

The **Brownfield** Consultancy



Cotefield Farm, Bodicote OX15 4AQ

DESK TOP STUDY AND SITE INVESTIGATION REPORT

Prepared for: **BANNER HOMES**

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CONTENTS

	Page
1 INTRODUCTION	1
2 SITE DESCRIPTION	1
3 GEOLOGY, HYDROLOGY AND HYDROGEOLOGY	2
3.1 Geology	2
3.2 Hydrology	2
3.3 Hydrogeology	2
4 SITE HISTORY	3
4.1 Site History Summary	4
5 INFORMATION HELD BY STATUTORY AUTHORITIES	5
5.1 Waste Management Facilities	5
5.2 Integrated and Local Authority Pollution Prevention and Control Permits	5
5.3 Pollution Incidents to Controlled Waters	5
5.4 Discharge Consents	5
5.5 Fuel Sites	5
5.6 Radon	5
5.7 Environmentally Sensitive Areas	5
6 UK CONTAMINATED LAND LEGISLATIVE FRAMEWORK	6
6.1 Legislation on Contaminated Land	6
7 CONCEPTUAL MODEL	7
7.1 General	7
7.2 Potential Sources of Contamination	7
8 CONCLUSIONS AND RECOMMENDATIONS OF THE DESK STUDY	8
9 FIELDWORK AND MONITORING	9
9.1 Trial Pits	9
9.2 Soakaway Test Pits	9
10 LABORATORY TESTING	9
10.1 Geotechnical	9
10.2 Environmental	10
11 GROUND AND GROUNDWATER CONDITIONS	10
11.1 Strata Encountered	10
11.2 Topsoil	11
11.3 Marlstone Rock Bed (Weathered)	11
11.5 Groundwater	12
11.6 Contamination	12
11.7 Trees and Tree Roots	12
12 HUMAN HEALTH QUANTITATIVE RISK ASSESSMENT	12
12.1 CLEA Soil Guideline Values	13
12.2 CIEH Land Quality Management Generic Assessment Criteria – Version 2 (2009)	13
13 SOIL CHEMISTRY	14
13.1 Results	14
13.2 Interpretation	15
13.3 Waste Classification and Site Waste Management	16

14	GEOTECHNICAL ENGINEERING ASSESSMENT	17
14.1	Proposed Redevelopment	17
14.2	Summary of Ground Conditions	17
14.3	Shallow Foundations	17
14.4	Ground Slabs	18
14.5	Road Pavement Design	19
14.6	Chemical Considerations for Buried Concrete	19
15	SOAKAWAY DRAINAGE	19
16	CONCLUSIONS AND RECOMMENDATIONS	20
16.1	Land Quality	20
16.2	Gas Protection Measures	20
16.3	Buried Services	20
16.4	Soil Disposal and Reuse	20
16.5	Soakaways	20
16.6	Geotechnical	21
	REFERENCES	22
	FIGURES	
	Figure 1 Key Plan	
	Figure 2 Plasticity Chart	
	Figure 3 Undrained Shear Strength / Depth Plot	
	APPENDICES	
Appendix A	Exploratory Hole Location Plan Proposed Layout	
Appendix B	Historical Map Extracts	
Appendix C	Environmental Insight Report	
Appendix D	Radon Report	
Appendix E	Exploratory Hole Records	
Appendix F	Geotechnical Laboratory Test Results	
Appendix G	Chemical Laboratory Test Results PBET Results	
Appendix H	Soakaway Results	
Appendix I	CLEA spreadsheets	
Appendix J	Limitations	

DESK STUDY AND SITE INVESTIGATION REPORT

COTEFIELD FARM, OXFORD ROAD, BODICOTE OX15 4AQ

1 INTRODUCTION

The Brownfield Consultancy was instructed by Banner Homes to carry out a Desk Study and Site Investigation of a site known as Cotefield Farm, Oxford Road, Bodicote (hereinafter referred to as 'the site'). The offer to carry out the works was contained in an email dated 21st November 2012 to Banner Homes. The instruction to proceed was received from Banner Homes in an email dated 22th November 2012.

The site currently comprises of an open field located to the south of the village of Bodicote. We understand that 83No. residential houses and flats will be constructed with roads, parking areas and driveways. A proposed layout is presented in Appendix A.

The purpose of the desk top study and site investigation is to provide an assessment of the geotechnical engineering properties of the soils and the extent of any soil contamination at the site. The report is subject to Limitations which are set out in Appendix I.

2 SITE DESCRIPTION

The site is located on the south eastern edge of Bodicote, approximately 300m south east of the centre of Bodicote. Bodicote is a village located approximately 2km to the south of Banbury, North Oxfordshire.

The site covers an area of approximately 3.28 hectare and is roughly triangular in shape.

The surface of the site is covered in a stubble of recently cut straw. A tree that is denoted on aerial photographs in the south west of the site is not present. Residential houses are present to the north and west, and the southern boundary is marked by a row of trees, beyond which lie further agricultural fields. To the immediate east, a garden centre is present and to the south east there is an auction house. There is no feature marking the eastern boundary and this boundary was inferred during the site investigation.

The western two thirds of the site is relatively flat whilst the eastern one third drops towards the east by about 5 m.

3 GEOLOGY, HYDROLOGY AND HYDROGEOLOGY

3.1 Geology

Reference to the on line BGS Mapping Index indicates that the site is directly underlain by the Marlstone Rock Bed described as a ferruginous limestone and ironstone. The unit is often be fractured and is frequently fossiliferous.

The following table details the risk of geological hazard potential on or underlying the site as identified in the Groundsure Report.

Table 1 Geological Hazards

Hazard	Risk
Compressible ground	Negligible
Landslide ground	Very low
Shallow mining	Negligible
Running sand	Negligible
Swelling clay	Low
Ground dissolution	Negligible

Hence geological hazards do not present a constraint at the site.

3.2 Hydrology

The nearest surface water feature is an extended culvert 193m to the west of the site. The nearest natural surface water course is the Sor Brook located approximately 500m to the south east of the site. There is no water quality information on either of these water courses.

The site is not located in an area considered at risk of flooding by the Environment Agency.

There is one surface water abstraction within 1km of the site at Bodicote Pumping Station located 547m to the south west of the site. The license is held by Thames Water who can abstract a maximum of 4546m³ / day from the Sor Brook

3.3 Hydrogeology

The Groundwater Vulnerability map contained in the Groundsure Report indicates that the site is underlain by 'Secondary A aquifer' referring to the Marlstone Rock Bed.

The Environment Agency define a Secondary A aquifer as:-

‘Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers’.

Groundwater is therefore considered vulnerable to pollution.

There is one groundwater abstraction within 500m of the site located 91m east of the site at Cotefield Farm. The borehole abstracts up to 109m³/day from ‘Thames Groundwater’ and the water is used for vegetable washing.

The site is not located within a groundwater Source Protection Zone.

4 SITE HISTORY

The history of the site and the surrounding area has been determined from historical map extracts. Copies of these extracts are included in Appendix B. The historical land uses on site and in close proximity to the site are summarised in the following table:-

Table 2 Site History Summary

DATE	ON SITE HISTORICAL LAND USE	OFF SITE HISTORICAL LAND USE
1881	The site is part of a larger field. The far south west of the site crosses a second field boundary. Trees are denoted along the western boundary of the site.	The site is surrounded in all compass directions by open fields. Buildings associated with Cotefield Farm are located approximately 200m to the south east. The Oxford Road is denoted running north south, approximately 200m to the east of the site.

DATE	ON SITE HISTORICAL LAND USE	OFF SITE HISTORICAL LAND USE
1900	The trees are no longer denoted along the western boundary. There are no further changes.	A large building denoted Red house has been built just off the western boundary of the site. Approximately 200m to the North of the site, Bodicote Lodge has been built. This is set in its own grounds with what appears to be an orchard to the immediate south. Two buidings are present approximately 200m to the north east of the site, immediately adjacent to the Oxford Road. A number of north south trending field boundaries to the east of the site have disappeared.
1923	There is a change to the field boundaries.	No significant changes.
1967	The coverage on this map is limited to the northern sector. No changes have taken place.	Significant residential expansion has occurred to the north of the site.
1972	No significant changes.	Residential housing is present to the north and west of the site. There are no further changes.
1984	No significant changes.	No significant changes.
1988	No significant changes.	No significant changes.
1989	No significant changes.	No significant changes.
2012	No significant changes.	No significant changes.
Present day	No significant changes.	No significant changes.

4.1 Site History Summary

The earliest historical map, dated 1881, denotes the site as a field. There have been no changes since that time other than minor variations in field boundaries.

Off site, fields were present in all compass directions until 1967 when residential housing is denoted to the north and west of the site. There are no further changes.

5 INFORMATION HELD BY STATUTORY AUTHORITIES

This section details any relevant information held in the registers maintained by statutory bodies as identified in the Groundsure EnviroSight Report in Appendix C.

5.1 Waste Management Facilities

The Groundsure Report does not identify any waste management facilities within 1000m of the site.

5.2 Integrated and Local Authority Pollution Prevention and Control Permits

There are no Local Authority Pollution Prevention and Control Permits within 500m of the site.

5.3 Pollution Incidents to Controlled Waters

Records held by the Environment Agency identified no pollution incidents to controlled waters within 250m of the site.

5.4 Discharge Consents

The Groundsure Report identifies 3No. licensed active discharge consents within 500m of the site. The nearest is located 120m north east of the site and relates to the discharge of sewage effluent to a tributary of the Sor Brook.

5.5 Fuel Sites

The Groundsure Report identifies no fuel station entries within 500m of the site.

5.6 Radon

The BGS Radon Report states that the site is in a radon affected area and that **full radon protection measures** are required. The radon report is presented in Appendix D.

5.7 Environmentally Sensitive Areas

The Groundsure Report indicates that the site is located within a Nitrate Vulnerable Zone (NVZ). NVZs are designated areas where levels of agricultural nitrate in groundwater are above guideline values e.g. Drinking Water Standards. High levels of nitrate in groundwaters has given rise to environmental and health concerns and these have been reflected in the EC

Nitrates Directive (91/676/EEC) which is aimed at reducing the use of nitrate fertilisers and hence nitrate pollution in controlled waters from agriculture.

6 UK CONTAMINATED LAND LEGISLATIVE FRAMEWORK

6.1 Legislation on Contaminated Land

Part IIA of the Environmental Protection Act, 1990, enacted by Section 57 of the Environment Act 1995 and the associated Contaminated Land (England) Regulations 2000 (SI 2000/227) was introduced on 1 April 2000.

Part IIA provides a statutory definition of contaminated land:

“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 a 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 be all groundwaters, inland surface waters and estuarine and coastal waters.

To determine whether land falls under the Part IIA definition of contaminated land the site should be evaluated in the context of a risk based framework. The assessment of contaminated land is typically a two-phase process which is initially based on a qualitative assessment of the likelihood of complete pollution linkages, with a quantitative element which seeks to determine the degree and the significance of the harm. Land is only defined as ‘Contaminated Land’ if a “significant pollutant linkage” is present.

A pollutant linkage must comprise of the following:-

Source - a contaminant or substance which is located in, on or under the land and has potential to cause harm to human health, water resources or the wider environment.

Pathway - the means or route by which a source can migrate;

Receptor - something which could come to harm, including human health, water resources, surface water courses or the wider environment.

The responsible authority then needs to consider whether the identified pollution linkage:

- is resulting in significant harm being caused to the receptor in the pollutant linkage;
- presents a significant possibility of significant harm being caused to that receptor;
- is resulting in the pollution of controlled waters, which constitute the receptor; or is likely to result in such pollution.

If a pollutant linkage is demonstrated, then the Part IIA legislation provides powers for remedial action to be enforced by the Local Authority in whose area the contaminated land is situated.

7 CONCEPTUAL MODEL

7.1 General

This section uses information from historical maps to provide a conceptual model and qualitative assessment of the potential risks posed to human health and environmental receptors from potential on-site and off-site sources of contamination. The assessment is presented as a 'source-pathway-receptor' model in accordance with Part IIa of the Environmental Protection Act 1990.

The conceptual model has been developed assuming that the site will be redeveloped for a residential end use with residential gardens.

7.2 Potential Sources of Contamination

Potential On-site Sources of Contamination

- Historically, the site not been developed. It has remained a field since the earliest map dated 1881.

Potential Off-Site Sources of Contamination

- No off site sources of contamination have been identified.

In accordance with CLR 11 – 'Model Procedures for the Management of Land Contamination', no sources of contamination have been identified. Hence pathways and receptors are not considered further. The site walkover confirmed that the fields is under agricultural use (hay stubble was present) and therefore we would recommend that a limited number of near surface soil samples are submitted to a metals testing suite and a pesticide analysis.

8 CONCLUSIONS AND RECOMMENDATIONS OF THE DESK STUDY

- Historically, the site has been a field currently used for agricultural purposes. No potentially contaminative proximal off-site land uses have been identified.
- There are no recorded waste management facilities within 500m of the site.
- Ground gas and landfill gas is not considered a constraint to development.
- The site is immediately underlain by the Marlstone Rock Bed described as a ferruginous limestone and ironstone.
- The Marlstone Rock Bed is designated as a Secondary A aquifer and hence any groundwater stored in this formation is considered vulnerable to pollution.
- The site is not located in an area considered at risk of surface water flooding by the Environment Agency.
- At outcrop the Marlstone Rock is fractured and hence soakaways may be feasible.
- A radon report obtained from the British Geological Survey states that full radon protection measures are necessary for new build. The radon report is presented in Appendix D.
- Should the residential housing proposals proceed then we would recommend that the following works are undertaken:-
 - Three days of trial pitting to determine ground conditions. This should include soakaway testing in accordance with BRE365.
 - Geotechnical testing of the soils to identify volume change potential of cohesive material, concrete classification and predicted CBR values.
 - The risk of contamination is considered to be low. However we would recommend some limited laboratory testing of near surface soils for a suite of metals and pesticides. Waste classification testing is also recommended so site derived soils can be correctly classified should landfill disposal of site arisings be envisaged.

9 FIELDWORK AND MONITORING

The intrusive fieldwork was carried out on the 5th, 6th and 7th December 2012 and comprised of 21No. mechanically excavated trial pits. In three of these pits soakaway tests were undertaken.

The site work was undertaken by Discovery CE under the instruction and supervision of **The Brownfield Consultancy**, with the ground investigation procedures and sample descriptions based on BS 5930 (1999) 'Code of Practice for Site Investigations' and BS 10175 (2011) "Investigation of potentially contaminated sites - code of practice". The locations of the exploratory holes are shown on the Drawing included in Appendix A. The exploratory hole records are presented in Appendix E. The full details of the fieldwork undertaken are summarised in the following sections.

9.1 Trial Pits

Twenty one trial pits, designated TP101 to TP121 were excavated on 5th, 6th and 7th December 2012 to depths of between 0.70m and 4.00m bgl at various locations across the site. The pits were excavated by a JCB 3CX and backfilled with arisings upon completion. In several pits, the JCB refused on strong limestone and ironstone (the Marlstone Rock Bed).

9.2 Soakaway Test Pits

Three trial pits, TP119, TP120 and TP121 were excavated for the purposes of soakaway testing to depths of between 1.35 and 2.50m. The pits were accurately measured, rapidly filled with water from a mobile bowser and the time taken for the water to drain was recorded. The results of these tests are presented in Appendix H.

10 LABORATORY TESTING

10.1 Geotechnical

A programme of laboratory testing was scheduled to determine the geotechnical properties of selected soil samples obtained from the investigation. The details of the geotechnical testing are summarised below:-

Table 3 Summary of Geotechnical Laboratory Testing Suites

Determinant	No
Water soluble sulphate and pH	5
Atterberg limits including moisture content	10

Tests were carried out in accordance with BS1377 (1990) "Methods of test for Soils for Civil Engineering purposes". The results of the geotechnical testing are presented in Appendix F.

10.2 Environmental

A programme of chemical laboratory testing was scheduled by **The Brownfield Consultancy** on 10No. soil samples taken from various depths in the natural soils recovered from the trial pits. The samples were placed into suitable containers for the required chemical analysis.

All samples were transported, on the day of collection to I2 in Watford which is accredited under UKAS and MCerts. The following table summarises the contaminants scheduled:-

Table 4 Summary of Soil Chemical Laboratory Testing Suites

Determinant	No
Metals and semi-metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium and zinc)	10
Oragnophosphate and Organochlorine Pesticides	1
Full Waste Acceptance Criteria	1

The results of the laboratory chemical testing are interpreted in Section 13 and presented in full in Appendix G.

11 GROUND AND GROUNDWATER CONDITIONS

11.1 Strata Encountered

The ground conditions encountered during the intrusive investigation were consistent with the published geological map. A variable thickness of topsoil overlies weathered Marlstone Rock Bed which in turn was underlain by bedrock of the Marlstone Rock Bed (hard limestone and ironstone). The base of the weathered Marlstone Rock Bed was not encountered in 6No. trial pits.

A summary of the strata encountered during the investigation is shown in Table 6 and described in the following sections, but for full details and descriptions, reference should be made to the exploratory hole records presented in Appendix E.

Table 5 Strata Encountered

Stratum	Depth to Top (m bgl)	Depth to Base (m bgl)	Thickness (m)
Topsoil	Ground level	0.20 - 0.30	0.20 – 0.30
Marlstone Rock Bed (weathered) All holes	0.20 – 0.30	0.68 - >4.00	0.48 - >3.75
Marlstone Rock Bed (bedrock) All holes except TP101, TP103, TP106, TP109, TP116.	0.68 – 3.10	Not encountered	NA

11.2 Topsoil

Topsoil was encountered in all locations and comprised of a soft to firm brown slightly sandy clay with rare medium gravel of limestone. Occasional roots and rootlets were noted.

11.3 Marlstone Rock Bed (Weathered)

The weathered Marlstone Rock Bed (MRB) was encountered in all locations, directly below the Topsoil. The base of the weathered MRB was not encountered in TP101, TP103, TP106, TP109 and TP116.

The materials were generally cohesive, comprising of grey brown, orange and orange brown slightly sandy silt/clay and a gravelly silt/clay with the gravel fraction comprising of angular fine to coarse of limestone and ironstone. Fissuring of the clay and silt was frequently observed together with rust coloured staining on fissured surfaces.

A distinct horizon of gravel and cobbles of ironstone and limestone was encountered in TP106 (3.20 - >4.00m), TP107 (0.40 – 0.70m), TP109 (0.90 – 1.55m), TP110 (0.90 – 1.55m), TP115 (0.40 – 0.85m), TP117 (0.65 – 0.95m) and TP120 (0.80 – 1.35m).

Forty three 19mm hand vane tests were undertaken in the cohesive weathered MRB. The recorded values of undrained shear strength ranged from 62 (firm) to >120kPa (stiff). The undrained shear strength v depth profile is presented in Figure 3.

Nine Atterberg Limit analyses undertaken on samples of the weathered Marlstone Rock Bed gave plasticity indices ranging from 11% to 32%, with plastic limits ranging from 22% to 30% and liquid limits ranging from 35% to 58%, indicating that the samples were clays of high plasticity (with respect to BS 5930, 1999) and of medium volume change potential (with respect to NHBC Chapter 4.2). A plasticity chart is presented as Figure 2.

11.4 Marlstone Rock Bed

Bedrock was encountered in fourteen locations. The materials comprised of moderately weak limestone and ironstone recovered as angular cobbles. The base of the Marlstone Rock Bed was not proven. The trial pits terminated in this unit as no further penetration was possible with the JCB.

11.5 Groundwater

Groundwater was encountered at the following exploratory hole locations:-

- TP103 slight seepage at 2.70m bgl
- TP105 at 2.50m bgl (rate of inflow not recorded)
- TP106 slight seepage at 3.60m bgl
- TP112 slight seepage at 2.10m

It must be noted that groundwater levels can vary seasonally and in response to high rainfall events.

11.6 Contamination

Evidence of significant contamination was not encountered.

11.7 Trees and Tree Roots

There are no trees at the site and tree roots were not encountered in any of the exploratory hole locations.

12 HUMAN HEALTH QUANTITATIVE RISK ASSESSMENT

Part IIa of the Environmental Protection Act 1990 (which was inserted into that Act by Section 57 of the Environment Act 1995) provides a regulatory regime for the identification and remediation of contaminated land. The main objective of the Part IIa contaminated land regime was to provide an improved system for the identification and remediation of land

A risk based approach is recommended where contamination is causing unacceptable risks to human health or the wider environment, assessed in the context of the current or proposed use and circumstances of the land.

Our proposed risk assessment methodology is based upon UK DEFRA and EA best practice in regard to the assessment of contaminated land. We follow the framework set out in CLR 11 – Model Procedures for the Management of Contaminated Land. This assesses whether

contaminated land decisions are rigorous and defensible. The CLR method adopts the characterisation of the Source-Pathway-Receptor pollutant linkage.

12.1 CLEA Soil Guideline Values

The UK technical guidance for assessing risks to human health and controlled waters is split into two parts, both issued by the Environment Agency (EA). The Contaminated Land Exposure Assessment (CLEA) framework produced by the EA can be used to assess potential risks to human health, while a separate tiered methodology has been produced by the UK Environment Agency for assessment of controlled waters (EA, 1999).

The original CLEA Soil Guideline Values (SGVs) were withdrawn in August 2008. The Environment Agency has published a revision of CLEA, and new SGVs for arsenic, cadmium, mercury, nickel and selenium. The new SGVs are not definitive values and the onus is on the contaminated land practitioner to derive Site Specific Assessment Criteria (SSAC) using officially produced toxicity and physico-chemical data.

SGVs for other priority contaminants as well as toxicological profiles were rolled out during 2009. Until a full suite of toxicological profiles are issued, we consider that the existing SGVs for lead and chromium (total) remain a useful tool in assessing the risks to human health from soil contamination.

12.2 CIEH Land Quality Management Generic Assessment Criteria – Version 2 (2009)

Due to the limited range of chemicals for which SGVs were derived by the Environment Agency, [The Brownfield Consultancy](#) have adopted the CIEH Land Quality Management Generic Assessment Criteria (LQM GAC) for a variety of other contaminants.

The LQM GACs have been calculated in accordance with the current (2008) CLEA model for a variety of commonly encountered contaminants for which an SGV has not been published by the EA. LQM GACs have been calculated for chromium (iii), chromium (VI), copper, zinc and a variety of organic compounds including PAH species and TPH CWG bands. Values have been published for 'sandy soils' at Soil Organic Matter contents of 1%, 2.5% and 5%. For the purposes of this assessment we have adopted 1% Soil Organic Matter.

13 SOIL CHEMISTRY

13.1 Results

The results of chemical testing of 10No. samples of near surface soils are compared with the SGVs and the LQM GACs for a residential with plant uptake end use. These comparisons are summarised in the following table:-

Table 6 Comparison of Soil Chemical Test Results with Guideline Values

Determinant	Maximum Measured Concentration (mg/kg)	CLEA SGV Residential (mg/kg)	No. of tests carried out	No. of exceedences
Arsenic	210	32	10	8
Cadmium	<0.2	10	10	0
Mercury	<0.3	1	10	0
Lead	39	450	10	0
Nickel	150	130	10	1
Selenium	<1.0	350	10	0
Benzene	<1.0	0.33	10	0
Toluene	<1.0	223	10	0
Ethylbenzene	<1.0	350	10	0
Xylene	<1.0	230	10	0
Determinant	Maximum Measured Concentration (mg/kg)	LQM GAC Residential (mg/kg)	No. of tests carried out	No. of exceedences
Beryllium	4.9	51	3	0
Chromium (III)	360	3000	5	0
Chromium (VI)	<4.0	4.3	5	0
Copper	17	2330	3	0
Vanadium	360	75	3	3
Zinc	210	3750	3	0
Acenaphthene	<dl	210	1	0
Acenaphthylene	<dl	170	1	0
Anthracene	<dl	2300	1	0
Benzo(a)anthracene	<dl	3.1	1	0
Benzo(a)pyrene	<dl	0.83	1	0
Benzo(b)fluoranthene	<dl	5.6	1	0
Benzo(k)fluoranthene	<dl	8.5	1	0
Benzo(g,h,i)perylene	<dl	44	1	0
Chrysene	<dl	6	1	0
Dibenzo(a,h)anthracene	<dl	0.76	1	0
Fluoranthene	<dl	260	1	0
Fluorene	<dl	160	1	0
Indeno(1,2,3-c,d)pyrene	<dl	3.2	1	0
Naphthalene	<dl	1.5	1	0
Phenanthrene	<dl	92	1	0
Pyrene	<dl	560	1	0

13.2 Interpretation

One sample of soil (TP102 at 0.50m) was submitted to analysis for organochlorine and organophosphate pesticides (OCPs and OPPs) and these compounds were not recorded above the analytical limit of detection.

The results recorded levels of arsenic, nickel and vanadium at greater concentrations than the soil guideline value for the proposed end use of residential houses with gardens. We consider that these concentrations represent naturally occurring concentrations; the Marlstone Rock Bed is a metalliferous deposit particularly rich in iron and associated metals.

Soil Guideline Values (SGVs) derived using the CLEA model include the assumption that a contaminant might be taken up into the body from soil to the same extent as from the medium of exposure in the study used to derive the oral HCV. Contaminants are often so tightly bound within the soil that only a small percentage of this contamination present is actually mobile and could potentially pose a risk to human health. Physiologically based extraction tests (PBET) measures the percentage of the contaminant present which is not tightly bound to the soil and thus presents a risk to human health. Thus a selection of samples of soil which recorded elevated concentrations of arsenic, nickel and vanadium were rescheduled for PBET testing. This methodology was agreed with the Environmental Health Protection Officer at Cherwell District Council.

The soil samples were submitted to i2 laboratories in Watford for bioaccessibility testing using the Unified Barge Method (UBM). The UBM has been developed by the Bioaccessibility Research Group Europe (BARGE) and has been validated by in vivo bioaccessibility data and by inter laboratory comparison. The test involves simulating the stomach and intestinal digestion tracts.

Bioaccessibility Results and Site Specific Modelling using CLEA software version 1.06

The results from the bioaccessibility testing are given in the following table. The actual laboratory results are given in Appendix G.

Table 1 – Bioaccessibility Results

Trial Pit	Bioaccessibility (%)
TP110 (0.15m)	2.6 As
TP110 (0.15m)	2.8 Ni
TP114 (0.50m)	4.7 V

The results of the bioaccessibility testing indicate that the arsenic, nickel and vanadium present both in the natural soil is not 100% bioaccessible i.e. not all of the metal will be released from the soil following ingestion and digestion and be available for absorption.

Thus the use of the published soil guideline values are considered overly conservative Therefore site specific assessment criteria have been derived by **The Brownfield Consultancy** using the Contaminated Land Exposure Assessment (CLEA) software version 1.06.

The only site specific data used in the software was a pH of 7 based on the results and the bioaccessibility results. Within the software, in step 4 “Advanced Settings - chemical data” oral bioaccessibility is entered as a bioaccessibility fraction, the default being 1.00 therefore 0.03 was entered to reflect Arsenic bioaccessibility, 0.03 to reflect Nickel bioaccessibility and 0.05 to reflect Vanadium bioaccessibility. The software was then re-run.

The resulting site specific assessment criteria are 220mg/kg for Arsenic, 13,700 for Nickel and 4890mg/kg for Vanadium. Copies of the CLEA reports for the three derived site specific assessment criteria are given in Appendix G. When using the site specific derived assessment criteria, the original concentrations recorded in natural ground are considered acceptable and hence considered unlikely to pose a risk to human health receptors. Thus remediation is not considered necessary.

13.3 Waste Classification and Site Waste Management

There has been no history of use at the site since the earliest historical maps. The results of WAC testing suggest that soils across the site will be classified as inert waste.

Any excavated material and excess spoil should always be classified prior to removal from site as required by ‘Duty of Care’ (Environmental Protection Act 1990) legislation. This means that material has to be given a proper description and waste classification prior to removal consequently; details of the materials required for disposal, together with certificates of

chemical analysis should be sent to a suitably licensed waste disposal contractor for classification and to confirm compliance with their license conditions.

It should also be noted that Site Waste Management Plans Regulations 2008 came into force in April 2008. The Regulations require the preparation of a Site Waste Management Plan (SWMP) for all construction projects in England with a value of more than £300,000 and a more detailed plan for projects with a value of more than £500,000. The purpose of the SWMPs is to encourage better resource utilisation and waste management practices in construction, improve environmental performance, minimise the landfilling of wastes, and reduce instances of fly-tipping.

A SWMP is therefore likely to be required for the development and will need to consider all potential construction waste streams, including soils.

14 GEOTECHNICAL ENGINEERING ASSESSMENT

14.1 Proposed Redevelopment

We understand that the existing structures on site will be removed and 82No. detached and semi-detached houses with associated areas of car parking and access roads will be constructed.

14.2 Summary of Ground Conditions

The ground conditions encountered during the intrusive investigation were consistent with the published geological map. A variable thickness of topsoil overlies weathered Marlstone Rock Bed which in turn was underlain by bedrock of the Marlstone Rock Bed (hard limestone and ironstone). A distinct horizon of gravel and cobbles of ironstone and limestone was encountered in TP106 (3.20 - >4.00m), TP107 (0.40 – 0.70m), TP109 (0.90 – 1.55m), TP110 (0.90 – 1.55m), TP115 (0.40 – 0.85m), TP117 (0.65 – 0.95m) and TP120 (0.80 – 1.35m). This horizon is generally encountered across the northern and north eastern half of the site.

14.3 Shallow Foundations

Foundations should be taken through topsoil and any soft compressible soils and placed within the weathered Marlstone Rock Bed at a minimum acceptable founding depth of 0.90m bgl based upon soils of medium volume change potential. An allowable bearing pressure of 100kPa at 0.90m bgl is considered appropriate.

The allowable bearing capacity includes an overall factor of safety of 3 against bearing capacity failure and with total settlements associated with the bearing pressure estimated to be less than 25mm.

Foundations will need to be deepened and heave precautions adopted in accordance with NHBC Chapter 4.2 'Building Near Trees' where the plots are in the influence of existing, felled or proposed trees, based upon soils of medium volume change potential. A hedgerow including small trees is present along the southern boundary of the site. An arboriculturalist should be consulted on the types of species, and foundations should be designed accordingly. We recommend that foundation excavations are inspected by a suitably qualified person to ensure that competent materials are reached and that no soft or loose spots are present.

At founding depths of 0.90m, clay and silt soils will predominate. However a distinct horizon of gravel and cobbles of ironstone and limestone was encountered in TP106 (3.20 - >4.00m), TP107 (0.40 – 0.70m), TP109 (0.90 – 1.55m), TP110 (0.90 – 1.55m), TP115 (0.40 – 0.85m), TP117 (0.65 – 0.95m) and TP120 (0.80 – 1.35m). To avoid potential differential settlement where foundations span from clay to gravel, foundations should be locally reinforced.

Groundwater was encountered at the following exploratory hole locations:-

- TP103 slight seepage at 2.70m bgl
- TP105 at 2.50m bgl (rate of inflow not recorded)
- TP106 slight seepage at 3.60m bgl
- TP112 slight seepage at 2.10m

Hence groundwater should not present a constraint to foundation excavations. It must be noted that groundwater levels can vary seasonally and in response to high rainfall events. All trial pits remained stable during the investigations.

14.4 Ground Slabs

The underlying soils are shrinkable and consequently have the potential for heave. Therefore a suspended floor should be used incorporating a suitable underfloor void, based on the recommendations in NHBC Chapter 4.2, assuming soils of medium volume change potential.

14.5 Road Pavement Design

The site is underlain by cohesive soils of medium volume change potential. A CBR value of 3% would be appropriate, in accordance with Highways Agency Design Manual for Roads and Bridges HD25/94.

14.6 Chemical Considerations for Buried Concrete

Chemical analysis of five samples of the Marlstone Rock Bed gave water-soluble sulphate concentrations (SO_4 in 2:1 soil aqueous extract) of between 7.9mg/l and 52mg/l with pH values of between 6.5 and 7.1. Groundwater was encountered during the investigation, consequently a mobile groundwater regime is assumed. On this basis and in accordance with BRE SD1 (2005) "Concrete in aggressive ground" a Design Sulphate Class of DS1 with an ACEC of AC-1 would apply for all buried concrete.

15 SOAKAWAY DRAINAGE

Three trial pits, denoted TP119, TP120 and TP121 were excavated in order to undertake soakaway tests. The soakaway test in TP119 undertaken in clay, failed to achieve a 75% reduction in head, a requirement under BRE 365.

The test in TP120 was undertaken in ironstone described as '*brown very clayey angular GRAVEL and COBBLE of Limestone and Ironstone*' from 0.80m – 1.35m bgl. This test achieved an infiltration rate of 1.54×10^{-4} m/s. This layer is limited in its lateral extent, noted only in TP107, TP109, TP110 and TP120. It was not noted in the proximal trial pits TP108 and TP118.

The test in TP121 was located in '*Moderately weak limestone and ironstone recovered as angular cobbles*' at a depth of 2.15-2.20m. Above this depth sandy fissured Clay was recorded. The test in TP121 achieved an infiltration rate of 1.2×10^{-5} m/s.

Soakaway drainage is therefore feasible but soakaways must be located in layers of ironstone and limestone.

Any design should also take into account groundwater occurrence as described in Section 11.5.

16 CONCLUSIONS AND RECOMMENDATIONS

16.1 Land Quality

Elevated concentrations of naturally occurring arsenic, nickel and vanadium are recorded in soils which exceed the soil guideline values for a residential end use. However, **The Brownfield Consultancy** have determined through physiologically based extraction tests (PBET) analysis that a risk to future residential end users is not present. Thus remediation is not a requirement.

Should contamination be observed during groundworks then the principal contractor should contact **The Brownfield Consultancy** who will attend site and advise on the best course of action.

16.2 Gas Protection Measures

The site is not located within 250m of a landfill site. In addition, extensive thicknesses of Made Ground were not encountered. Hence ground gas protection measures are not required.

A radon report obtained from the British Geological Survey states that full radon protection measures are necessary for new build. The radon report is presented in Appendix D.

16.3 Buried Services

The site is a green field and does not have a contaminative history. The ground investigation and results of laboratory testing have confirmed that the site is free from contamination. Hence there is no requirement for protective water supply pipework.

16.4 Soil Disposal and Reuse

The results of WAC and air dried chemical testing suggest that the soils are inert and thus any surplus soil can be reused on site. The reader is referred to Section 13.3

16.5 Soakaways

Soakaway drainage is considered feasible in the Marlstone Rock Bed strata which outcrop discontinuously across the northern and north eastern half of the site. Infiltration rates of 1.54×10^{-4} m/s and 1.2×10^{-5} m/s are derived and the reader is referred to Section 15.

16.6 Geotechnical

Traditional shallow foundations at a depth of 0.90m bgl with an allowable bearing capacity of 100kPa are recommended. The reader is referred to Section 14 where the geotechnical conclusions are presented in full.

Prepared and approved by



JIM TWADDLE BSc (Hons) CGeol FGS
Director

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FIGURES

- 1 Key Plan
- 2 Plasticity Chart
- 3 Undrained Shear Strength v Depth

Figure 1

Project:

Cotefield Farm, Bodicote

Project No:

BC008

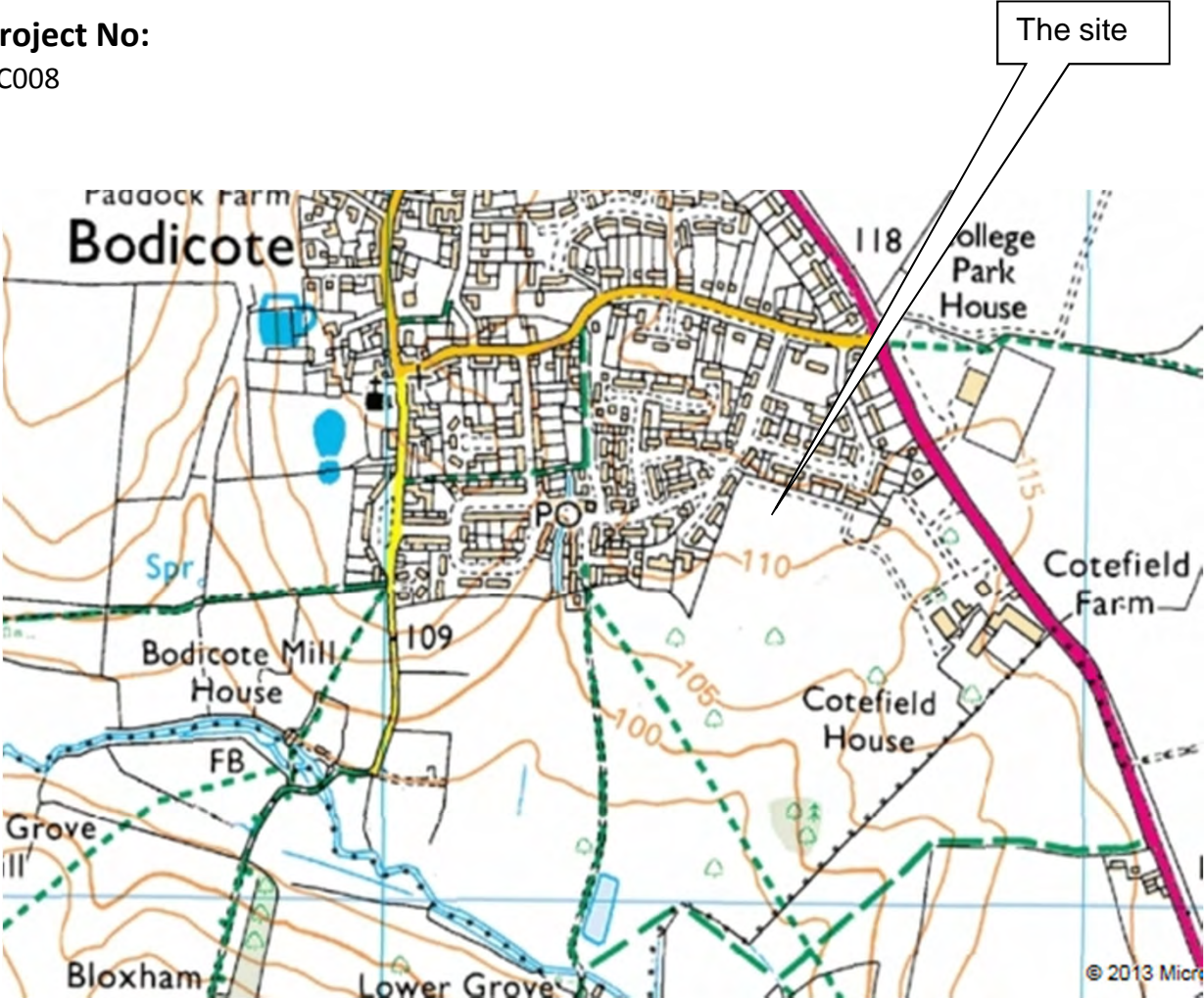


Figure 2

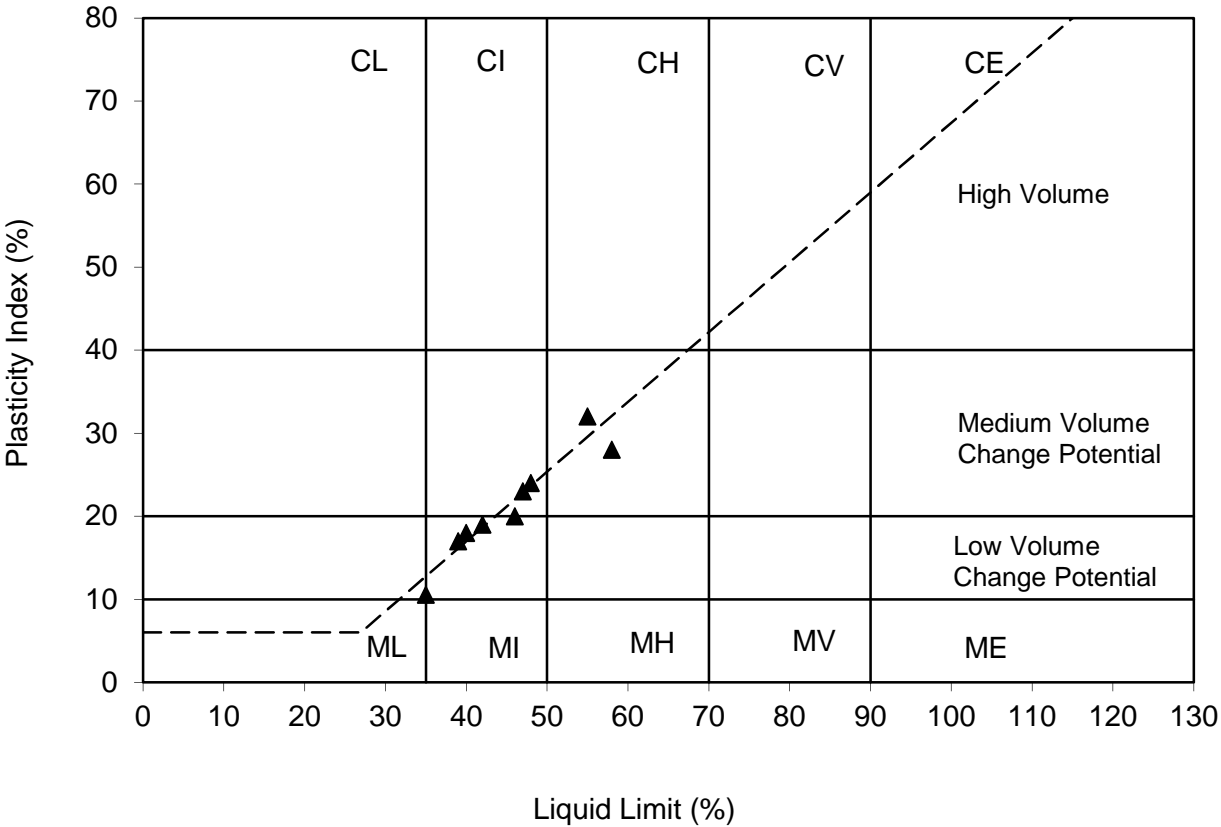
Project:

Cotefield Farm, Bodicote

Project No:

BC008

- Key:
- C Clay M Silt
 - L Low plasticity
 - I Intermediate plasticity
 - H High plasticity
 - V Very high plasticity
 - E Extremely high plasticity



▲ Weathered Marlstone Rock Bed □ - - - A Line

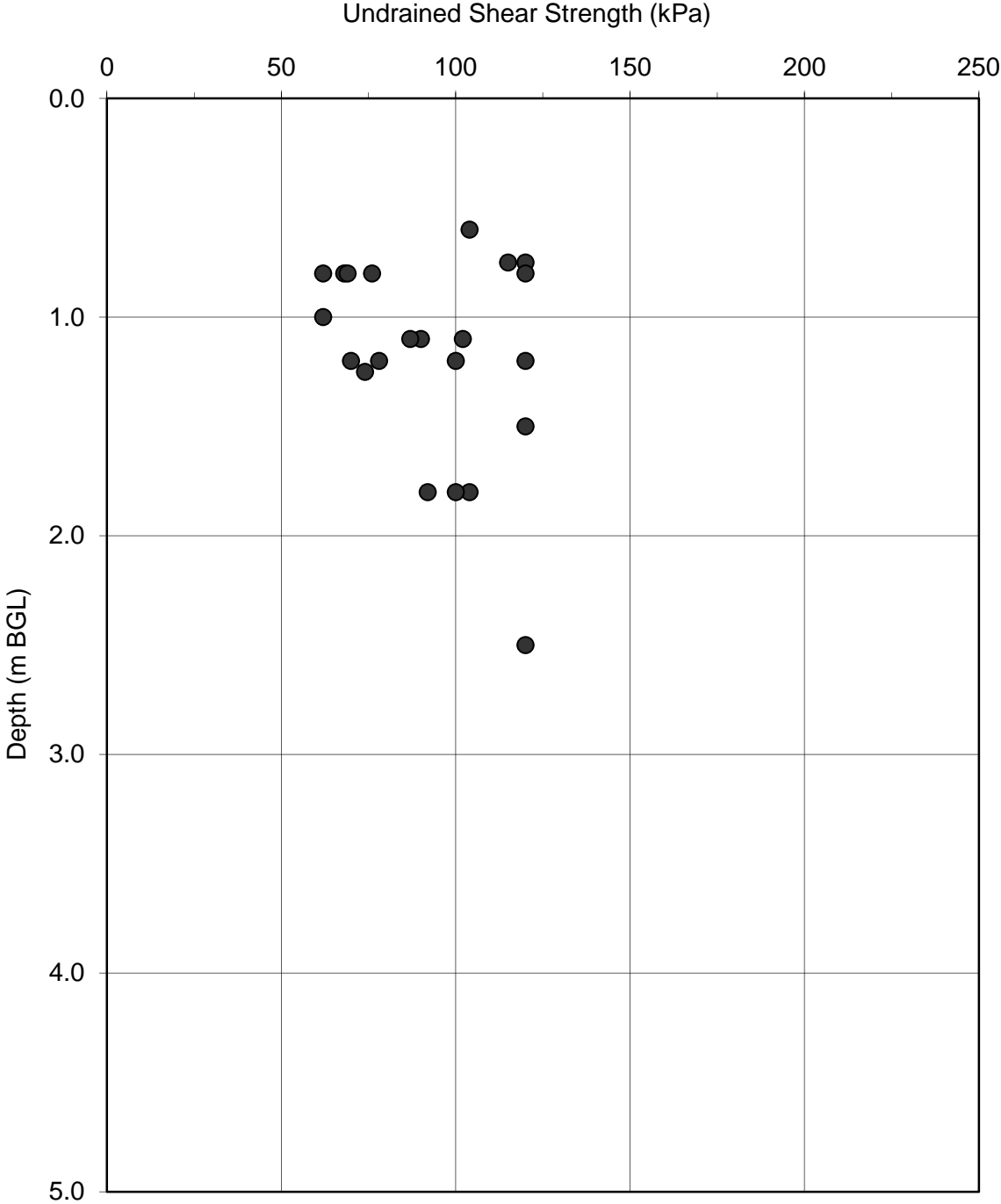
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Project:

Cotefield Farm, Bodicote

Project No:

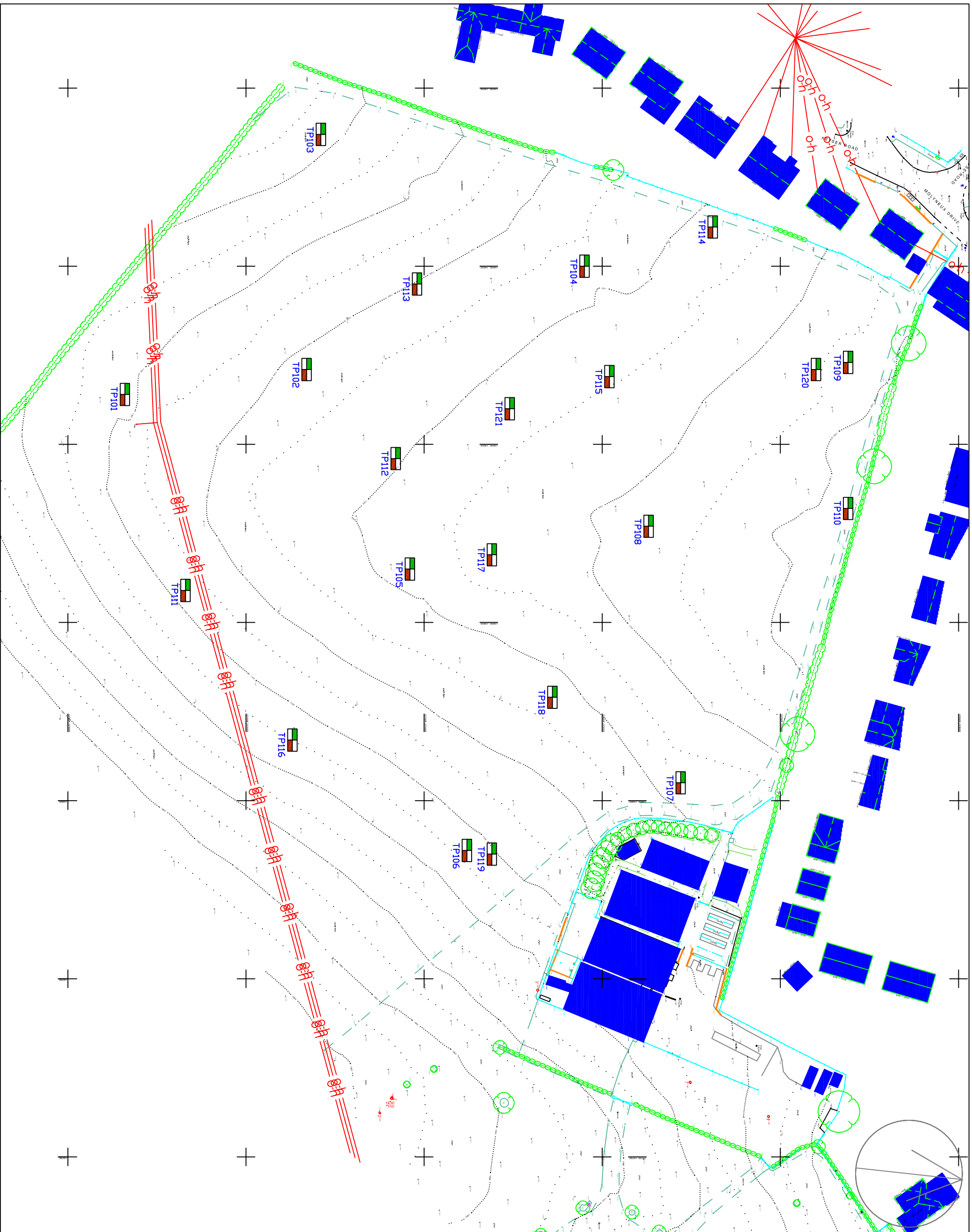
BC008



APPENDIX A

Exploratory Hole Location Plan

Proposed Layout



General notes

1. Base Drawing Taken From Interlock Survey Drawing 120278

Legend to symbols

 Machine Excavated Trial Pit

Revision	Description

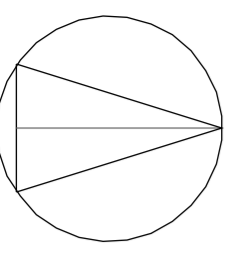
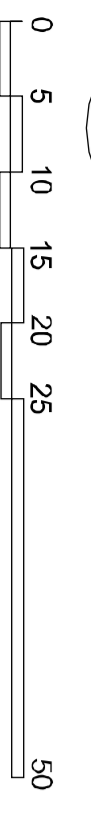
Title
EXPLORATORY HOLE LOCATIONS

Project
BODICOTE

Client
BANNER HOMES

The Brownfield Consultancy

Date	Drawing No.	Scale
29/01/2013	121601-001	1:500
Drawn By	Checked by	Sheet Size
TH	JT	A3



- accommodation schedule:
- affordable:
- A 1 bed flats @ 495 sq ft 4
 - B 2 bed flats @ 646 sq ft 4
 - C 2 bed houses @ 785 sq ft 15
 - D 3 bed houses @ 946 sq ft 6
 - E 4 bed houses @ 1098 sq ft 3
- open market:
- F 3 bed houses @ 915 sq ft 6
 - G1 3 bed houses @ 950 sq ft 6
 - G2 3 bed houses @ 950 sq ft 6
 - H 3 bed houses @ 1100 sq ft 6
 - I 4 bed houses @ 1250 sq ft 5
 - J1 4 bed houses @ 1250 sq ft 3
 - J2 4 bed houses @ 1400 sq ft 2
 - K1 4 bed houses @ 1750 sq ft 6
 - K2 4 bed houses @ 1750 sq ft 6
 - L 5 bed houses @ 1950 sq ft 2



Land South of Blackwood Place,
Bodicote

Oct 2012
1:500@A1
2012049

Site plan
P01

4.5m x 120m
Visibility Splay

Cottages

Existing Garden Centre

Existing customer access/operation centre to be retained

Existing garden centre delivery access to be retained

BLACKWOOD PLACE

Hunters End

Orchard View

KEYSER ROAD

APPENDIX B

Historical Map Extracts

Site Details:

COTEFIELD FARM, OXFORD ROAD, BODICOTE, BANBURY, OX15 4AQ

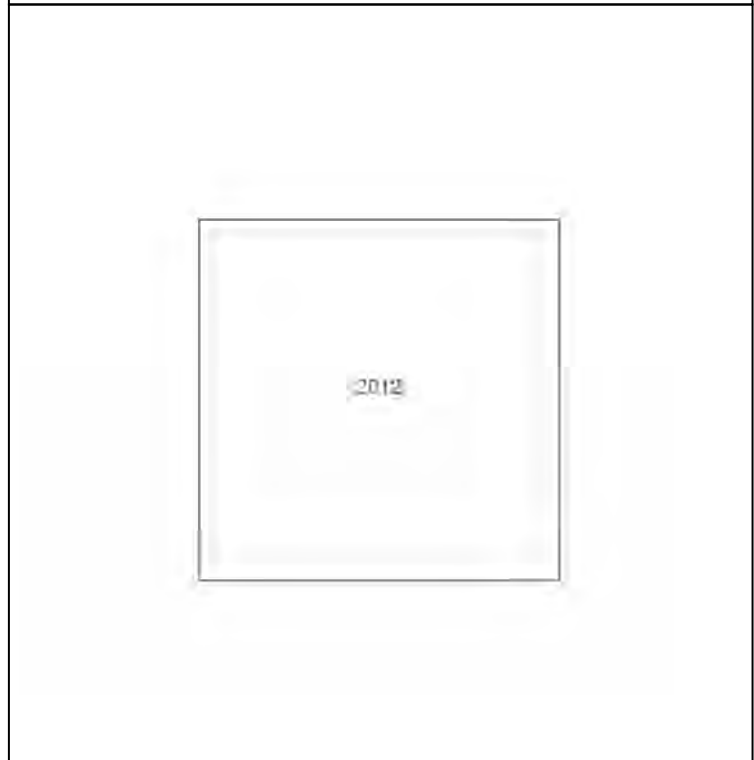
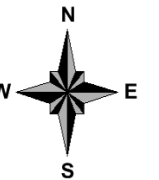
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Map Name: MasterMap

Map date: 2012

Scale: 1:1,250

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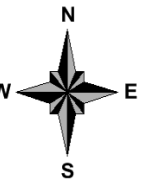
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Map Name: National Grid

Map date: 1994

Scale: 1:1,250

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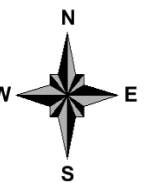
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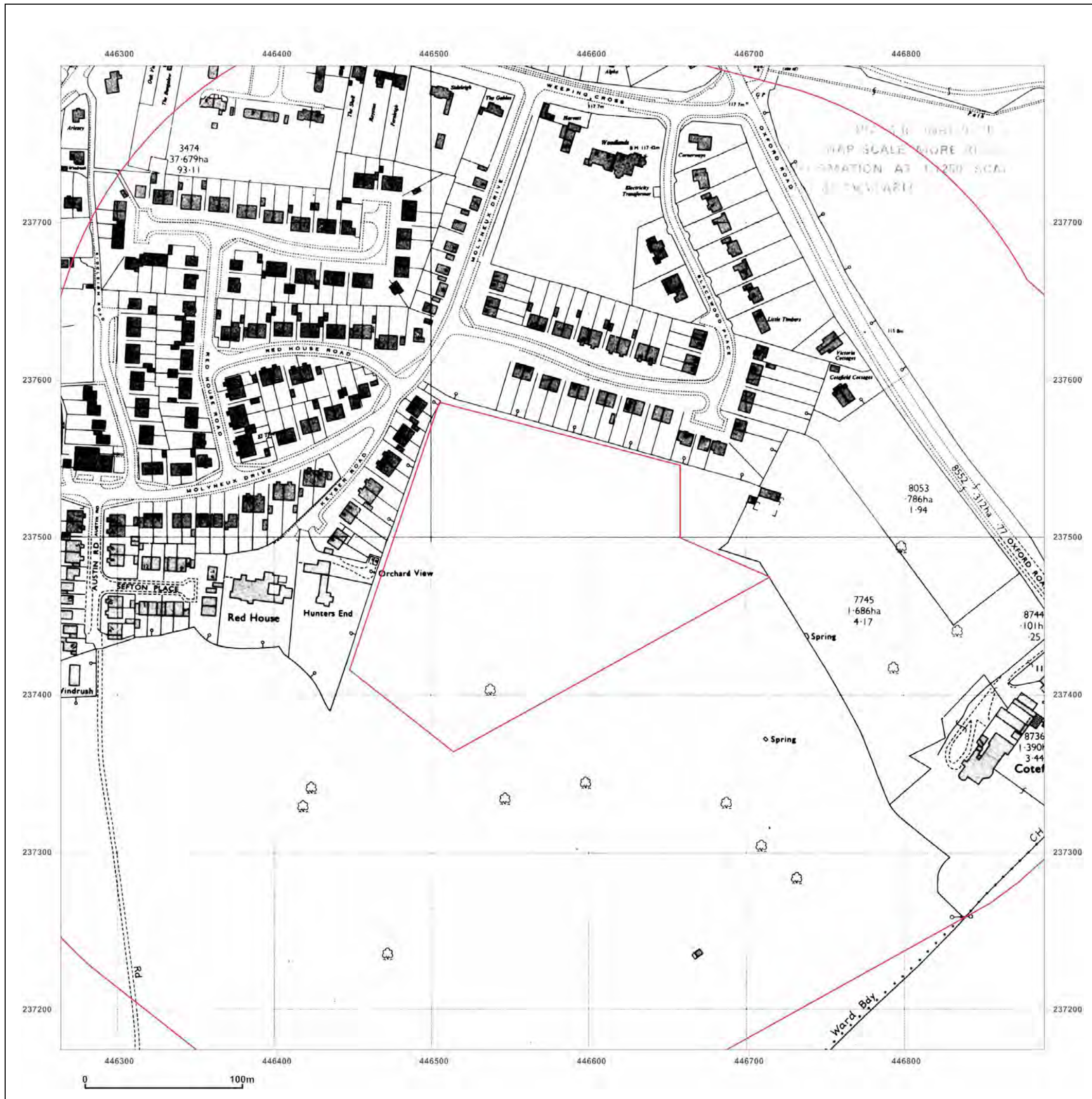
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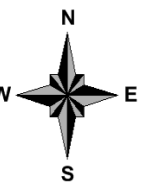
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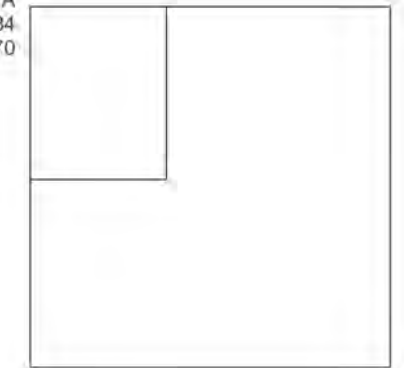
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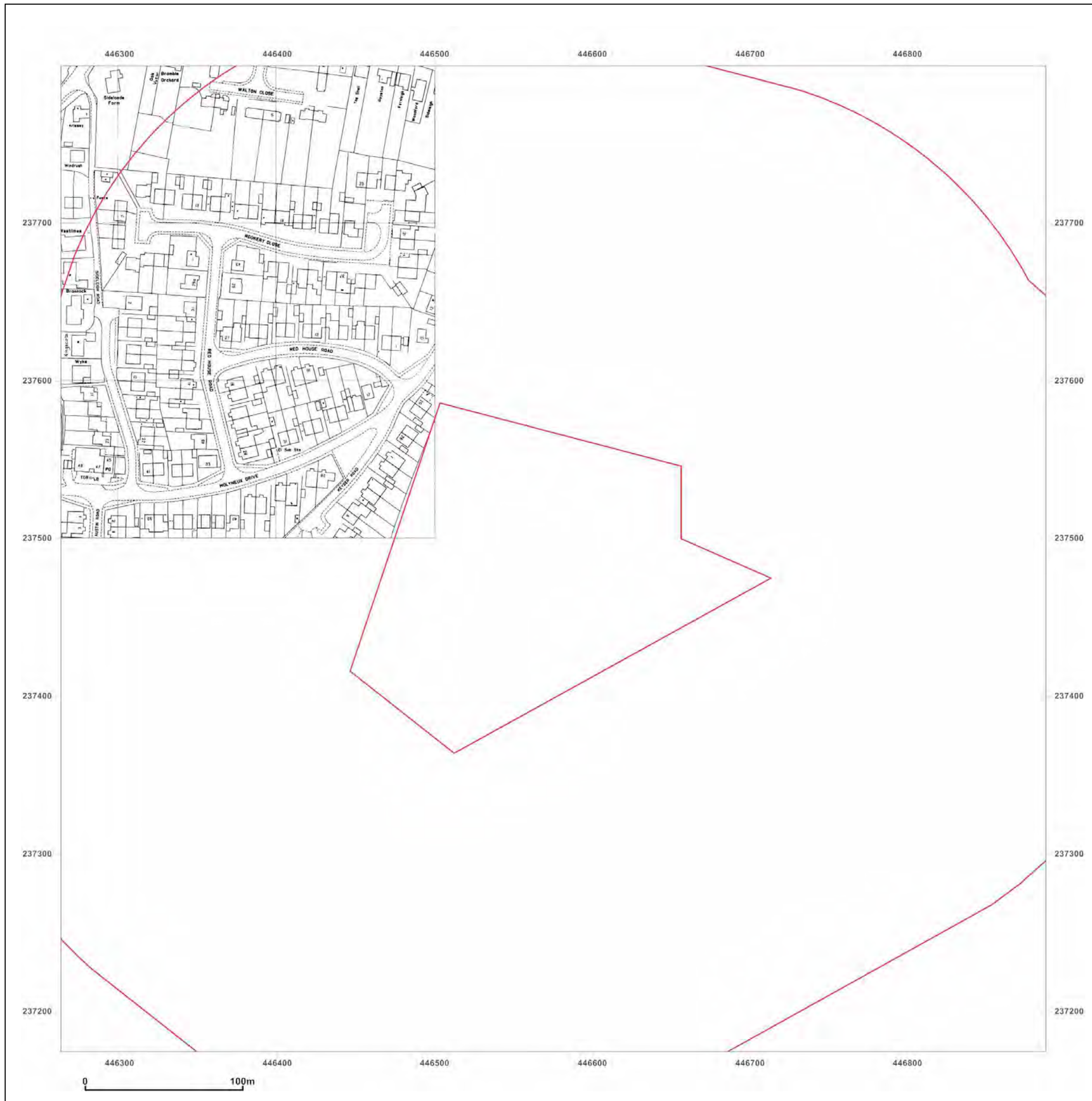


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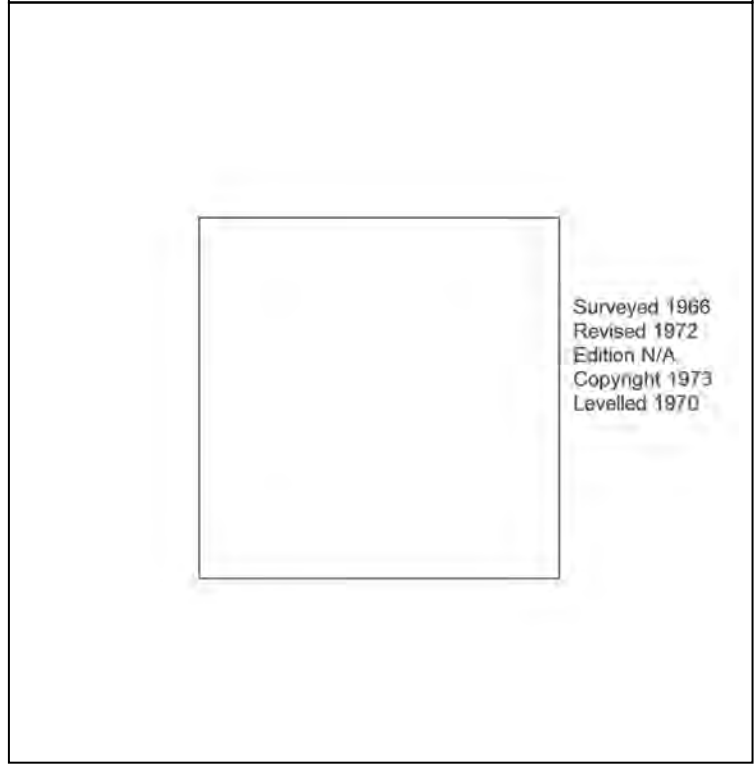
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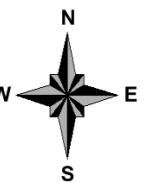
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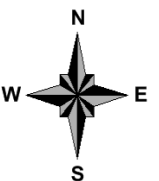
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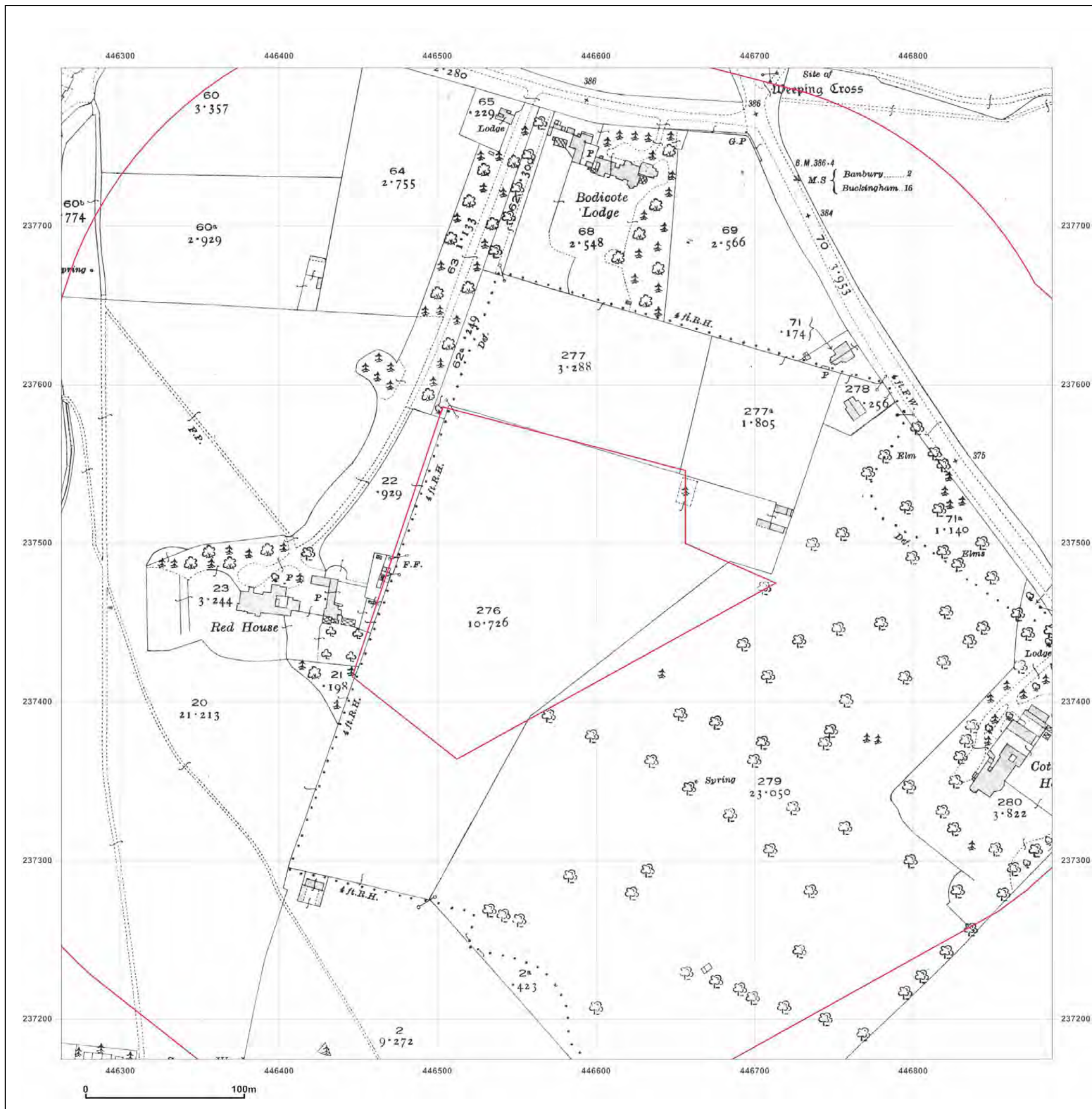


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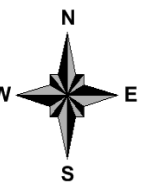
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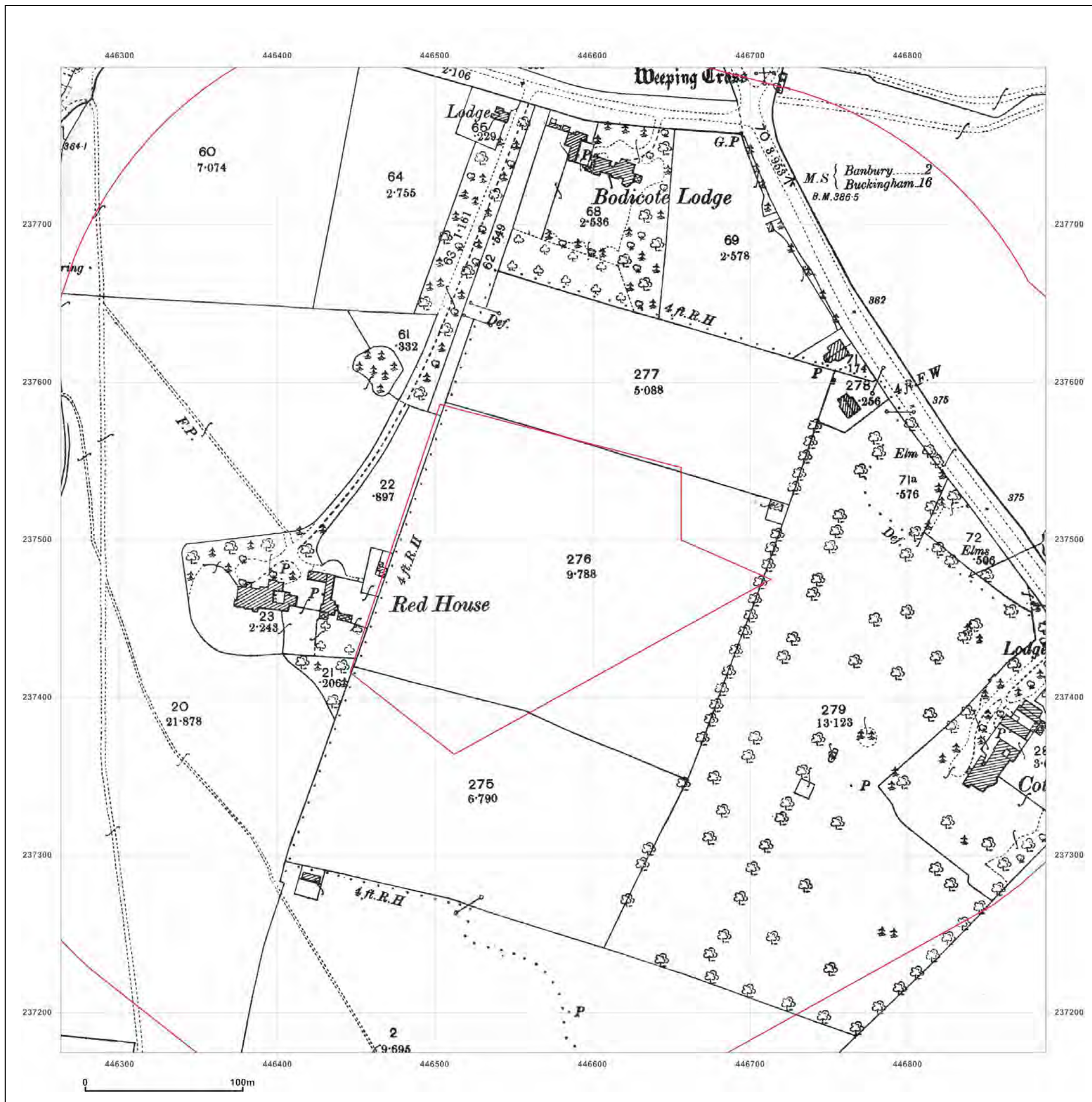


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Client Ref: Cotefield Farm, Bodicote
Report Ref: GS-558784
Grid Ref: 446575, 237487

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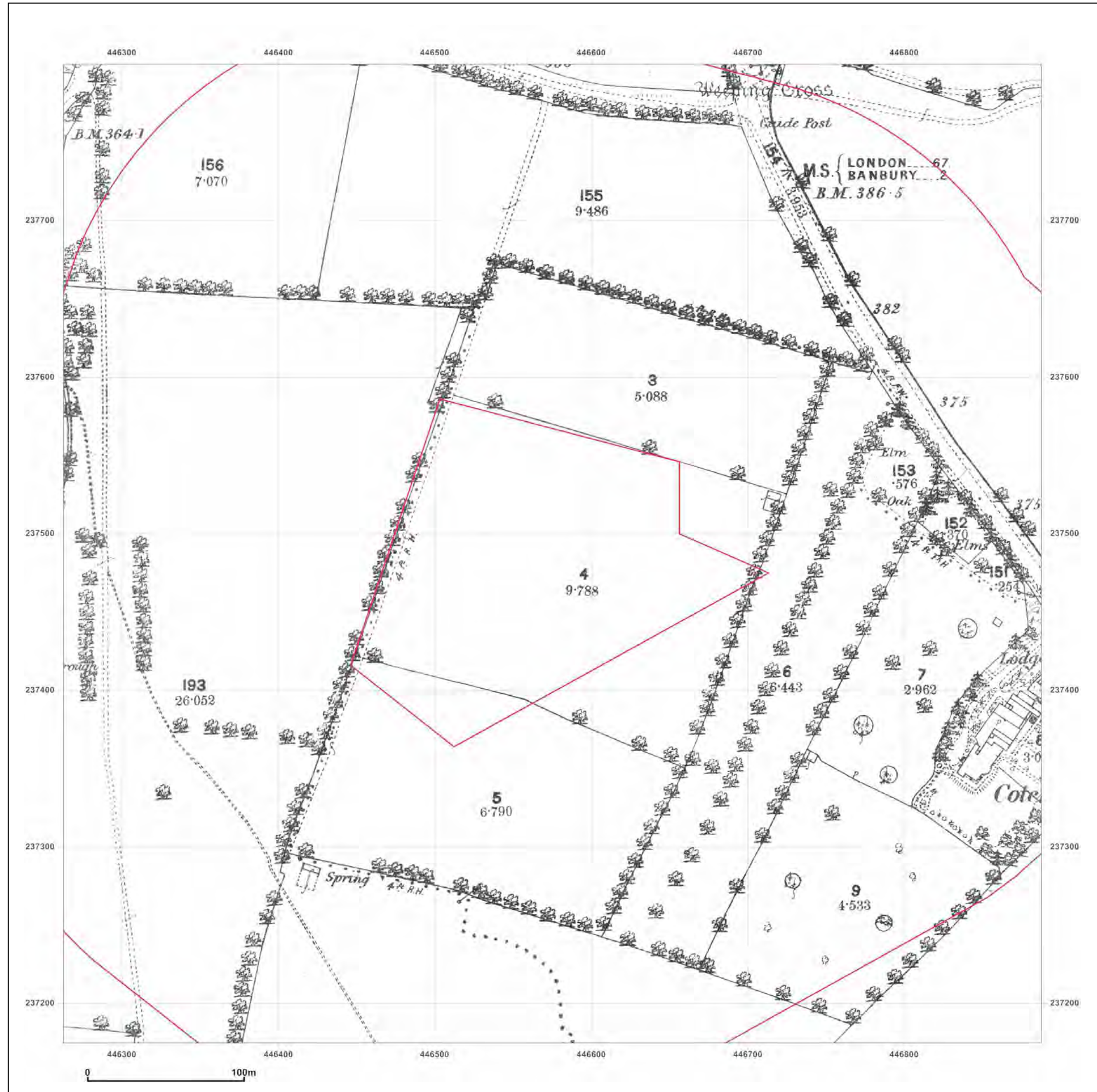


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APPENDIX C

Environmental Insight Report



The Brownfield Consultancy
The Cottage, Mill Lane,
Warwickshire,
Southam, CV47 2YF

GroundSure Reference: GS-558783
Your Reference: Cotefield Farm, Bodicote
Report Date: Dec 5, 2012
Report Delivery Method: **xml**
Client Email: jim.twaddle@brownfieldconsultancy.co.uk

GroundSure EnviroInsight

**Address: COTEFIELD FARM, OXFORD ROAD, BODICOTE,
BANBURY, OX15 4AQ**

Dear Sir/Madam,

Thank you for placing your order with GroundSure. Please find enclosed the GroundSure EnviroInsight as requested

If you need any further assistance, please do not hesitate to contact our helpline on 08444 159000 quoting the above GroundSure reference number.

Yours faithfully,

A handwritten signature in black ink, appearing to be "Jim Twaddle", followed by a small circle and a comma.

Managing Director
Groundsure Limited

Enc.
GroundSure EnviroInsight

GroundSure EnviroInsight

Address: COTEFIELD FARM, OXFORD ROAD, BODICOTE, BANBURY, OX15 4AQ

Date: Dec 5, 2012

GroundSure Reference: GS-558783

Your Reference: Cotefield Farm, Bodicote

Client: The Brownfield Consultancy



Brought to you by GroundSure

Aerial Photograph of Study Site



Aerial photography supplied by Getmapping PLC.
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Site Name: COTEFIELD FARM, OXFORD ROAD, BODICOTE,
BANBURY, OX15 4AQ
Grid Reference: 446575,237487
Size of Site: 3.28 ha

Overview of Findings

For further details on each dataset, please refer to each individual section in the main report as listed. Where the database has been searched a numerical result will be recorded. Where the database has not been searched '-' will be recorded.

Report Section	Number of records found within (X) m of the study site boundary					
	on-site	0-50	51-250	251-500	501-1000	1000-1500
1. Environmental Permits, Incidents and Registers						
1.1 Industrial Sites Holding Environmental Permits and/or Authorisations						
Records of historic IPC Authorisations	0	0	0	0	-	-
Records of Part A(1) and IPPC Authorised Activities	0	0	0	0	-	-
Records of Water Industry Referrals (potentially harmful discharges to the public sewer)	0	0	0	0	-	-
Records of Red List Discharge Consents (potentially harmful discharges to controlled waters)	0	0	0	0	-	-
Records of List 1 Dangerous Substances Inventory sites	0	0	0	0	-	-
Records of List 2 Dangerous Substances Inventory sites	0	0	0	0	-	-
Records of Part A(2) and Part B Activities and Enforcements	0	0	0	0	-	-
Records of Category 3 or 4 Radioactive Substances Authorisations	0	0	0	0	-	-
Records of Licensed Discharge Consents	0	0	3	0	-	-
Records of Planning Hazardous Substance Consents and Enforcements	0	0	0	0		
1.2 Records of COMAH and NIHHS sites	0	0	0	0	-	-
1.3 Environment Agency Recorded Pollution Incidents						
National Incidents Recording System, List 2	0	0	0	-	-	-
National Incidents Recording System, List 1	0	0	0	-	-	-
1.4 Sites Determined as Contaminated Land under Part IIA EPA 1990	0	0	0	0	-	-
2. Landfill and Other Waste Sites						
2.1 Landfill Sites						
Environment Agency Registered Landfill Sites	0	0	0	0	0	-
Landfill Data – Operational Landfill Sites	0	0	0	0	0	-
Environment Agency Historic Landfill Sites	0	0	0	0	0	0
Landfill Data – Non-Operational Landfill Sites	0	0	0	0	0	-
BGS/DoE Landfill Site Survey	0	0	0	0	0	0
GroundSure Local Authority Landfill Sites Data	0	0	0	0	0	0
2.2 Landfill and Other Waste Sites Findings						
Operational Waste Treatment, Transfer and Disposal Sites	0	0	0	0	-	-
Non-Operational Waste Treatment, Transfer and Disposal Sites	0	0	0	0	-	-
Environment Agency Licensed Waste Sites	0	0	0	0	0	0

3. Current Land Uses	on-site	0-50	51-250	251-500	501-1000	1000-1500
3.1 Current Industrial Sites Data	0	0	4	-	-	-
3.2 Records of Petrol and Fuel Sites	0	0	0	0	-	-
3.3 Underground High Pressure Oil and Gas Pipelines	0	0	0	0	-	-

4. Geology

	Description
4.1 Are there any records of Artificial Ground and Made Ground present beneath the study site? *	No
4.2 Are there any records of Superficial Ground and Drift Geology present beneath the study site? *	No
4.3 For records of Bedrock and Solid Geology beneath the study site* see the detailed findings section.	

Source: Scale: 1:50,000 BGS Sheet 218

* This includes an automatically generated 50m buffer zone around the site.

5. Hydrogeology and Hydrology

	on-site	0-50	51-250	251-500	501-1000	1001-2000
5.1 Are there any records of Productive Strata in the Superficial Geology within 500m of the study site?				Yes		
5.2 Are there any records of Productive Strata in the Bedrock Geology within 500m of the study site?				Yes		
5.3 Groundwater Abstraction Licences (within 2000m of the study site).	0	0	1	0	1	2
5.4 Surface Water Abstraction Licences (within 2000m of the study site).	0	0	0	0	3	2
5.5 Potable Water Abstraction Licences (within 2000m of the study site).	0	0	0	0	3	0
5.6 Are there any Source Protection Zones within 500m of the study site?					No	
5.7 River Quality						
Is there any Environment Agency information on river quality within 1500m of the study site?	No	No	No	No	No	No
5.8 Detailed River Network entries within 500m of the site	0	0	2	1	-	-
5.9 Surface water features within 250m of the study site	No	No	Yes	-	-	-

6. Flooding

6.1 Are there any Environment Agency indicative Zone 2 floodplains within 250m of the study site?	No
6.2 Are there any Environment Agency indicative Zone 3 floodplains within 250m of the study site?	No
6.3 Are there any Flood Defences within 250m of the study site?	No
6.4 Are there any areas benefiting from Flood Defences within 250m of the study site?	No
6.5 Are there any areas used for Flood Storage within 250m of the study site?	No
6.6 What is the maximum BGS Groundwater Flooding susceptibility within 50m of the study site?	High
6.7 What is the BGS confidence rating for the Groundwater Flooding susceptibility areas?	Low

7. Designated Environmentally Sensitive Sites

	on-site	0-50	51-250	251-500	501-1000	1001-2000
7.1 Records of Sites of Special Scientific Interest (SSSI)	0	0	0	0	0	0
7.2 Records of National Nature Reserves (NNR)	0	0	0	0	0	0

7.1 Records of Sites of Special Scientific Interest (SSSI)	0	0	0	0	0	0
7.3 Records of Local Nature Reserves (LNR)	0	0	0	0	0	0
7.4 Records of Special Areas of Conservation (SAC)	0	0	0	0	0	0
7.5 Records of Special Protection Areas (SPA)	0	0	0	0	0	0
7.6 Records of Ramsar sites	0	0	0	0	0	0
7.7 Records of World Heritage Sites	0	0	0	0	0	0
7.8 Records of Environmentally Sensitive Areas	0	0	0	0	0	1
7.9 Records of Areas of Outstanding Natural Beauty (AONB)	0	0	0	0	0	0
7.10 Records of National Parks	0	0	0	0	0	0
7.11 Records of Nitrate Sensitive Areas	0	0	0	0	0	0
7.12 Records of Nitrate Vulnerable Zones	1	0	0	0	0	0
7.13 Records of Ancient Woodlands	0	0	0	0	0	0

8. Natural Hazards

8.1 What is the maximum risk of natural ground subsidence? Low

9. Mining

9.1 Are there any coal mining areas within 75m of the study site? No

9.2 What is the risk of subsidence relating to shallow mining within 150m of the study site? Negligible

9.3 Are there any brine affected areas within 75m of the study site? No

Using this Report

The following report is designed by Environmental Consultants for Environmental Professionals bringing together the most up-to-date market leading environmental data. This report is provided under and subject to the Terms & Conditions agreed between GroundSure and the Client. The document contains the following sections:

1. Environmental Permits, Incidents and Registers

Provides information on Regulated Industrial Activities and Pollution Incidents as recorded by Regulatory Authorities, and sites determined as Contaminated Land. This search is conducted using radii up to 500m.

2. Landfills and Other Waste Sites

Provides information on landfills and other waste sites that may pose a risk to the study site. This search is conducted using radii up to 1500m.

3. Current Land Uses

Provides information on current land uses that may pose a risk to the study site in terms of potential contamination from activities or processes. These searches are conducted using radii of up to 500m. This includes information on potentially contaminative industrial sites, petrol stations and fuel sites as well as high pressure underground oil and gas pipelines.

4. Geology

Provides information on artificial and superficial deposits and bedrock beneath the study site.

5. Hydrogeology and Hydrology

Provides information on productive strata within the bedrock and superficial geological layers, abstraction licenses, Source Protection Zones (SPZs) and river quality. These searches are conducted using radii of up to 2000m.

6. Flooding

Provides information on surface water flooding, flood defences, flood storage areas and groundwater flood areas. This search is conducted using radii of up to 250m.

7. Designated Environmentally Sensitive Sites

Provides information on the Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR), Special Areas of Conservation (SAC), Special Protection Areas (SPA), Ramsar sites, Local Nature Reserves (LNR), Areas of Outstanding Natural Beauty (AONB), National Parks (NP), Environmentally Sensitive Areas, Nitrate Sensitive Areas, Nitrate Vulnerable Zones and World Heritage Sites. These searches are conducted using radii of up to 500m.

8. Natural Hazards

Provides information on a range of natural hazards that may pose a risk to the study site. These factors include natural ground subsidence.

9. Mining

Provides information on areas of coal and shallow mining.