

- 10.7** The results of percolation testing confirm that due to very low/negligible permeability the site is unsuitable for the adoption of a soakaway (SUDS) drainage system, thus an alternative method of surface water disposal will be required.
- 10.8** A detailed ground contamination risk assessment has identified the site to be mostly uncontaminated with the exception of a single localised hotspot (TP1), where elevated lead was recorded within near surface made ground that may pose a risk to future site users. This can be easily mitigated either by selective removal of the offending stratum or through the application of a clean cover system within affected areas (**see Section 7 for details**). There is no perceived risk to controlled waters.
- 10.9** There are no requirements for landfill gas or radon gas protection measures in new development at this site.
- 10.10** Should planning consent be subject to certain conditions, this report and attachments should be lodged with the local planning authority, such that they can update their records.
- 10.11** The above recommendations must not be used in respect of any development differing in any way from the proposals described in this report, without reference back to this Practice or to another geotechnical/geo-environmental specialist. This report is subject to our standard terms and conditions.

11 REFERENCES

Geotechnical

- BS EN 1997-1:2004 'Geotechnical Design - General Rules'
- BS EN 1997-2:2007 'Geotechnical Design - Ground Investigation and Testing'
- British Standards Institute, BS5930:2015 'Code of Practice for Ground Investigations'
- National House Building Council (NHBC) Standards: Chapter 4.2 'Building Near Trees' (2023)
- BS EN 14688: 'Geotechnical Investigation and Testing - Identification and Classification of Soil Part 1 Identification and Description' (2002)
- BS EN 14688: 'Geotechnical Investigation and Testing - Identification and Classification of Soil Part 2 Principles for a Classification' (2004)
- BS EN 14689: 'Geotechnical Investigation and Testing - Identification and Classification of Rock Part 1 Identification and Description' (2003)
- British Standards Institute, BS 1377: 'British Standard Methods of Test for Soils for Civil Engineering Purposes', Parts 1 - 9, (1990)
- Highways Agency *Interim Advice Note 73/06 Rev.1 (2009) Design Guidance for Road Pavement Foundations*
- Building Research Establishment (BRE) Special Digest 1 'Concrete in Aggressive Ground' (2005)
- British Geological Survey 1:10,000 scale mapping sheet SP 49 SW and on-line
- Building Research Establishment (BRE) Digest 365 "Soakaway Design" (2016)
- Department of Transport Series 600: 'Specification for Earthworks' (1991)

Environmental

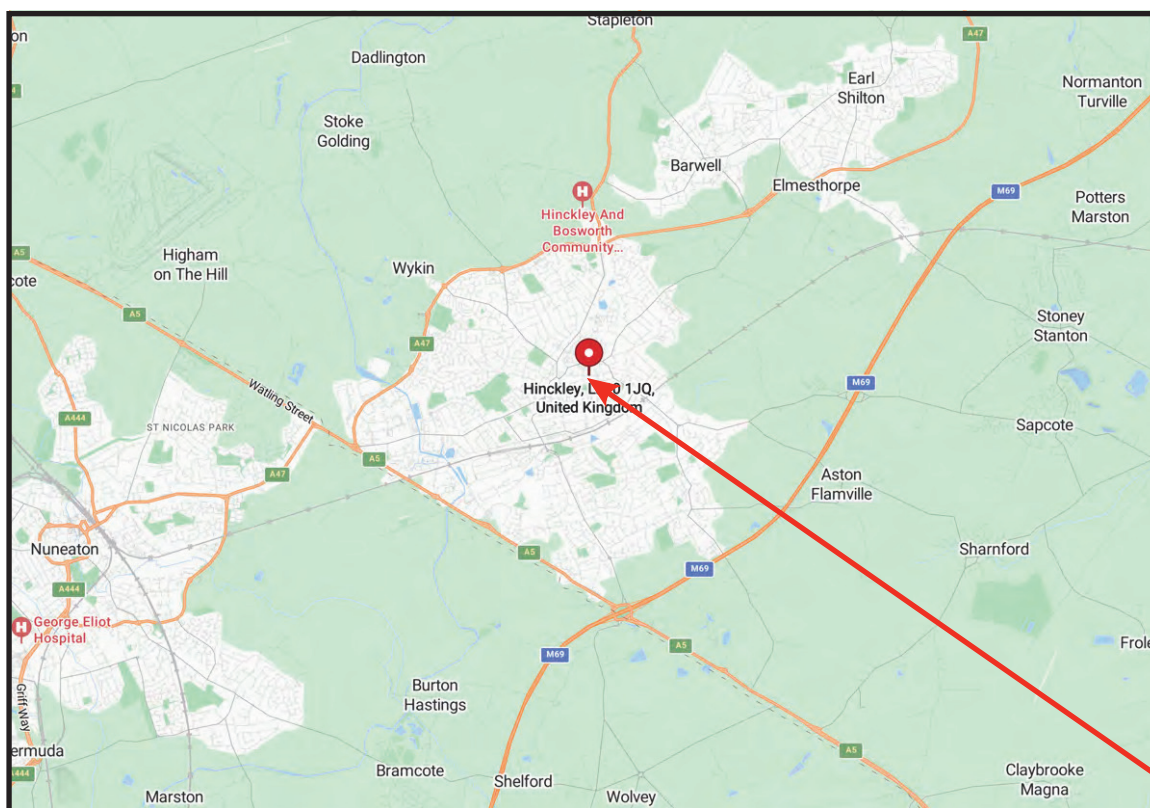
- British Standards Institute, BS 10175: 'Code of Practice for the Investigation of Potentially Contaminated Sites' (2011)
- Environment Agency LCRM: Land Contamination Risk Management (2020)
- Environment Agency/National House Building Council (NHBC) R&D 66 'Guidance for the Safe Development of Housing on Land Affected by Contamination' (2000)
- Chartered Institute of Environmental Health (CIEH)/Land Quality Management Limited (LQM). The LQM/CIEH 'Generic Assessment Criteria for Human Health Risk Assessment' (2nd Edition). Land Quality Press
- DEFRA: SP1010: *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination - Policy Companion Document* (2014)
- CIEH/LQM. 'S4ULs for Human Health Risk Assessment' (2015); Land Quality Press"
- Department of the Environment, Transport & the Regions: 'The Environmental Protection Act 1990: Part IIA' (2000)
- Construction Industry Research & Information Association (CIRIA) 665: 'Assessing Risks Posed by Hazardous Ground Gases to Buildings' (2007)
- CIRIA C735:2014 'Good Practice on the Testing and Verification of Protection Systems for Buildings Against Hazardous Ground Gases'
- British Standards Institute, BS8485: 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings' (2015)
- Building Research Establishment (BRE BR211): Radon – 'Guidance on protective measures for new buildings' (2023)
- Environment Agency. 'River Basins Typology, Standards and Groundwater (Water Framework Directive) (England and Wales) Directions' (2010)
- Environment Agency. 'The Water Framework Directive (Standards and Classification) Directions (England and Wales)' (2015)
- The Water Supply (Water Quality) Regulations 2000 (Amendment) Regulations (2007)
- UK Water Industry Research Limited (UKWIR). 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites' (2010)
- Technical Guidance Waste Management 3 (TGWM3, EA Version 1.0, May 2015)
- Building Research Establishment (BRE)- 'Cover Systems for Land Regeneration' (2004)
- Landmark Historical Mapping Ref: 363734955_1_1 dated 18 November 2024
- Environment Agency (www.environment-agency.gov.uk)
- Zetica (www.zetica.com)
- Google Earth (current and historical aerial mapping plus street view)
- UK Grid Reference Finder (www.gridreferencefinder.com)
- MAGIC (www.magic-defra.gov.uk)
- One Touch Data (www.HazWasteOnLine.com)
- UK Health Security Agency (ukradon.org/information/ukmaps)

FACTORY UNITS, 23 WOOD STREET, HINCKLEY, LEICESTERSHIRE
LE10 1JQ



SITE LOCATION (based on Microsoft Bing Mapping)

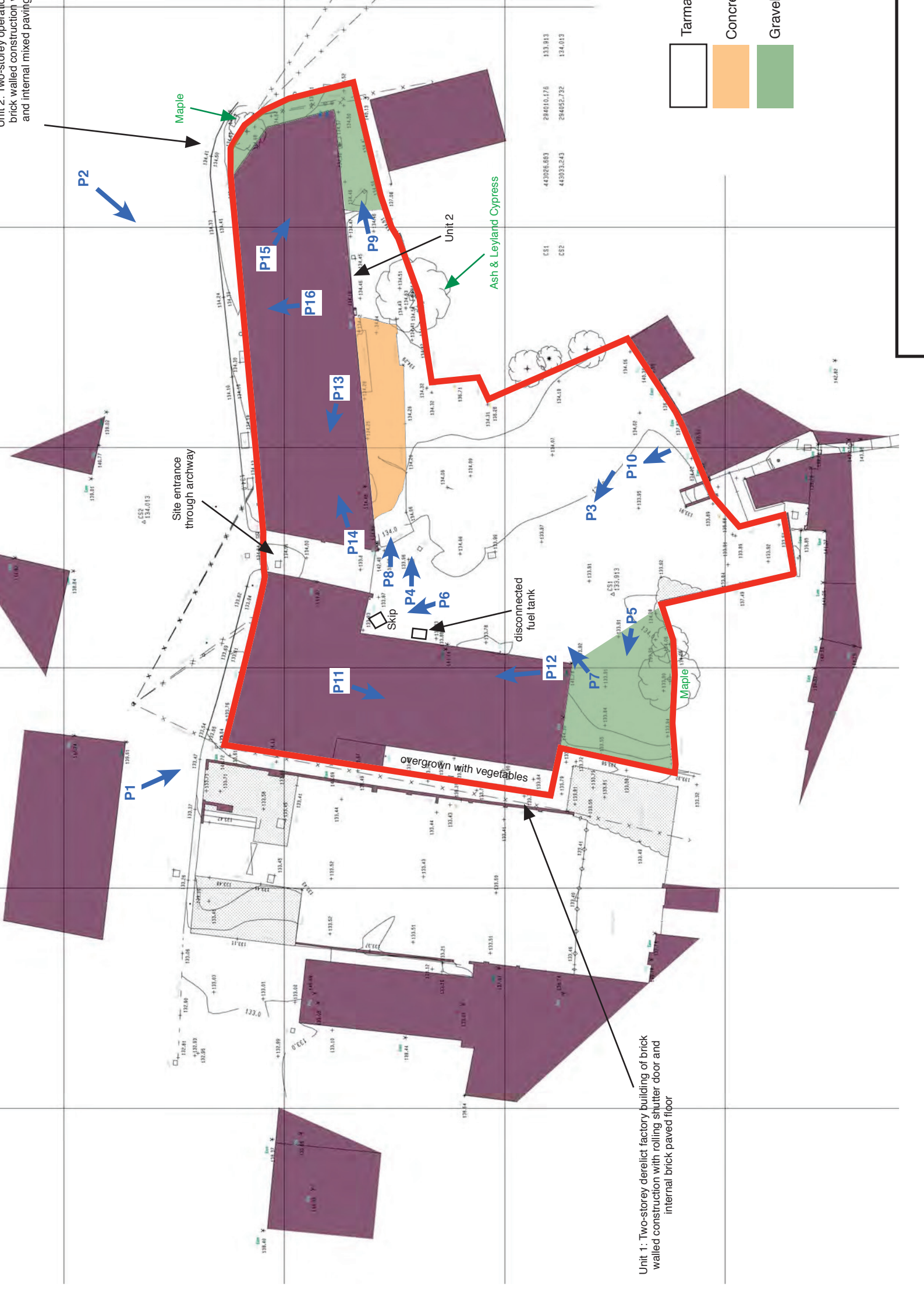
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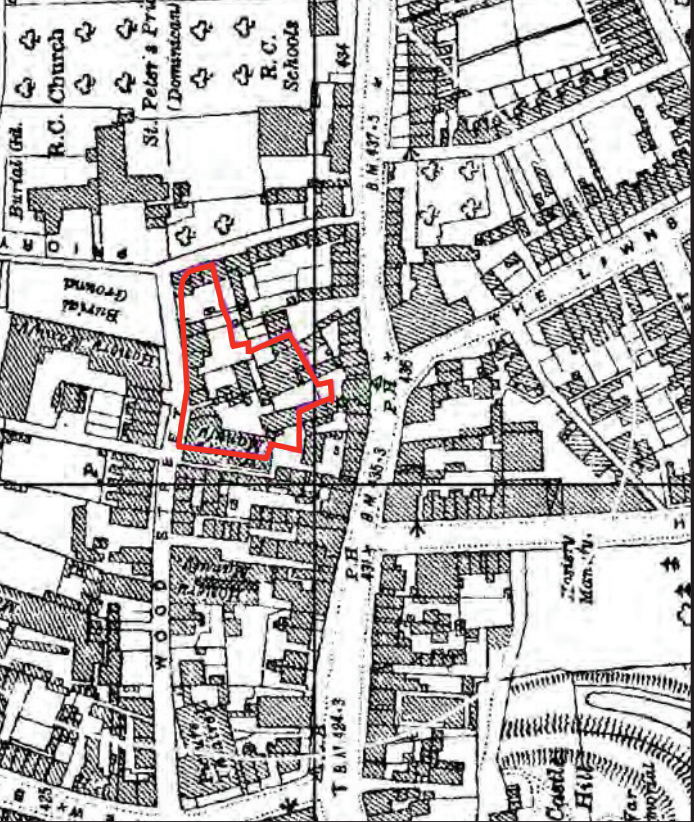
THE SITE



Unit 2: Two-storey derelict building with brick walled construction and internal mixed paving



Unit 1: Two-storey derelict factory building of brick walled construction with rolling shutter door and internal brick paved floor

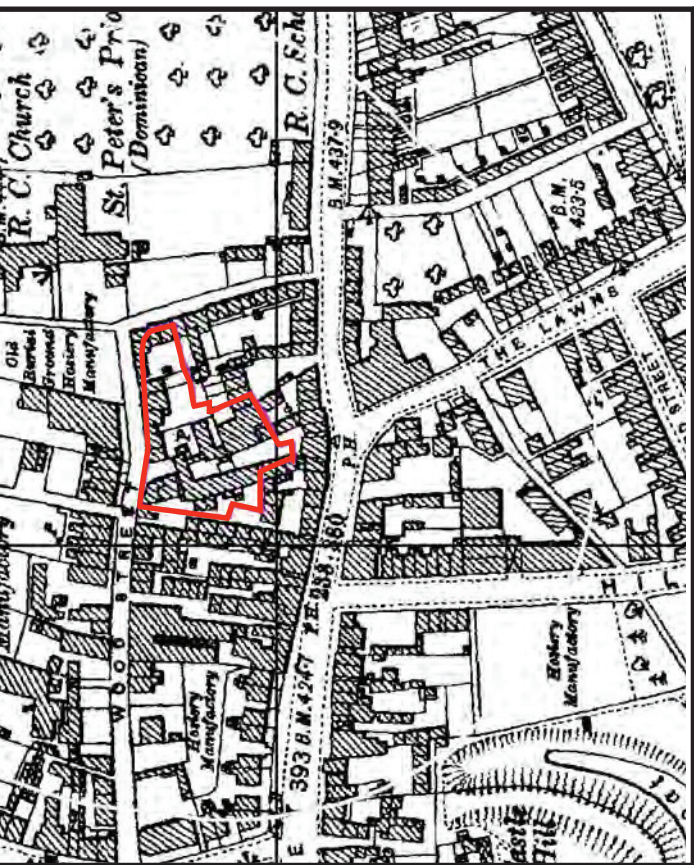


1924

(scale 1:2500)

2008

(Google Earth)

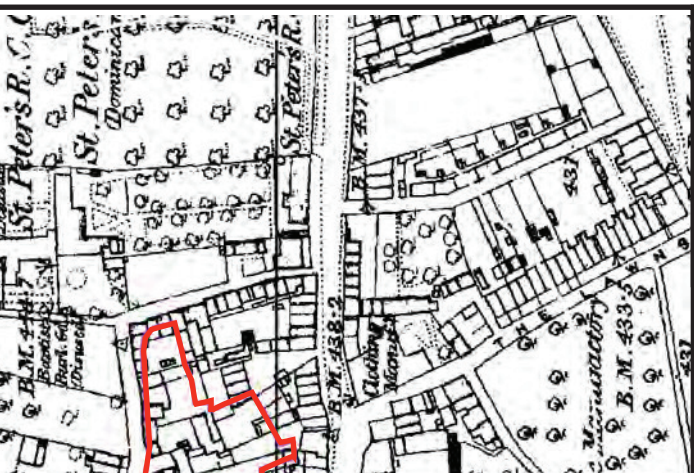


1903

(scale 1:2500)

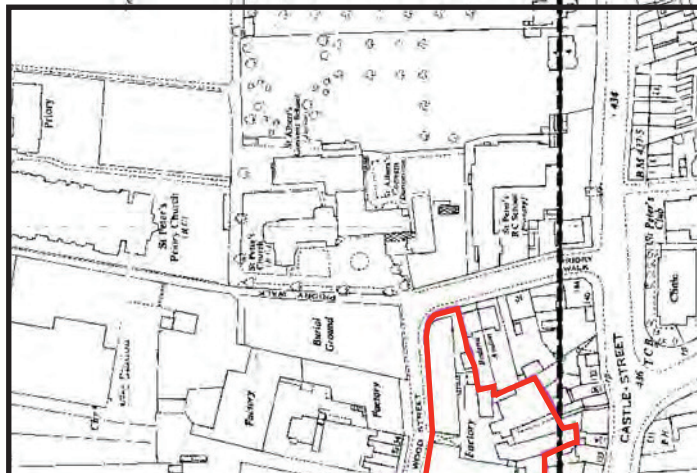
1993

(scale 1:2500)



1889

(scale 1:2500)



the corner and reflect the Victorian character of the street lamps

the pedestrian usage

Wood Street

Priory Walk

bin store with direct access to public highway for collections

widen existing access

3No. 2 bed @ 51.5m²

3No. 2 bed @ 53.5m²

1.5m

WS4

link through to jitty

1No. 1 bed @ 42m²
2No. 2 bed @ 51m² over

WS3

3No. 2 bed @ 50m²

WS2

1.5m

existing building demolished shown dotted

TP3

C2

6No. 1 bed @ min 37m²
8No. 2 bed @ min 58m²

C1

TP4

covered cycle store

screen wall with planting will hide the car park from Wood Street

18 parking spaces

soft landscaping will break up the hard paved car park area and provide some natural screening to the rear of the Castle Street properties

WS1

TP2

11 parking spaces

TP1

Cross Keys Yard link to Castle Street

1.5 = minimum recommended founding depths



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LEICESTERSHIRE LE10 1JQ



SITE SENSITIVITY RESEARCH DATA

Job No. 5435

Drawing No. 5435/5

Scale: NTS

Date: 02-04-25

LEGEND (source date)



SSS1 (20-01-25)



Historic Landfill (14-08-23)



EA Abstraction (02-07-18)



Authorised landfill

