



**Phase I - II
Geo-Environmental Site Assessment**

Land east of Moorhill Road, West End, Southampton, SO30 3AX

*Prepared for:
Highwood Homes
The Hay Barn
Upper Ashfield Farm
Hoe Lane
Romsey
SO51 9HU*

August 2022

Omnia ref: A11641/1.1



ISO Accredited Certification



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Phase I-II Geo-Environmental Assessment					
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Executive Summary	
Site Address	Land east of Moorhill Road, West End, Southampton, SO30 3AX
National Grid Reference	447112, 113545
Site Area	0.72 ha
Current Site Use	Open land, with demolition rubble and mixed stockpiles scattered across the site.
Site History	From the first historical map dated coniferous woodland, with a dirt track running west to east along the southern boundary until 1896. From 1896-2020 a residential house was erected with one (1no.) outbuilding in the centre of the northern boundary and two (2no.) smaller structures appeared within the southern extent, associated with the residential dwelling to the south. From 2020, the on-site residential house and associated structure are demolished, and the site is depicted as open land, with areas of hard standing.
Geology & Hydrogeology	Geology BGS records indicate that the site is directly underlain by Superficial Deposits of the River Terrace Deposits, comprising Sand and Gravel, which is classified as a Secondary A Aquifer. Bedrock geology is Wittering Formation, comprising of Clay, Silt and Sand, which is classified as a Secondary A Aquifer. The Groundsure report records no data for Artificial and Made Ground on the proposed site. Made Ground, landscaped ground and reclaimed ground were not identified within 250m of the site. The closest Made Ground being 304m north of the site. Geology encountered during intrusive works was topsoil/ made ground (within one location), over superficial deposits of River Terrace Deposits, overlaying the Wittering Formation. Hydrogeology Review of the environmental database indicates that the site is not located within a groundwater Source Protection Zone. There are no active or historical water abstractions are located within 250m of the site. The closest active groundwater abstraction is located 1012m northeast. There are no active or historical potable water abstractions are located within 250m of the site.
Hydrology & Flooding	Groundwater vulnerability data indicates that the site is underlain by a Secondary A Aquifer with medium vulnerability, as well as a Secondary A Superficial Aquifer with Medium vulnerability. Based on local topography, where the site is elevated and the location of surface watercourses it is considered that shallow groundwater, if present, will follow local topography and flow away from site West towards The River Itchen.
Landfill Sites & Ground Gases	The Groundsure Report identified no records of historic landfill sites or historic waste treatment sites within 250m of the subject site. The Groundsure Report identified no active or recently closed licensed waste sites within 250m of the site boundary.
Radon	The site lies within an area where less than 1% of the properties are above the Action Level. At these levels BRE publication BR211 indicates that no special radon protective measures are required in the construction of new extensions or dwellings.

Revised Conceptual Site Model
Following completion of the Tier 1 risk assessment no active pollution pathways have been identified based on a residential end use without homegrown produce.
Waste Acceptance Criteria Testing
WAC assessment of soils analysed at incremental depths across the site material at depths of 0.10-0.20 at (WS102) and 0.40-0.60 (WS105) is classed as Inert Waste for waste disposal purposes based on the analysis and classification with values within the Inert Waste criteria limits. Samples were also screened using Hazwaste software which classified the waste as non hazardous waste for disposal.
Omnia have provided an anticipated Waste Classification of soil derived from values presented within the laboratory results. However, the acceptance criteria for materials are dependent on the license held by the individual landfill site. As a result, waste acceptance criteria may vary between landfill sites and it is therefore recommended that the test results are submitted to the preferred waste disposal site for review.
Concrete Classification
Soils encountered beneath the site have been classified in accordance with DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-3z with the recommendations provided in BRE Special Digest 1 (2005).
Geotechnical Assessment
Foundations All foundations should be placed beneath any Made Ground or Topsoil to found on the underlying natural strata. Presumed bearing capacities at 1.20m bgl within the Head Deposits provide bearing capacities of 150-500kN/m² within the granular deposits across site. In the location of WS102 where cohesive soils of the Head Deposits were encountered, bearing capacities of 200-400 kN/m² have been provided. Bearing capacities at 2.00m bgl provide bearing capacities of 500-800kN/m² within the granular soils of the Head Deposits across site. Within the shallow soils of the Wittering Formation, it is considered that a traditional strip foundation of 1.00m width at a depth 2.00m bgl provides a presumed bearing capacity of approximately 50-100 kN/m². Ground Floor Slabs Due to the High volume change potential of the ground, it is considered that ground floor slabs are not suitable for adoption and therefore a suspended floor slab should be adopted in accordance with NHBC Chapter 5.2 to mitigate against the effects of differential settlement. Pavement Construction CBR values ranged from 8.0% to 73.2% between ground level and 878mm bgl. Using a conservative approach, a CBR value of 8.0% should be adopted across the site at this stage. Notwithstanding these results, confirmatory CBR testing should be carried out at formation level once details are finalised.
Recommendations
Environmental All monitoring points should be decommissioned in accordance with Environment Agency guidance ahead of site development in order to avoid the creation of preferential pathways. If during the development stage any evidence of contamination is identified, works should be halted, and contact made with a suitably qualified Environmental Consultant. As determined appropriate by the Consultant, further investigation and sampling may be required to determine the appropriate actions. Upon completion contact should be made with the regulator to achieve sign off of the works. It is recommended that a further three (3no.) gas monitoring visits are undertaken in line with best practice and guidance provided within CIRIA C665, due to concentrations of CO₂ exceeding the screening value of 5% v/v

identified during the monitoring visits on-site.

Geotechnical

Values for foundation are based on approximate ultimate bearing capacity and are given to provide outline options and should be subject to detailed analysis by the Structural Engineer. Should the bearing strength set out above prove to be incompetent for the proposed loading, consideration should be given to a deeper foundation solution. As necessary, and as dictated by the site layout plan this may lead to a requirement for an assessment of deeper soils for a piled foundation.

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1 INTRODUCTION

1.1 Background

Omnia have been commissioned by Highwood Homes to undertake a Geo-Environmental investigation at the site of Land east of Moorhill Road, West End, Southampton, SO30 3AX to assist with their full planning application. A site location plan is presented as Figure 1.0 within Appendix III.

1.2 Proposed Development

It is understood that Highwood Homes are proposing to redevelop the site to comprise a Care Home with 70 beds over 3 storeys with associated areas of vehicle parking, access routes and infrastructure to the west of the site. We note that the site has existing planning permission for a replacement dwelling, under the local authority reference [F/20/87694](#), however the proposed care home development scheme as outlined in the Feasibility Booklet entitled 'Proposed Care Home, Moorhill, West End, Southampton' (dated May 2021) requires a new planning application.

The outline proposed site layout is presented as Figure 2.0 (Appendix III).

1.3 Objectives

The objectives of the Phase I-II Geo-Environmental Site Assessment are to:

- Undertake a site walkover and inspection;
- Review historical plans, site investigations, geology, hydrogeology, site sensitivity, floodplain issues, mining records and any local authority information available in order to complete a Desk Study in line with the Environment Agency (EA) document *Land Contamination Risk Management (LCRM)*;
- Undertake an assessment of the near surface through intrusive site investigation;
- Assess the implications of any potential environmental risks, liabilities and development constraints associated with the site in relation to the future use of the site and in relation to off-site receptors;
- Provide a general geotechnical characterisation of the site, including outline recommendations for pavement design and appropriate foundation options; and,
- Provide a factual and interpretative report relating to the site and provide recommendations on any potential development issues with consideration of residential and environmental receptors.

1.4 Sources of Information

Background information was sought from the following sources:

- Groundsure Environmental Database Search (GS-8775595);

-
- Historical Ordnance Survey Mapping (1868 –2022);
 - The British Geological Survey (BGS) map for the site (Sheet 315, Southampton, Solid and Drift Edition at a scale of 1:50,000, 1987);
 - Environment Agency flood designations, aquifer designations and groundwater source protection zones (<https://magic.defra.gov.uk/MagicMap.aspx>) [Accessed: 2022/06/22];
 - Zetica UXO Risk Maps (<https://zeticauxo.com/downloads-and-resources/risk-maps>); [Accessed: 2022/06/22]
 - British Standard BS10175:2011+A2:2017 – Investigation of Potentially Contaminated Sites – Code of Practice;
 - British Standard BS5930:2015+A1:2020 – *Code of Practice for Ground Investigations*;
 - British Standard BS1377-9:1990 Incorporating Amendment No. 1 – *Methods of Test for Soils for Civil Engineering Purposes – Part 9: In-situ Tests*;
 - British Standard BS8485:2015+A1:2019 – *Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings*;
 - CIRIA Publication C665 (2007). *Assessing Risks Posed by Hazardous Ground Gases to Buildings*;
 - BRE DG365 (2016). *Soakaway Design*;
 - BRE Special Digest 1 (2005). *Concrete in Aggressive Ground*;
 - Tomlinson, M.J. (2001). *Foundation Design and Construction*. 7th Edition. Pearson Prentice;
 - NHBC Standards (2019). Chapter 4.2 – *Building Near Trees* (2020); and,
 - British Standard BS8004:2015 - *Code of Practice for Foundations*.

1.5 Limitations

The limitations of this report are presented in Appendix I.

1.6 Confidentiality

Omnia has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from Omnia; a charge may be levied against such approval.

2 SITE SETTING

2.1 Site Details

Table 2-1 Site Details

Site Address	Land east of Moorhill Road, West End, Southampton, SO30 3AX
National Grid Reference	447112 113545
Site Area	0.72ha

All acronyms used within this report are defined in the Glossary presented in Appendix II.

A site location plan is presented as Figure 1.0 (Appendix III).

2.2 Current Site Use

2.2.1 Site Description

The area of investigation is located approximately 2.0 km east of Southampton city centre, and 800m southwest of West End, Southampton. It is approximately rectangular in shape, covering an area of 0.72ha. Access was from the north western corner of the site, off Moorhill Road (A27) to the west.

At the time of the site walkover the site was accessed via a private tarmac road which was noted from visual inspection to be in good condition. The site was secured by two (2no.) wooden gates with concrete pillars at this access point from Moorhill Road (Photograph 1). The wooden gates were secured by key padlocks. The remainder of the site was bordered by wooden fencing.

During the site walkover, the site comprised open, heavily vegetated land with three (3no.) mixed stockpiles scattered throughout the site. Further detail on these stockpiles are explained below. A dirt track, assumed to be previous soft landscaping ran along the west and southern border of the boundary.

Within the north-western corner of the site presumed fly-tipped waste was noted and comprised three (3no.) disused fridges (Photograph 2). Within the centre of the site was an approximately 10.00m x 3.00m x 2.00m pile of presumed demolition rubble (Photograph 3) which is presumed to be from the demolition of the former residential house evident on historical mapping. The demolition rubble contained glass, brick, concrete, and metal and was overgrown with grass.

In the centre of the northern extent of the site was a stockpile of metal (Photograph 4). This was rusted, and staining was noted on the hardcore tarmac floor from previous burning. The pile of metal contained metal racking, corrugated iron roofing approximately 5.00m x 2.00m x 2.00m in size.

On the north western boundary was a rusted green above ground storage tank (AST) tank (Photograph 5) measuring approximately 1.50m x 1.50m x 1.50m. There was no visual evidence of leaking or staining on the floor, however a tar like substance (Photograph 6) was noted within the

pipe exiting the tank. A concrete covered reservoir was also noted in the neighbouring site to the north, which ran the length of the northern boundary, which was identified as such on contemporary OS mapping.

The site was overgrown with vegetation, of dense bushes, weeds, long grass, and scattered deciduous and coniferous trees apart from in the west and centre. Multiple mature coniferous trees were present surrounding the boundary of the site and scattered in the western extent of the site. These were noted to be approximately 8.00m tall.

The site boundary was noted to be surrounded on all sides with wooden panelled fencing. One fence panel had fallen down on the southern boundary, which showed a mound associated with a covered reservoir located to the south and identified as such on contemporary OS mapping. Adjacent to the southern boundary was a control building associated with the reservoir with attached aerials presumed for a telemetry system (Photograph 7).

The general topography of the site was flat, with a gradual west to east slope.

An annotated site location plan showing observations from the walk-over survey is presented as Figure 2.0 and 3.0 (Appendix III). Relevant photographs from the site walk-over survey are located in Appendix IV.

2.2.2 Hazardous Materials Storage

In the northern extent of the site was a green above ground storage tank (Photograph 5) approximately 1.50x1.50x1.50m. There was no visual evidence that the tank was leaking and no staining on the floor, however a tar like substance was noted with the pipe exiting the tank.

2.2.3 Potential Asbestos Containing Material (PACM)

The exact ages of the demolished buildings is unknown, but they are considered to pre-date the year 2000 as historical mapping denotes a residential house and outbuilding from 1896- 2020. As such, they were considered to have the potential to contain Asbestos Containing Materials (ACMs) within the building fabric. It was noted in the site walkover that mixed stockpiles from what is assumed the previous building is still on-site, and therefore it is considered that the stockpiles of demolition rubble have the potential to contain Asbestos Containing Materials. It is therefore recommended that the material within the stockpiles is classified prior to the commencement of site works and further testing is required for potential ACMs.

2.2.4 Waste Storage

Within the north-western corner of the site were three (3no.) presumably fly-tipped disused fridges (Photograph 2) and within the centre of the site an approximately 10.0x3.0x2.0m pile of demolition rubble (Photograph 3) which is presumed to be from the residential house from historical mapping. The demolition rubble contained glass, brick, concrete, and metal and overgrown with grass.

In the centre of the northern extent of the site was a stockpile of metal (Photograph 4). This was rusted, and staining was noted on the hardcore tarmac floor from previous burning. The pile of metal contained metal racking, corrugated iron roofing approximately 5.00x2.00x2.00m.

2.2.5 Tree Species

At the time of the site walkover the site was overgrown with bushes, weeds, long grass and had multiple coniferous trees on the western boundary of the site, these were noted to be approximately 8.00m tall. Additional coniferous and deciduous trees were scattered around the site.

2.2.6 Potential Invasive Species

During the site walkover no obvious signs of potential invasive species were identified.

2.3 Surrounding Area

The surrounding land uses are summarised in Table 2-2 below:

Table 2-2 Land Use

Direction	Land Use
North	Covered reservoir Telegraph Road, with residential housing beyond.
East	Dense coniferous woodland
South	Covered reservoir beyond which is dense woodland, golf course and residential housing.
West	Moorhill Road, with residential housing beyond.

3 SITE HISTORY

3.1 Site History

A review of historical land use pertinent to the site and within a 250m radius is summarised in Table 3-1.

Table 3-1 Historical Land Use

Map Edition	Historical Land Use	
	On Site	Off Site
1868-1869 (1:10,560) (1:2,500)	Site is entirely occupied by undeveloped with coniferous trees. An access track runs west to east along the southern boundary. The southwest corner of the site is deciduous woodland.	The immediate area around the site is mapped as predominately undeveloped land, with to the south and coniferous forests immediately to the north and east. A residential house with five (5no.) associated buildings on the southern boundary on the site. Residential housing from 181m north and from 26m west. A well is noted 53m west and 119m northwest.
1896-1871 (1:10,560 -Partial mapping) (1:2,500)	The site occupied with a residential house denoted 'Fir Cottage' in the northwest of the site with an additional associated building in the centre of the northern extent. The eastern of the site is denoted as coniferous woodland. An assumed greenhouse is located within the southern extent, and a single structure within the south-eastern corner. These are both assumed to be associated with the residential development to the south.	Gravel pits located 111m and 178m north. Pump noted 143m south.
1895-1910 (1:2,500) (1:10,560)	No significant change.	The gravel pit 111m north has been extended to the south, and now is located 81m north. Additional gravel pit 227m north.
1932-1938 (1:10,560)	Partial mapping, no mapping across the site, mapping only shows from 273m west.	Partial mapping, no mapping across the site, mapping only shows from 273m west.

Map Edition	Historical Land Use	
	On Site	Off Site
1940-1950 (1:2,500- Partial mapping) (1:10,560)	No significant change.	Reservoir 24m southwest. Gravel pit 62m northeast. Gravel pit 81m north infilled, coniferous woodland present within the gravel pit. Unspecified tank 108m south. Increase in residential development to the west and north.
1951-1959 (1:2,500-Partial mapping) (1:10,560- Partial mapping)	Additional access added in the northwest corner connection the two buildings along the northern boundary. Structures within the south are no longer depicted on mapping.	Additional residential development to the west. Gravel pit 227m north no longer depicted on mapping.
1962-1967 (1:2,500) (1:10,560)	Outbuilding present on the track of the southern boundary. .	Drain noted 185m northeast, running west to east. Tank 7m southeast and 250m northeast. Gravel pit 18m northeast are no longer present.
1970-1978 (1:10,000) (1:2,500-Partial mapping)	No significant change.	Reservoir on the southern boundary of the site. Electrical substation 40m southwest. No gravel pits present.
1987 (1:10,000)	No significant change.	Reservoir north of the northern boundary of the site. This appears to contain water.
1993 (1:10,000) (1:1,250)	No significant change.	Reservoir to the south depicted as 'covered'.
2001 (1:10,000)	No significant change.	Gravel pit 227m northeast no longer present.
2003 (1:10,000)	No significant change.	Reservoir southwest, now replaced with residential housing.
2010 (1:10,000)	No significant change.	No significant change.
2020 (Aerial Photograph)	Residential house and outbuildings demolished.	No significant change.
2022 (1:10,000)	No significant change.	No significant change.

A selection of historical maps are presented in Appendix V.

3.2 Historical Tank Database

The Groundsure Report identified one (1no.) records of historical tanks within 250m of the study site. The one (1no.) record relating to a single tank located approximately 108m southeast of the site which was identified on historic mapping dated from 1940.

3.3 Historical Energy Features Database

The Groundsure Report identified two (2no.) historical energy features within a 250m radius of the subject site.

- 35-40m southwest – Electricity Substation (1970-1993), shown on historical mapping from 1970; and,
- 212m west – Electricity Substation (1955).

Due to the distance and groundwater flow direction being away from the site in a westerly direction towards the river Itchen and the low mobility of PCBs, the identified electricity sub stations are not considered to have the potential to impact the subject site and have therefore not been considered further.

3.4 Historic Garages and Petrol Stations

The Groundsure Report did not identify any historical petrol stations or historical garages within a 250m radius of the site.

3.5 Historic Industrial Land Uses

The Groundsure Report identified fourteen (14no.) records of historical industrial land uses within 250m of the study site, upon further review these relate to seven (7no.) separate historical land uses.

The identified land uses are:

- 23-27m southwest – Unspecified Heap (2 records) – (1957);
- 50-54m northeast – Gravel Pit (3 Records) – (1957);
- 82m north – Unspecified Pit (2 Records) – (1967-1993);
- 83-115m north – Gravel Pits (3 Records) – (1895-1993);
- 130m north – Unspecified Tank (2 Records) – (1977-1993);
- 184m north – Gravel Pits – (1897); and,
- 218-263m northeast - Gravel Pits (2 Records) – (1897-1957).

Due to the distance from site, the expected groundwater flow direction and the industrial use profiles, the unspecified tank is not considered to have the potential to impact the subject site and have therefore not been considered further.

3.6 Planning History

A review of the online planning portal of Eastleigh Borough Council identified five (5no.) planning applications attributed to the site postcode.

Numerous applications relate to Tree Protection Orders (TPO) and extensions, with any pertinent information summaries below. All application for tree works on TPO's were granted or withdrawn by the applicant.

No environmental conditions were places on the applications for the extensions.

One (1no.) application was the current planning permission held for a replacement dwelling, under the local authority reference [F/20/87694](#).

3.7 Unexploded Ordnance Risk Assessment

A review of publicly available information (provided by Zetica UXO) shows the site as having a 'low risk' associated with bombing density and bomb risk.

The site is consequently considered **Low Risk** with regards to unexploded ordnance.

4 ENVIRONMENTAL SETTING

4.1 Geology and Hydrogeology

British Geological Survey Map (Sheet 315, Southampton, Solid and Drift Edition at a scale of 1:50,000, 1987) indicates that the site is underlain by the following geological sequence:

Table 4-1 Geology

Geological Unit	Formation Name	Description	Aquifer Classification
Superficial	River Terrace Deposits	Sand & Gravel	Secondary A
Bedrock	Wittering Formation	Sand, silt and clay	Secondary A

The Groundsure report records no data for Artificial and Made Ground on the proposed site. Made Ground, landscaped ground and reclaimed ground were not identified within 250m of the site. The closest Made Ground being 304m north of the site.

Review of the environmental database indicates that the site is not located within a groundwater Source Protection Zone. There are no active or historical water abstractions located within 250m of the site. The closest active groundwater abstraction is located 1012m northeast. There are no active or historical potable water abstractions located within 250m of the site.

Groundwater vulnerability data indicates that the site is underlain by a Superficial Secondary A Aquifer with medium vulnerability, as well as a Secondary A Aquifer with medium vulnerability within the bedrock.

Based on local topography and the location of surface watercourses, it is considered that shallow groundwater, if present, will follow local topography and flow away from site in a westerly direction towards The River Itchen.

4.1.1 Groundwater Flooding

The Groundsure report indicates that the site is at low risk of groundwater flooding, with land within 50m north of the site having a low risk.

4.2 Hydrology and Flooding

The Groundsure report identifies three (3no.) inland watercourses within 250m of the site (two located 153-169m southeast and one located 178m northeast of the site). These are all unaffected by tidal action. Historical maps indicate these watercourses to be drainage pathways and attributed to the reservoirs.

Two (2no.) surface water body catchments were recorded onsite, noted as a costal catchment for both The River Itchen and East Hampshire Rivers. The southeast Hampshire Group was noted as

having chemical and ecological ratings of 'poor' and 'good' respectively, with an overall rating of 'poor' measured in 2016 by the Environment Agency.

No surface water abstraction licences were identified on-site or within a 250m radius.

The Groundsure Report identified the site to be within an area of both low risk of river and coastal flooding and negligible risk of surface water flooding.

4.3 Geotechnical Data

Geotechnical Data presented within the Groundsure Report identifies the following potential ground hazards which are summarised in Table 4-2 below:

Table 4-2 Geotechnical Data

Hazard	Designation
Shrink-Swell Clay	Moderate- Ground conditions predominantly high plasticity.
Landslides	Very Low- Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.
Ground Dissolution	Negligible- Deposits with potential to collapse when loaded and saturated are unlikely to be present.
Compressible Ground	Negligible- Compressible strata are not thought to occur.
Collapsible Deposits	Very Low- Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present.
Running Sand	Very Low- Running sand conditions are unlikely.

4.4 Mining and Ground Workings

The site is not located within an area that is affected by coal mining and therefore no Coal Authority mining report was obtained for the purposes of this report.

BritPits, which is a database containing information of active and closed surface and underground mineral workings, detailed two (2no.) records of pits. These are located 136m and 208m north, both named as Telegraph Wood Gravel Pit.

There are no active records of mining within 500m of the site however the Groundsure identified twenty-five (25no.) records exist for historic surface ground workings within 250m of the study site, which relate to eight (8no.) different uses, summarised below:

- 6m north - Reservoir (2 records) - (1987-1993); *-this source is still current, the date relate to the covering of the reservoir.*
- 11m south - Reservoir (3 records) - (1977-1993); *-this source is still current, the date relate to the covering of the reservoir.*
- 18-30m southwest – Reservoirs (3 records) – (1977-1993);
- 23-30m southwest - Unspecified Heap (3 records) - (1957);
- 50-54m northeast - Gravel Pit (3 records) – (1957);

- 82m north - Unspecified Pit (4 records) – (1967-1993);
- 83-184 north - Gravel Pits (4 records) – (1895-1910); and,
- 218m northeast – Gravel Pits (3 records) – (1957).

4.5 Radon Risk Potential

The site lies within an area where less than 1% of the properties are above the Action Level. At these levels BRE publication BR211 indicates that no special radon protective measures are required in the construction of new extensions or dwellings.

4.6 Current Industrial Land Uses

The Groundsure Report identified seven (7no.) current industrial land uses within a 250m radius of the subject site:

- 6m north - Reservoir (Current);- *this feature is currently active, filled with water and maintained therefore is not considered to pose a significant risk and therefore will not be considered further.*
- 11m south - Reservoir (Current);- *this feature is currently active, filled with water and maintained therefore is not considered to pose a significant risk and therefore will not be considered further.*
- 26m southwest - Pumping Station;- *this feature was identified within the site walkover as a control building for the covered reservoir.*
- 38m southwest - Electrical Substation;
- 91m southeast – Pylon- *After review this feature is not considered to pose a significant risk and therefore will not be considered further;*
- 93m south – Mast – *After review this feature is not considered to pose a significant risk and therefore will not be considered further;*
- 144m south – J P Appliances and Aztec Appliances – *After review it is a repair service operating as a home call out business and therefore is not considered to have the potential to pose a significant risk and will not be considered further;* and,
- 215m west – Electrical substation.

As set out in Section 3.3, due to the distance and direction from the site and the low mobility of PCBs, the identified electricity sub stations are not considered to have the potential to impact the subject site and have therefore not been considered further.

4.7 Sensitive Land Uses

The Groundsure report indicates that the site is located within a currently defined Nitrate Vulnerable Zone (NVZ) associated with the Hamble Estuary.

The Groundsure report also identified the site to be within a SSSI Impact Risk Zone.

4.7.1 Sites of Special Scientific Interest (SSSI) Impact Risk Zones

The Groundsure Report identified that the site is located within an SSSI Impact Risk Zone associated with Moorgreen Meadows.

The Groundsure Report states that any discharges of water or waste to ground or a surface watercourse require consultation, and it is recommended that contact should be made with a suitably qualified planning consultant for further information.

4.7.2 Nitrate Vulnerable Zone (NVZ)

The site lies within the Hamble Estuary Eutrophic Nitrate Vulnerable Zone and due to site lying within a SSSI Impact Risk Zone, the nutrient contents of all discharges, including those to the main sewer, need to be considered in combination for impacts on the surrounding area and Solent Water.

It is considered likely that a nitrate balance report will be required as part of the planning application to assess the potential risk posed from the proposed development on nitrates entering surrounding waters.

4.8 Site Sensitivity Assessment

Based on the information presented in the sections above, the site is considered as being located within a Low-Moderate sensitivity setting due to the following reasons:

- Underlying Secondary A Aquifer within superficial strata and bedrock;
- Geological mapping indicates granular deposits for both superficial deposits and bedrock deposits beneath the site;
- Site located within a SSSI impact risk zone (Moorgreen Meadows);
- Site is within a Nitrate Vulnerable Zone (NVZ); and,
- Moderate groundwater flooding risk.

5 CONSULTATIONS

5.1 Contaminated Land Officer

Contact was made with Eastleigh Borough Council via email in June 2022 regarding whether the council were aware of any environmental issues pertaining to the site.

A response was received stating that there are no entries in the register maintained under S.78 R (1) of the Environmental Protection Act 1990 regarding the site.

5.2 Landfill and Waste Treatment Sites

The Groundsure Report identified no records of historic landfill sites or historic waste treatment sites within 250m of the subject site.

The Groundsure Report identified no active or recently closed licensed waste sites within 250m of the site boundary.

5.3 Potentially Infilled Land

The Groundsure report identified no areas of infilled land within 250m of the site. However, a review of Section 4.4 and historical maps indicates historical ground workings that have the potential to have been infilled as listed below:

- 6m north - Reservoir (2 records) - (1987-1993); *-this source is still current; the dates relate to the covering of the reservoir.*
- 11m south - Reservoir (3 records) - (1977-1993); *-this source is still current; the dates relate to the covering of the reservoir.*
- 18-30m southwest – Reservoirs (3 records) – (1977-1993);
- 23-30m southwest - Unspecified Heap (3 records) - (1957);
- 50-54m northeast - Gravel Pit (3 records) – (1957);
- 82m north - Unspecified Pit (4 records) – (1967-1993);
- 83-184 north - Gravel Pits (4 records) – (1895-1910); and,
- 218m northeast – Gravel Pits (3 records) – (1957).

5.4 Regulatory Database

The following information has been obtained from a commercially available environmental database. The summary table (Table 5-1) only includes records not otherwise detailed in the report. Where more than two entries have been identified, the Table summarises the closest two entries to the site.

Table 5-1 Summary of Groundsure Data

	0-249m	250-500m	Details
Sites Determined as Contaminated Land	0	0	N/A
Control of Major Accident Hazards (COMAH)	0	0	N/A
Regulated Explosive Sites	0	0	N/A
Hazardous substance storage/usage	0	0	N/A
Historical licensed Industrial Activities (IPC)	0	0	N/A
Licensed Industrial Activities (Part A(1))	0	0	N/A
Licensed Pollutant Release (Part A(2)/B)	0	0	N/A
Radioactive Substance Authorisations	0	0	N/A
Licensed discharges to controlled waters	0	2	276m South – Sewage discharges into unnamed land (No longer active, revocation in 1989) 421m south – sewage discharges into unnamed land (no longer active, revocation in 1978)
Pollutant release to surface water (Red List)	0	0	N/A
Pollutant Release to public sewer	0	0	N/A
List 1 Dangerous Substances	0	0	N/A
List 2 Dangerous Substances	1	3	N/A
Pollution Incidents (EA/NRW)	0	0	N/A
Pollution Inventory Substances	0	0	N/A
Pollution Inventory Waste Transfers	0	0	N/A
Pollution Inventory Radioactive Waste	0	0	N/A

6 CONCEPTUAL SITE MODEL (CSM)

6.1 Initial CSM

In accordance with Environment Agency, CLR 11 (2004) and BSI 10175 (Code of Practice for Investigation of Potentially Contaminated Land), Omnia Environmental Consulting have developed an initial CSM to identify potential contamination sources, migration pathways and receptors within the study area. A residential end use has been adopted given the proposed site development.

6.1.1 On-site Potential Sources

- Made Ground associated with historical development of the site;
- Onsite Burning (Historic) – *Identified within the site walkover; and,*
- Metal Tank (Current) – *Identified within the site walkover.*
- *Waste stock Piles, presumed building demolition rubble and stockpile of waste metal*

6.1.2 Off-site Potential Sources

- 6m south – Electrical Substation (Current) – *Identified within Site Walkover;*
- 23-30m southwest - Unspecified Heap (Historic);
- 26m southwest- Pump station (Current);
- 30m southwest – Reservoir (1940-2003);
- 50-218m northeast and 83-184m north - Gravel Pits (Historic);
- 82m north – Unspecified Pit (Historic);
- 130m north – Unspecified tank (Historic).

6.1.3 Potential Pathways

- Inhalation and ingestion of impacted soils and dusts;
- Dermal contact with impacted soils;
- Inhalation of vapours;
- Vertical and lateral migration; and,
- Migration of gas into confined spaces.

6.1.4 Potential Receptors

- Future Site Users.
- Controlled Waters
 - Groundwater in underlying Secondary A Aquifer
 - Inland watercourses within 250m of the site (two located 153-169m southeast and one located 178m northeast of the site).

Construction workers are not considered to be a plausible receptor due to management of their exposure through the use of suitable PPE and hygienic working practices as required under HSE/CDM regulations. Furthermore, the length of any exposure is considered to be very short in comparison to the criteria for which the adopted end use has been derived. An Initial Conceptual Site Model has been prepared for the site and is presented overleaf within Table 6-1.

Table 6-1 Initial Conceptual Site Model

Source	Contaminant	Potential Migration Pathway	Potential Receptors	Likelihood of Occurrence	Magnitude of Occurrence	Overall Risk Rating	Active/Inactive
On-Site Potential Sources							
Made Ground associated with historical development of the site	Ground Gas (CO ₂ , CH ₄)	Vertical and lateral migration into confined spaces	Future site users	Low	Severe	Low/Moderate	Potentially Active – Phase II Investigation Required (See Section 7). Gas Monitoring being undertaken (See Section 8.3.4)
	Metals (As, B, Cd, Cr, Pb, Hg, Se, Ni, Zn)	Ingestion of impacted soils and dust	Future site users	Moderate	Moderate	Moderate	Potentially Active – Phase II Investigation Required (See Section 7).
		Vertical and lateral migration	Controlled Waters	Moderate	Minor	Low/Moderate	
	Total Petroleum Hydrocarbons (TPH)	Ingestion of impacted soils and dust	Future site users	Moderate	Moderate	Moderate	
		Vertical and lateral migration	Controlled Waters	Low	Minor	Low/Moderate	
	Polycyclic Aromatic Hydrocarbons (PAH)	Ingestion of impacted soils and dust	Future site users	Moderate	Moderate	Moderate	
		Vertical and lateral migration	Controlled Waters	Low	Minor	Low/Moderate	
	Asbestos	Inhalation of fibres	Future site users	Moderate	Moderate	Moderate	

Source	Contaminant	Potential Migration Pathway	Potential Receptors	Likelihood of Occurrence	Magnitude of Occurrence	Overall Risk Rating	Active/Inactive
On-site Burning	Total Petroleum Hydrocarbons (TPH)	Ingestion of impacted soils and dust	Future site users	Low	Moderate	Low/Moderate	Potentially Active – Phase II Investigation Required (See Section 7).
		Vertical and lateral migration	Controlled Waters	Low	Minor	Low/Moderate	
	Polycyclic Aromatic Hydrocarbons (PAH)	Ingestion of impacted soils and dust	Future site users	Moderate	Moderate	Moderate	
		Vertical and lateral migration	Controlled Waters	Low	Minor	Low/Moderate	
Metal above ground storage tank (AST)	Total Petroleum Hydrocarbons (TPH)	Ingestion of impacted soils and dust	Future site users	Moderate	Moderate	Low/Moderate	Potentially Active – Phase II Investigation Required (See Section 7).
		Vertical and lateral migration	Controlled Waters	Low	Minor	Low/Moderate	
Off-Site Potential Sources							
Electrical Substation 6m south (Current)	Polychlorinated Biphenyls (PCBs)	Lateral Migration	Future site users	Low	Moderate	Low/Moderate	Potentially Active – Phase II Investigation Required (See Section 7).
23-30m southwest - Unspecified Heap (1967-1993)	Ground Gas (CO ₂ , CH ₄)	Vertical and lateral migration into confined spaces	Future site users	Moderate	Severe	High	Inactive – Due to the source being a heap, it is considered that ground gas would vent freely and not migrate. In addition due direction of the source, and the anticipated groundwater flow it is considered unlikely to pose a potential risk for the future site users.
	Metals (As, B, Cd, Cr, Pb, Hg, Se, Ni, Zn)	Lateral Migration	Future site users	Low	Moderate	Low/Moderate	
		Vertical and lateral migration	Controlled Waters	Low	Minor	Low/Moderate	

Source	Contaminant	Potential Migration Pathway	Potential Receptors	Likelihood of Occurrence	Magnitude of Occurrence	Overall Risk Rating	Active/Inactive
	Total Petroleum Hydrocarbons (TPH)	Lateral Migration	Future site users	Low	Moderate	Low/Moderate	
		Vertical and lateral migration	Controlled Waters	Low	Minor	Low/Moderate	
	Polycyclic Aromatic Hydrocarbons (PAH)	Lateral Migration	Future site users	Low	Moderate	Low/Moderate	
		Vertical and lateral migration	Controlled Waters	Low	Minor	Low/Moderate	
	Asbestos	Lateral Migration	Future site users	Low	Moderate	Low/Moderate	
	Total Petroleum Hydrocarbons (TPH)	Lateral Migration	Future site users	Low	Moderate	Low/Moderate	
		Vertical and lateral migration	Controlled Waters	Low	Minor	Low/Moderate	
	Polycyclic Aromatic Hydrocarbons (PAH)	Lateral Migration	Future site users	Low	Moderate	Low/Moderate	
		Vertical and lateral migration	Controlled Waters	Low	Minor	Low/Moderate	
50-218m northeast and 83-184m north Gravel Pit (1895-1993)	Ground Gas (CO ₂ , CH ₄)	Vertical and lateral migration into confined spaces	Future site users	Moderate	Severe	High	Potentially Active – Phase II Investigation Required (See Section 7).
	Metals (As, B, Cd, Cr, Pb, Hg,	Lateral Migration	Future site users	Low	Moderate	Low/Moderate	Inactive – Due to the direction of the potential source away from site and

Source	Contaminant	Potential Migration Pathway	Potential Receptors	Likelihood of Occurrence	Magnitude of Occurrence	Overall Risk Rating	Active/Inactive
	Se, Ni, Zn)	Vertical and lateral migration	Controlled Waters	Low	Minor	Low/Moderate	the anticipated groundwater flow, it is considered unlikely to pose a potential risk for the future site users.
	Total Petroleum Hydrocarbons (TPH)	Lateral Migration	Future site users	Low	Moderate	Low/Moderate	
		Vertical and lateral migration	Controlled Waters	Low	Minor	Low/Moderate	
82m north Unspecified Pit (1967-1993)	Ground Gas (CO ₂ , CH ₄)	Vertical and lateral migration into confined spaces	Future site users	Moderate	Severe	High	Potentially Active – Phase II Investigation Required (See Section 7).
	Metals (As, B, Cd, Cr, Pb, Hg, Se, Ni, Zn)	Lateral Migration	Future site users	Low	Moderate	Low/Moderate	Inactive – Due to the direction of the potential source away from site and the anticipated groundwater flow, it is considered unlikely to pose a potential risk for the future site users.
		Vertical and lateral migration	Controlled Waters	Low	Minor	Low/Moderate	
	Total Petroleum Hydrocarbons (TPH)	Lateral Migration	Future site users	Low	Moderate	Low/Moderate	
		Vertical and lateral migration	Controlled Waters	Low	Minor	Low/Moderate	
130m north Unspecified Tank (1977-1993)	Total Petroleum Hydrocarbons (TPH)	Lateral Migration	Future site users	Low	Moderate	Low/Moderate	Inactive – Due to the direction of the potential source away from site and the anticipated groundwater flow, it is considered unlikely to pose a potential risk for the future site users.
		Vertical and lateral migration	Controlled Waters	Low	Minor	Low/Moderate	

7 SITE INVESTIGATION

7.1 General

A ground investigation was designed based on your requirements and the proposed site development as shown in Figure 2.0 (Appendix III).

Following completion of the desk study and a review of the available data, ground investigation works were required on site to investigate the potential for impacted materials to be present on-site from identified on-site and nearby off-site potential sources.

Exploratory fieldwork was conducted over two (2no.) working days, commencing on 25th May 2022 and comprised the following:

Table 7-1 Site Investigation Summary

Potential Source/Rationale	Location Hole	Type	Maximum Depth (m bgl)	Borehole Response Zone (m bgl)
To investigate any spill from the tank identified within the site walkover.	HP101	Hand Pit	0.60	N/A
Locations for the assessment of drainage conditions of shallow soils to facilitate soakaway design. To allow the assessment of potential contamination and to gather information on geotechnical characterisation of the soil and collection of chemical and geotechnical samples.	SA101	Machine Excavated Trial Pit	2.30	
Locations for the assessment of drainage conditions of shallow soils to facilitate soakaway design. To allow the assessment of potential contamination from the stockpile of mixed rubble from the previous residential house and to gather information on geotechnical characterisation of the soil and collection of chemical and geotechnical samples.	SA102		1.60	
Locations for the assessment of drainage conditions of shallow soils to facilitate soakaway design. To allow the assessment of potential contamination from the stock pile of metal and to gather information on geotechnical	SA103		2.60	

Potential Source/Rationale	Location Hole	Type	Maximum Depth (m bgl)	Borehole Response Zone (m bgl)
characterisation of the soil and collection of chemical and geotechnical samples.				
To undertake additional soakaway testing in in full accordance with BRE DG365 – <i>Soakaway Design</i> , in locations specified by the drainage engineer.	SA201		1.70	N/A
	SA202		1.70	
	SA203		1.80	
	SA204		2.10	
With locations targeting below the proposed footprint of the development onsite to allow the assessment of potential contamination and to gather information on geotechnical characterisation of the soil and collection of chemical and geotechnical samples.	WS101	Window Sampling	2.00	1.00-2.00
	WS102		1.70	N/A
To allow the assessment of potential contamination from the tank identified within the site walkover and to gather information on geotechnical characterisation of the soil and collection of chemical and geotechnical samples.	WS105		2.10	
To allow the assessment of potential contamination and to gather information on geotechnical characterisation of the soil and collection of chemical and geotechnical samples.	WS103		2.00	1.00-2.00
To allow the assessment of potential contamination from the stockpile of mixed rubble from the previous residential house and to gather information on geotechnical characterisation of the soil and collection of chemical and geotechnical samples.	WS104		1.30	0.60-1.30
Targeted below the proposed roads, used for derivation of in-situ California Bearing Ratios use to facilitate road pavement design	DCP101	Dynamic Cone Penetrometer	0.86	N/A
	DCP102		0.86	
	DCP103		0.86	
	DCP104		0.34	
	DCP105		0.87	

The exploratory hole locations are illustrated on Figure 3.0 (Appendix III). The ground conditions encountered are indicated on the exploratory hole logs, which are provided in Appendix VI.

7.2 Laboratory Analysis

Selected soil samples were submitted for a range of chemical analysis including:

- CLEA Metals;
- Asbestos fibres in soil;
- Speciated Polycyclic Aromatic Hydrocarbons (PAHs);
- Banded Gasoline Range Organics (GRO);
- Banded Extractible Petroleum Hydrocarbons (TPHs);
- Total Cyanide;
- PH;
- Phenols; and,
- Polychlorinated Biphenyls (PCBs).

Element Materials Technology of Deeside undertook the analytical work in accordance with UKAS accreditation where applicable and the laboratory analysis certificates are presented as Appendix VII and discussed in Section 9.

Selected soil samples were submitted to I2 Analytical for a range of geotechnical testing, in accordance with UKAS methodology where applicable, comprising:

- Moisture Content;
- Atterberg Limit Testing;
- Partial Size Distribution (PSD) Wet Sieve;
- PH; and,
- Water Soluble Sulphate (2:1).

The geotechnical analysis certificates are presented in Appendix IX.

7.3 Ground Gas and Groundwater Monitoring

Concentrations of methane (CH₄), carbon dioxide (CO₂) and oxygen (O₂) were measured using an infrared gas analyser (GA5000), calibrated to a reference standard (before and after each survey) and gas flow rates were measured using an internal flow pod.

Gas concentrations were recorded at thirty second intervals until gas concentrations stabilised for three (3no.) consecutive readings (a minimum of ninety seconds) at each location, at which point the maximum concentrations of CH₄ and CO₂, together with the lowest concentration of O₂ were recorded.

Groundwater monitoring was undertaken using an electronic dip tape to record the depth to groundwater. Ground gas and groundwater results are presented in Section 8.3.4 and discussed in Section 9.

8 GROUND AND GROUNDWATER CONDITIONS

8.1 Summary of Ground Conditions

The published British Geological Survey (BGS) map for the site (Sheet 315, Southampton, Solid and Drift Edition at a scale of 1:50,000, 1987) indicates that the superficial geology on-site comprises River Terrace Deposits of sand and gravel overlying bedrock deposits of the Wittering Formation across the entire site.

Geology encountered on site generally corresponds with that highlighted within published BGS Mapping and the findings have been outlined below.

8.1.1 Made Ground

Made Ground was encountered within four (4no.) intrusive location (SA101, SA202-SA204) and generally comprised grass over reddish brown slightly silty gravelly fine to coarse SAND with frequent rootlets. Gravel was angular to subrounded fine to coarse flint, brick, concrete, and tile.

The Made Ground encountered within SA203 consisted of 200mm of Reddish brown and grey Type 1 concrete crush.

Made Ground was encountered to a maximum depth of 0.60m bgl within SA204.

8.1.2 Topsoil

Topsoil was encountered within nine (9no.) intrusive locations, and generally comprised grass over dark brown gravelly fine SAND. Gravel was subangular to rounded fine to medium flint. Topsoil was encountered to a maximum depth of 0.60m bgl.

8.1.3 Superficial Deposits

8.1.3.1 River Terrace Deposits

Superficial deposits were encountered within all thirteen (13no.) intrusive locations and generally comprised orangish brown slightly clayey gravelly fine to medium SAND. Gravel was subangular to subrounded fine to medium flint.

Within five (5no.) intrusive locations (SA101, SA103, WS101, WS105 and SA202) the superficial deposits comprised soft orange gravelly sandy CLAY/SILT. Sand was coarse, gravel was subangular to subrounded fine to coarse flint; and within one (1no.) intrusive location (SA101) and comprised soft orange mottled blueish grey CLAY.

The base of the superficial deposits was not proven by the intrusive investigation.

8.1.4 Groundwater Conditions

Groundwater strikes were encountered during works in one (1no.) location only, as summarised in Table 8-1.

Table 8-1. Summary of Groundwater Conditions

Location	Depth (m bgl)	Strata	Type of Water Strike
SA103	2.60	River Terrace Deposits	Seepage

8.2 Laboratory Classification Analysis

Soil classification testing, including Atterberg Limits, Moisture Content, Particle Size Distribution and pH and Sulphate results are summarised in Table 8-2 – Table 8-5 with analysis certificates presented in Appendix VIII.

8.2.1 Soil Plasticity

Five (5no.) samples taken from cohesive deposits across the site were submitted to the laboratory for laboratory plasticity analysis. The results of this analysis have been summarised in Table 8-2 below.

Table 8-2. Summary of Soil Plasticity

Location	Depth (m bgl)	Geology	Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Percentage passing 425µm sieve (%)	Modified Plasticity Index	Plasticity	Volume Change Potential
SA101	0.40-0.50	Brown very gravelly slightly sandy CLAY	12	48	24	24	34	8	Medium	low
SA101	2.00-2.30	Yellowish brown CLAY	30	86	32	54	100	54	High	High
SA103	0.70-0.80	Yellowish brown slightly gravelly sandy CLAY	11	35	16	19	81	15	Low	Medium
WS101	0.50-0.80	Brown gravelly very sandy CLAY	17	34	24	10	41	4	Low	Low
WS102	1.30-1.50	Yellowish brown slightly sandy CLAY	20	47	21	26	100	26	Medium	Medium

The results presented in Table 8-2 indicate that the plasticity of the clay present on site is Low to High. The volume change potential generally ranges from low to high.

8.2.2 Particle Size Distribution Analysis

Two (2no.) soil samples were submitted to the laboratory for Particle Size Distribution (PSD) analysis, with the results presented below in Table 8-3. The results are consistent with the on-site observations and descriptions.

Table 8-3. Summary of Particle Size Distribution

Location	Depth (m bgl)	Granulometric Composition (%)					
		Laboratory Description	Fines (<0.063mm)		Sand	Gravel	Cobbles
			Clay	Silt			
SA101	1.90-2.00	Yellowish brown slightly silty, clayey, sandy GRAVEL	9	6	21	64	0
SA103	1.10-1.30	Yellowish brown slightly clayey, silty, very sandy GRAVEL	3	10	42	45	0

8.2.3 Moisture Content

Seven (7no.) samples taken from deposits across the site were submitted to the laboratory for moisture content analysis. The results of this analysis have been summarised in Table 8-4 below.

Table 8-4. Summary of Moisture Content

Location	Depth (m bgl)	Natural Moisture Content (%)	Lab Description
SA101	1.90-2.00	8.6	Brown clay and loam with gravel and vegetation
SA101	2.00-2.30	17	Brown clay and loam
SA103	1.10-1.30	12	Brown sand with gravel
WS101	0.50-0.80	14	Brown clay and loam with gravel and vegetation
WS102	0.10-0.20	25.5	Brown soil/stones
	1.30-1.50	12	Brown clay and sand
WS105	0.40-0.60	11.1	Brown soil/stones

8.2.4 pH and Sulphate

Chemical analysis for pH and soluble sulphate content are summarised in Table 8-5 below with analysis certificates presented as Appendix VII and IX.

Table 8-5. Summary of pH and Sulphate Data

Location	Depth (m bgl)	SO ₄ in 2:1 water / soil (mg/l)	pH Value
HP101	0.20-0.30	11.3	4.56
SA101	0.10-0.20	8.4	7.91
	1.90-2.00	67	7.2
	2.00-2.30	36	5.2
SA102	0.40-0.60	9.4	4.96
SA103	1.10-1.30	29	4.9
WS101	0.30-0.50	26.3	6.68
	0.50-0.80	19	7.7
WS102	0.30-0.50	4.39	5.02
	1.30-1.50	4.3	4.7
WS103	0.90-1.00	87.9	4.36
WS104	0.10-0.20	9.6	6.17
WS105	0.40-0.60	38.3	7.58

Due to the size of the dataset (>10 samples), characteristic pH and SO₄ values were calculated using the highest 20% measured sulphate concentrations and the lowest 20% measured pH value as stated in the BRE Special Digest (2005) producing a site characteristic value for sulphate of 64.4mg/l and a pH value of 4.54.

Soils encountered beneath the site have been classified in accordance with DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-3z for brownfield locations with the recommendations provided in BRE Special Digest 1 (2005).

8.3 In-Situ Testing

8.3.1 Standard Penetration Tests (SPT)

Standard Penetration Tests (SPT) were carried out in all windowless sampling boreholes in accordance with techniques outlined in BS1377, to assess the strength/density of the underlying strata. The 'N' value (number of blows per 300mm penetration) was recorded for each test. The results of these in-situ tests, including full blow counts, are presented on the borehole logs within Appendix VI.

8.3.2 Dynamic Cone Penetrometer (DCP) Testing

In-situ California Bearing Ratio (CBR) values for near surface strata were obtained via Dynamic Cone Penetrometer (DCP) testing and were undertaken at within locations DCP101 – DCP105 in areas of proposed access infrastructure, as presented on Figure 3.0, Appendix III. The results are summarised in Table 8-6 below with CBR values of underlying strata provided.

The DCP results sheets are included within Appendix IX. CBR results have been given from the blow counts across the strata tested, abnormally high blow counts are likely attributed from larger granular material within the strata and have been excluded as they are not considered to be representative.

Table 8-6. Summary of In-situ CBR Results

Location	Depth (mm bgl)	CBR Value (%)
DCP101	32-330	8.4
	330-600	20.3
	600-860	22.2
DCP102	21-140	17.4
	140-600	12.1
	140-862	44.7
DCP103	43-350	9.8
	350-610	7.6
	610-860	24.3
DCP104	28-110	22.4
	110-200	68.1
	200-341	34.3
DCP105	25-230	42.4
	230-640	32.0
	640-878	14.0

CBR values ranged from 7.6% to 68.1% between ground level and 878mm bgl. Using a conservative approach, a CBR value of 7.6% should be adopted across the site at this stage. Notwithstanding these results, confirmatory CBR testing should be carried out at formation level once details are finalised.

8.3.3 Soil Infiltration Testing – Falling Head Permeability Test

In-situ soil infiltration testing was undertaken in general accordance with BRE DG365 – *Soakaway Design* within the near surface at locations SA101-SA103 at a depths of 1.40-2.40m bgl during the initial intrusive investigation works undertaken in May 2022.

Additional soil infiltration testing was undertaken in full accordance with BRE DG365 – *Soakaway Design* within the near surface at locations SA201-SA104 at a depths of 1.70-2.10m bgl during the additional works undertaken in July 2022.

All soil Infiltration test certificates are presented as Appendix XI and summarised in Table 8-7 below.

Table 8-7. Summary of Soil Infiltration Testing

Location	Test	Pit Dimensions (L x W x D) (m)	Depth to fill (m bgl)	Strata Type	Duration of test (hrs:mm)	Soil Infiltrations Rate (m/s)
SA101	1*	2.10x0.55x2.00	1.30	Orange clayey gravelly SAND	24 Hours	1.83×10^{-6}
	2	2.10x0.55x2.00	0.88		5 hours 34 mins	Fail
SA102	1	2.15x0.50x1.60	0.60	Orange slightly clayey gravelly SAND	22 hours	3.25×10^{-6}
	2	2.15x0.50x1.40	0.45		6 hours 12 mins	Fail
SA103	1	2.70x0.50x2.40	1.54	Orange slightly	22 hours 25 mins	9.04×10^{-6}

Location	Test	Pit Dimensions (L x W x D) (m)	Depth to fill (m bgl)	Strata Type	Duration of test (hrs:mm)	Soil Infiltrations Rate (m/s)
	2	2.70x0.50x2.40	1.28	clayey gravelly SAND	6 hours 9 mins	7.91×10^{-6}
SA201	1	2.70x0.70x1.70	0.53	Orangish brown slightly silty	7 hours 30 mins	7.24×10^{-6}
	2	2.70x0.70x1.70	0.54	gravelly SAND and sandy	12 hours 40 mins	4.34×10^{-6}
	3	2.70x0.70x1.70	0.70	clayey GRAVEL	15 hours	3.82×10^{-6}
SA202	1	2.30x0.60x1.52	0.50	Orangish brown	2 hours 46 mins	1.71×10^{-5}
	2	2.30x0.60x1.52	0.35	slightly silty gravelly	4 hours 16 mins	1.17×10^{-5}
	3	2.30x0.60x1.52	0.55	SAND and sandy SILT	2 hours 36 mins	1.34×10^{-5}
SA203	1	2.30x0.70x1.83	0.90	Orange and dark brown	49 mins	6.31×10^{-5}
	2	2.30x0.70x1.83	0.58	slightly gravelly	40 mins	7.94×10^{-5}
	3	2.30x0.70x1.83	0.48	slightly silty SAND	54 mins	5.99×10^{-5}
SA204	1	2.60x0.80x1.94	0.91	Orangish brown silty	6 hours 21 mins	8.74×10^{-6}
	2	2.60x0.80x1.94	0.88	gravelly SAND and clayey	15 hours	3.59×10^{-6}
	3	2.60x0.80x1.94	0.90	sandy GRAVEL	22 hours 5 mins	2.52×10^{-6}

**Extrapolated data to provide an indicative soil infiltration rate only*

SA101-SA103

Test 1 within SA102 and Tests 1-2 within SA103 were considered successful as both the 25% and 75% effective storage depths were reached for each test, with infiltration rates provide above within Table 8-7 above. Due to the proximity of the results to the 25% depth intercept within Test 1 of SA101, the data has been extrapolated using a line of best fit for the linear part of the graph to provide an indicative soil infiltration rate. It should be noted that the infiltration rate for Test 1 of SA101 should be treated as indicative only and should not be used for design purposes.

The results of the soakaway tests are consistent with the encountered geology, with soakaway tests yielding soil infiltration rates ranging from 3.25×10^{-6} to 9.04×10^{-6} . By reference to published data (Carter & Bentley, 1981), the results are indicative of low to medium permeability and good drainage conditions.

The required 25% and 75% effective storage depth intercepts were not reached during Tests 2 of SA101 and SA102 and so the tests were considered to be unsuccessful and soil infiltration rates could not be calculated.

SA201-SA204

All three (3no.) tests within SA201-SA204 were considered successful as both the 25% and 75% effective storage depths were reached for each test, with infiltration rates provided above within Table 8-7 above.

The results of the soakaway tests are consistent with the encountered geology, with soakaway tests yielding soil infiltration rates ranging from 2.52×10^{-6} to 7.94×10^{-5} m/s. By reference to published data (Carter & Bentley, 1981), the results are indicative of low to medium permeability and good drainage conditions.

Based on the results presented above soils beneath the site may prove suitable for the adoption of conventional soakaway design. However, it is recommended that the calculated infiltration rates are provided to a suitability qualified drainage engineer. The application of soakaway drainage will ultimately be dependent on the specific requirements of the development. All soakaways should be designed in accordance with BRE Special Digest 365-Soakaway Design.

8.3.4 Ground Gas

A total of six (6no.) ground gas and groundwater monitoring visits have been undertaken across three (3no.) monitoring wells (WS101, WS103 and WS104) at the site. An initial three (3no.) visits were undertaken between 06/06/2022 and 22/06/2022 with an additional three (3no.) visits undertaken between 05/08/2022 and 16/08/2022. The results of the gas and groundwater monitoring are presented in Table 8-8 overleaf.

Table 8-8. Summary of Ground Gas and Groundwater Monitoring Results

Well	Date	CH ₄ Peak %v/v	CH ₄ Steady %v/v	CH ₄ GSV l/hr	CO ₂ Peak %v/v	CO ₂ Steady %v/v	CO ₂ GSV l/hr	O ₂ %v/v	Atmos (mb)	Atmos. Dynamic	Flow (l/hr)	Depth to Base (m bgl)	Depth to Water (m bgl)
WS101	06/06/2022	0.1	0.1	0.0001	8.2	6.2	0.0082	14.7	1015	Steady	<0.1	1.98	Dry
	13/06/2022	0.1	0.1	0.0001	8.7	8.0	0.0087	13.8	1018	Steady	0.1	2.00	Dry
	22/06/2022	<0.1	<0.1	0.0001	8.3	6.4	0.0083	14.6	1005	Steady	0.1	1.98	Dry
	05/08/2022	<0.1	<0.1	0.0001	4.3	3.4	0.0043	18.1	1016	Rising	0.1	1.98	Dry
	12/08/2022	<0.1	<0.1	0.0002	4.9	4.9	0.0098	17.6	1008	Falling	0.2	2.10	Dry
	16/08/2022	<0.1	<0.1	0.0001	4.6	1.7	0.0046	19.2	1011	Steady	<0.1	1.08	Dry
WS103	06/06/2022	0.1	0.1	0.0001	2.5	2.5	0.0025	18.9	1015	Steady	0.1	1.93	Dry
	13/06/2022	0.1	0.1	0.0001	2.7	2.7	0.0027	18.7	1018	Steady	0.1	1.95	Dry
	22/06/2022	<0.1	<0.1	0.0001	2.4	2.4	0.0024	19.1	1005	Steady	<0.1	1.94	Dry
	05/08/2022	<0.1	<0.1	0.0001	1.2	1.2	0.0012	20.1	1015	Rising	0.1	1.94	Dry
	12/08/2022	<0.1	<0.1	0.0002	1.1	1.1	0.0022	19.8	1008	Falling	0.2	1.92	Dry
	16/08/2022	<0.1	<0.1	0.0001	1.1	1.1	0.0011	20.5	1011	Steady	<0.1	1.85	Dry
WS104	06/06/2022	0.1	0.1	0.0001	2.0	1.9	0.0020	19.1	1015	Steady	0.1	1.12	Dry
	13/06/2022	0.1	0.1	0.0001	2.1	2.1	0.0021	19.1	1017	Steady	<0.1	1.11	Dry
	22/06/2022	<0.1	<0.1	0.0001	1.7	1.7	0.0017	19.0	1005	Steady	0.1	1.23	Dry
	05/08/2022	<0.1	<0.1	0.0001	1.0	1.0	0.0010	20.4	1015	Rising	0.1	1.23	Dry
	12/08/2022	<0.1	<0.1	0.0002	0.9	0.9	0.0018	20.00	1008	Falling	0.2	1.30	Dry
	16/08/2022	<0.1	<0.1	0.0001	0.9	0.1	0.0009	20.8	1011	Steady	<0.1	1.30	Dry

9 TIER 1 QUALITATIVE CONTAMINATED LAND RISK ASSESSMENT

Omnia has undertaken a Tier 1 qualitative risk assessment to determine if any potential contaminants within the underlying soils pose an unacceptable level of risk to the identified receptors.

9.1 Human Health Risk Assessment

At a Tier 1 stage the long term (chronic) human health toxicity of the soil has been assessed by comparing the on-site concentrations of organic and inorganic compounds with reference values published by the EA (Contaminated Land Exposure Assessment (CLEA) Soil Guideline Values (SGV)) and where absent, Generic Assessment Criteria (GACs) published by LQM/CIEH Suitable for Use Levels (S4UL) 2015. There are no currently defined screening values specifically for end use as a residential care home set out within UK guidance. Therefore, based on our understanding of the proposed development and a review of the proposed site layout, Omnia have adopted a conservative approach and have assessed soil concentrations against Tier 1 screening values for a residential end use without homegrown produce. The origin of the GAC values are presented within Appendix VIII.

The results of this comparison have been summarised within Table 9-1.

Table 9-1. Summary of Inorganic and Hydrocarbon Toxicity Assessment for a Residential End Use without Home Grown Produce

Determinant	Units	GAC	n	MC	Loc. of Ex	Pathway	Assessment
Inorganics							
Metals							
Arsenic	mg/kg	40	8	16.1	N/A	1	No Further Action
Beryllium	mg/kg	1.7	8	0.7	N/A	1	No Further Action
Boron	mg/kg	11,000	8	0.5	N/A	1	No Further Action
Cadmium	mg/kg	85	8	<0.1	N/A	1	No Further Action
Chromium (III)	mg/kg	910	8	91.2	N/A	1	No Further Action
Chromium (VI)	mg/kg	6	8	<0.3	N/A	1	No Further Action
Copper	mg/kg	7,100	8	20	N/A	1	No Further Action
Lead	mg/kg	310	8	256	N/A	1	No Further Action
Mercury	mg/kg	56	8	<0.1	N/A	4	No Further Action
Nickel	mg/kg	180	8	19.4	N/A	1	No Further Action
Selenium	mg/kg	430	8	2	N/A	1	No Further Action
Vanadium	mg/kg	1,200	8	53	N/A	1	No Further Action
Zinc	mg/kg	40,000	8	95	N/A	1	No Further Action
General Inorganics							
Asbestos	%	0.001	9	NAD	N/A	6	No Further Action
Total Cyanide *	mg/kg	50	9	0.9	N/A	1	No Further Action
Organics							
General Organics							
Phenol	mg/kg	750	9	<0.15	N/A	4,1	No Further Action
PAH							
Naphthalene	mg/kg	2.3	9	0.05	N/A	4	No Further Action
Acenaphthylene	mg/kg	2,900	9	0.12	N/A	1	No Further Action
Acenaphthene	mg/kg	3,000	9	<0.05	N/A	1	No Further Action
Fluorene	mg/kg	2,800	9	0.05	N/A	1	No Further Action
Phenanthrene	mg/kg	1,300	9	0.98	N/A	1	No Further Action
Anthracene	mg/kg	31,000	9	0.13	N/A	1	No Further Action

Fluoranthene	mg/kg	1,500	9	1.49	N/A	1	No Further Action
Pyrene	mg/kg	3,700	9	1.21	N/A	1	No Further Action
Benzo(a)Anthracene	mg/kg	11	9	0.54	N/A	1	No Further Action
Chrysene	mg/kg	30	9	0.67	N/A	1	No Further Action
Benzo(b)Fluoranthene	mg/kg	3.9	9	0.92	N/A	1	No Further Action
Benzo(k)Fluoranthene	mg/kg	110	9	0.36	N/A	1	No Further Action
Benzo(a)Pyrene	mg/kg	3.2	9	0.62	N/A	1	No Further Action
Indeno(123-cd)Pyrene	mg/kg	45	9	0.6	N/A	1	No Further Action
Dibenzo(a,h)Anthracene	mg/kg	0.31	9	0.11	N/A	1	No Further Action
Benzo(ghi)Perylene	mg/kg	360	9	0.61	N/A	1	No Further Action
BTEX							
Benzene	mg/kg	0.38	9	<5	N/A	4	No Further Action
Toluene	mg/kg	880	9	<5	N/A	4	No Further Action
Ethylbenzene	mg/kg	83	9	<5	N/A	4	No Further Action
Xylenes (p-Xylene)	mg/kg	79	9	<5	N/A	4	No Further Action
MTBE	mg/kg	73	9	<5	N/A	4	No Further Action
Banded TPH							
TPH EC 5-6**	mg/kg	42	9	<0.1	N/A	4	No Further Action
TPH EC >6-8**	mg/kg	100	9	<0.1	N/A	4	No Further Action
TPH EC >8-10**	mg/kg	27	9	<5	N/A	4	No Further Action
TPH EC >10-12**	mg/kg	130(vap)	9	<10	N/A	4	No Further Action
TPH EC > 12-16**	mg/kg	1,100(sol)	9	<10	N/A	4	No Further Action
TPH EC > 16-21**	mg/kg	1,900	9	32	N/A	2	No Further Action
TPH EC > 21-35**	mg/kg	1,900	9	362	N/A	1	No Further Action
TPH EC > 35-44**	mg/kg	1,900	9	61	N/A	1	No Further Action

Notes

Main Exposure Pathways: 1 = Ingestion of Soil & Indoor Dust, 2 = Consumption of Homegrown Produce & Attached Soil; 3 = Dermal Contact (Indoor & Outdoor); 4 = Inhalation of Vapour (Indoor & Outdoor); 5 = Inhalation of Dust (Indoor & Outdoor), 6 = Inhalation of Fibres

Abbreviations: GAC = General Assessment Criteria, n = number of samples, MC = Maximum Concentration; Loc of Ex = Location of Exceedance.

Total cyanide Tier 1 GAC is taken from the Dutch Intervention Value (2010) for complex cyanide.

* The Tier 1 GAC for the banded hydrocarbon fraction is derived from the CIEH/S4UL assessment for petroleum hydrocarbons Criteria Working Group (CWG) for both aliphatic and aromatic compounds. Omnia has utilised the lowest of the aliphatic and aromatic chain lengths in order to adopt a conservative approach, which is considered satisfactory for the protection of human health.

(sol) – GAC presented exceeds the solubility saturation limit

(vap) – GAC presented exceeds the vapour saturation limit.

Two (2no.) samples were also screened for PCBs which were less than the level of detect and therefore no active pollution pathways have been identified based on a residential end use without homegrown produce.

Following the completion of the Tier 1 risk assessment no exceedance were identified and therefore no active pollution pathways have been identified based on a residential end use without homegrown produce.

9.2 Controlled Waters Assessment

The site is considered to present a low risk to controlled waters for the following reasons:

- Site is Underlain by superficial and bedrock strata classified as Secondary A Aquifers;
- No history of industrial land use on site with the site comprising a residential property, outbuilding and associated garden since c.1896 with the site showing no significant change in configuration;
- No history of significant industrial land use in the surrounding area;
- Laboratory results generally show low concentrations across the site and do not suggest widespread impact of the underlying soils;
- Short chain, highly mobile TPH determinants were encountered at concentrations of less than the laboratory limit of detection;
- Long-chain, low mobility hydrocarbons were identified at relatively low concentrations and are not considered to have the potential to present a significant risk to controlled waters;
- The site is not located within a currently defined Source Protection Zone;
- There are no groundwater abstractions, including potable water supply abstractions within 250m of the subject site; and,
- The closest surface waters receptor is a inland watercourse located approximately 159-169m southeast of the site.

9.3 Waste Acceptance Criteria Testing

Two (2no.) composite soil samples were collected from across the site area and scheduled for Waste Acceptance Criteria (WAC) testing. The results of the laboratory testing are presented in Table 9-2 below and certificates are presented within Appendix VII.

Table 9-2 - Waste Acceptance Criteria (WAC) Summary

Sample Location (depth, m)	Classification	Exceedances
WS102 (0.10-0.20)	Inert Waste	N/A
WS105 (0.40-0.60)	Inert Waste	N/A

Based on the above assessment of soils analysed at incremental depths across the site material at depths of 0.10-0.20m bgl (WS102) and 0.40-0.60m bgl (WS105) is likely to be classed as Inert Waste for waste disposal purposes based on the analysis and classification above with values within the Inert Waste criteria limits.

Omnia have provided an anticipated Waste Classification of soil derived from values presented within the laboratory results. However, the acceptance criteria for materials are dependent on the license held by the individual landfill site. As a result, waste classifications may vary between landfill sites, and it is therefore recommended that the test results are submitted to the preferred waste disposal site for confirmation of suitability.

The two (2no.) soil samples results were entered in Hazardous Waste Classification software (Hazwaste) to determine the likely classification of the material for waste disposal purposes. The

results of this classification are presented in Table X below and Hazardous Waste Classification certificated are presented within Appendix VII.

Table 9-3 Hazardous Waste Classification Summary

Sample Location (depth, m)	Classification	Exceedances
WS102 (0.10-0.20)	Non-Hazardous Waste	N/A
WS105 (0.40-0.60)	Non-Hazardous Waste	N/A

Based on the above assessment of soils analysed at incremental depths across the site material at depths of 0.10-0.20 at WS102, and 0.40-0.60 at WS105 is likely to be classed as Inert Waste for waste disposal purposes based on the analysis and classification above with values within the Inert Waste criteria limits.

Omnia have provided an anticipated Waste Classification of soil derived from values presented within the laboratory results. However, the acceptance criteria for materials are dependent on the license held by the individual landfill site. As a result, waste acceptance criteria may vary between landfill sites and it is therefore recommended that the test results are submitted to the preferred waste disposal site for review.

9.4 Ground Gas Assessment

The potential impact on the development from ground gases has been assessed with reference to standards and guidelines published in CIRIA Report C665 (*Assessing risks posed by hazardous ground gases to buildings*, 2007). However, it is recommended that the full ground gas assessment and any recommended protection measures are agreed with the local authority prior to the adoption of any protection measures on-site. Furthermore, the installation of any gas protection measures should be validated by a suitably qualified engineer.

The results of the ground gas monitoring and calculated Gas Screening Values (GSVs) are presented in Table 8-8.

Six (6no.) ground gas monitoring visits have been undertaken at locations WS101, WS103, and WS104. CH₄ concentrations were recorded to a maximum concentration of 0.1% v/v at all locations. CO₂ concentrations were recorded to a maximum of 8.7% v/v at location WS101. Negligible ground gas flow rates were recorded across the site, with a maximum flow rate of 0.2l/hr recorded at all locations.

In accordance with the methodology outlined within the CIRIA publication C665, Omnia have utilised the results of the ground gas monitoring surveys to calculate a tentative Gas Screening Value (GSV). The maximum GSV calculated for methane was 0.0002l/hr whilst the maximum GSV for carbon dioxide was 0.0174l/hr.

It is understood that the proposed development is for the construction of a residential Care Home of 70 beds over 3-storeys with associated areas of vehicle parking, access routes and infrastructure to the west of the site.

Therefore, the proposed development is composed of low-rise residential dwellings assessed under BS8485:2015 classed as a **Type B** building.

9.4.1 BS 8485:2015 – Type B Building – Private Ownership with no Central Building Management

Guidance set out in BS 8485(2015)+A1(2019), which is equivalent to the Characteristic Situations of the modified Wilson & Card classification established in CIRIA Publication C665, stipulates a site characteristic GSV of <0.07 l/hr, with typical permissible concentrations of 1%v/v (CH₄) and 5% v/v (CO₂), for classification as Characteristic Situation 1 (CS-1); a very low hazard potential.

A review of Table 8-8 indicates that the calculated GSVs for both CH₄ (0.0002l/hr) and CO₂ (0.0098l/hr) are compliant with the maximum permissible GSV of <0.07l/hr for classification as CS-1. However, whilst the maximum recorded CH₄ concentration (0.1%v/v) is compliant with a CS-1 classification, the maximum recorded value of CO₂ (8.7%v/v) exceeds the typical permissible concentration of 5% (CO₂) for classification as CS-1. .

9.4.2 Ground Gas Discussion

A review of Section 6.1 indicates that the following potential sources of ground gas were identified:

- On-site – Made Ground
- 30m southwest – Covered reservoir – Infilled c.1998 (Planning App: Z/34487/000/00);
- 83m north – Historic Gravel Pit
- 50-218m northeast – Historic Gravel Pits

Following a review of published LiDAR data, contemporary topographic mapping, historic mapping and geological mapping, of the potential sources listed above, sources 2, 3 and 4 are considered to be a plausible source of ground gas for the following reasons:

- Made Ground (1) – Given the limited development on-site and a review of ground conditions encountered, which indicate Made Ground to a maximum thickness of 0.60m bgl, it is considered unlikely that Made Ground beneath the site will prove to be of sufficient thickness to present a plausible ground gas generation source;
- Infilled Covered Reservoir 30m southwest (2) – Based on OS mapping, and a review of the planning portal, it is considered that the reservoir was infilled in c.1998 based on planning application dates. Given that the structure has been built upon it is considered unlikely that putrescible waste would have been used as infill due to the potential for ground instability. However, due to the absence of scanned documents from the planning register, it is considered that the risks posed by this source to the subject site are low.
- Historic Gravel Pit (3) 83m north – Based on a review of contemporary and historic mapping together with a review of LiDAR data, it is unclear whether the gravel pit has been infilled and as such it is still considered to be a plausible source of ground gas;

- Historic Gravel Pits (3) 50-218m northeast - Based on a review of contemporary and historic mapping together with a review of LiDAR data, it is unclear whether the gravel pit has been infilled and as such it is still considered to be a plausible source of ground gas;

As set out above the calculated GSVs for CH₄ and CO₂ for the site fall comfortably within the range of values permissible for classification as CS-1, but the maximum concentrations for CO₂ have been found to exceed the 5% threshold set out within CIRIA C665.

Given the exceedance of the maximum permissible concentration of CO₂ for a CS-1 classification, Omnia have followed the procedure presented within BS 8485(2015)+A1(2019) to calculate the maximum hazardous gas flow rate for the site using the following equation:

$$Q_{hg} = q \left(\frac{C_{hg}}{100} \right)$$

Where:

C_{hg} is the maximum measured hazardous gas concentration (in %v/v) for the site

q is the maximum measured flow rate (l/hr) for the site

This results in the following Q_{hg} values:

$$Q_{hg}CH_4 = 0.2 \times \left(\frac{0.1}{100} \right) = 0.0002l/hr$$

$$Q_{hg}CO_2 = 0.2 \times \left(\frac{8.7}{100} \right) = 0.0174l/hr$$

Therefore, using a worst-case scenario of the highest recorded concentrations and highest recorded flow rates detected at the site yields worst-case Q_{hg} values which are compliant with a CS-1 classification.

A review of Table 8-8 indicates that the highest CO₂ concentrations (8.3 – 8.7%v/v) were detected at location WS101 following the installation of monitoring wells in June 2022. When supplementary ground gas monitoring was undertaken in August 2022, the maximum CO₂ concentrations recorded at location WS102 (4.3-4.9% v/v) were found to be lower and compliant with a CS-1 Classification.

It is generally accepted that CO₂ is widespread in the subsurface environment and is naturally generated by microbial and geochemical processes. Organic matter present within soils has the potential to generate CO₂ at elevated concentrations and in the UK, elevated concentrations of CO₂ are commonly encountered within Glacial Till, Chalk, River Terrace Gravels, Thanet Sand, Lambeth Group and Made Ground.

When ground gas monitoring wells are installed into soils, the small volumes of organic material present are exposed to oxygen which can result in biological respiration or oxidation of the material resulting in the production of CO₂ leading to elevated CO₂ concentrations within the well headspace.

Wilson, et al. (2018) states that low volumes of organic material in soils can degrade aerobically to produce CO₂, or may locally be degrading anaerobically with the process being so slow that the CH₄ completely oxidises to CO₂ before reaching the well headspace and that in all these cases the CO₂ is

generated so slowly that it will not be emitted from the ground surface in quantities or at a rate that is sufficient to pose a risk to overlying development.

Given the decrease in maximum recorded concentrations between June 2022 and August 2022, the fact that CO₂ concentrations stabilise at lower concentrations during each monitoring visit and the fact that the most recently recorded peak concentrations are compliant with a CS-1 Omnia consider that a CS-1 classification is suitable for the site and do not consider that an increase of the classification to CS-2 is required.

10 REVISED CONCEPTUAL SITE MODEL

Following completion of the Tier 1 risk assessment no active pollution pathways have been identified based on a residential end use without homegrown produce.

11 GEOTECHNICAL ASSESSMENT

11.1 Proposed Development

It is understood that Highwood Homes are proposing to redevelop the site to comprise a Care Home with 70 beds over 3 storeys with associated areas of vehicle parking, access routes and infrastructure to the west of the site. We note that the site has existing planning permission for a replacement dwelling, under the local authority reference [F/20/87694](#), however the proposed care home development scheme as outlined in the Feasibility Booklet entitled 'Proposed Care Home, Moorhill, West End, Southampton' (dated May 2021) requires a new planning application.

The outline proposed site layout is presented as Figure 2.0 (Appendix III).

11.2 Site Preparation

The site should be cleared of any vegetation below the areas of proposed development and stripped in accordance with [Series 200 of Specification of Highway Works](#).

Any roots present below the footprint of proposed structures and infrastructure should be grubbed out and the resulting voids in-filled with suitable compacted material. This should also be undertaken for any redundant or re-routed services.

11.3 Ground Profile

Based on the findings on the current ground investigation, ground conditions at the site comprise Topsoil/Made Ground overlying superficial deposits of River Terrace Deposits, further underlain by bedrock attributed to Wittering Formation to the full depth of the ground investigation, discussed in 8.1. Site ground conditions are summarised in Table 11-1.

Table 11-1 Summary of site ground conditions

Borehole	Topsoil Thickness (m)	Made Ground Thickness (m)	Superficial Deposits	Bedrock	Groundwater (m bgl)
			FORMATION 1 Thickness (m)	FORMATION 2 Thickness (m)	
HP101	0.30	-	0.30	-	-
SA101	-	0.40	2.00	-	-
SA102	0.40	-	1.20	-	-
SA103	0.60	-	2.00	-	2.60
WS101	0.20	-	1.80	-	-
WS102	0.25	-	1.45	-	-
WS103	0.40	-	1.60	-	-
WS104	0.40	-	0.90	-	-
WS105	0.60	-	2.10	-	-

11.4 Shallow Foundations

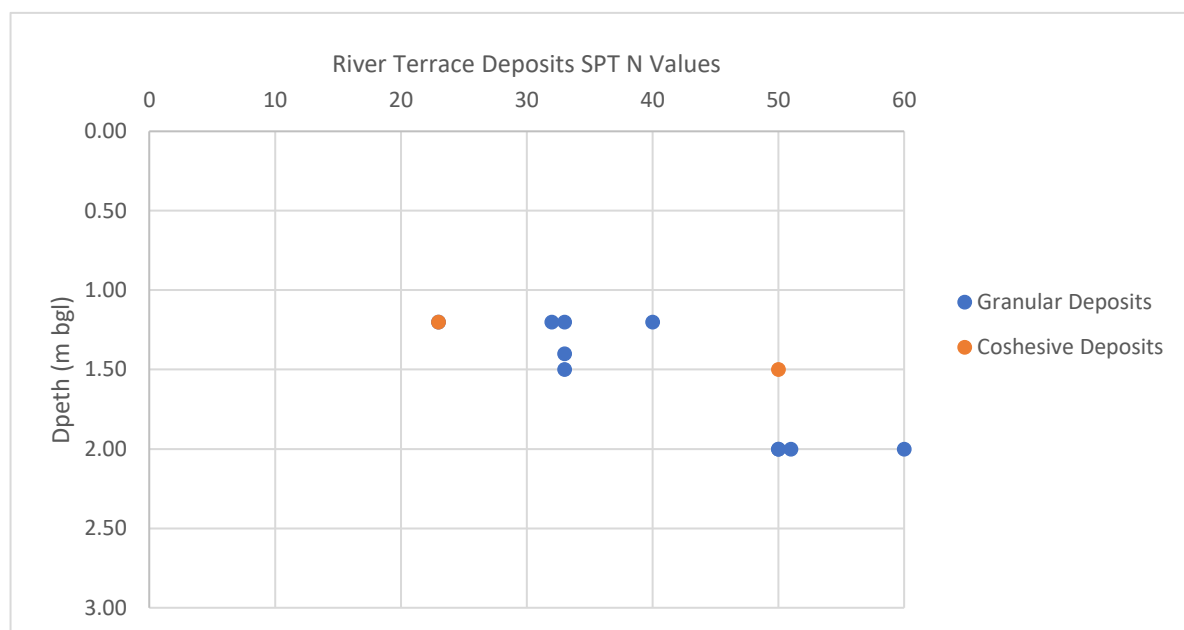
The following geotechnical assessment has been undertaken based on in-situ testing, laboratory analysis, and descriptions on the underlying geology. Foundation depths presented are indicative only based on a minimum presumed bearing value for a particular foundation type. Line loadings have not been made available such that the final depth and type of foundation required following design could vary.

It is considered that Topsoil/Made Ground would not form a suitable founding stratum due to characteristic variability and the associated potential for differential settlement. As such it is recommended that loads are transferred through the Topsoil/Made Ground to a depth at which competent geology, sufficient to support the proposed load, is encountered.

11.4.1 In Situ-Testing

Standard Penetration Testing was undertaken throughout the granular/cohesive River Terrace Deposits. The results are presented in Figure 11-1 **Error! Reference source not found.** below:

Figure 11-1 SPT vs Depth



The SPT data shows an increase in N-value with depth from N=23 at 1.20m bgl to N>50 at 2.00m bgl for the River Terrace Deposits.

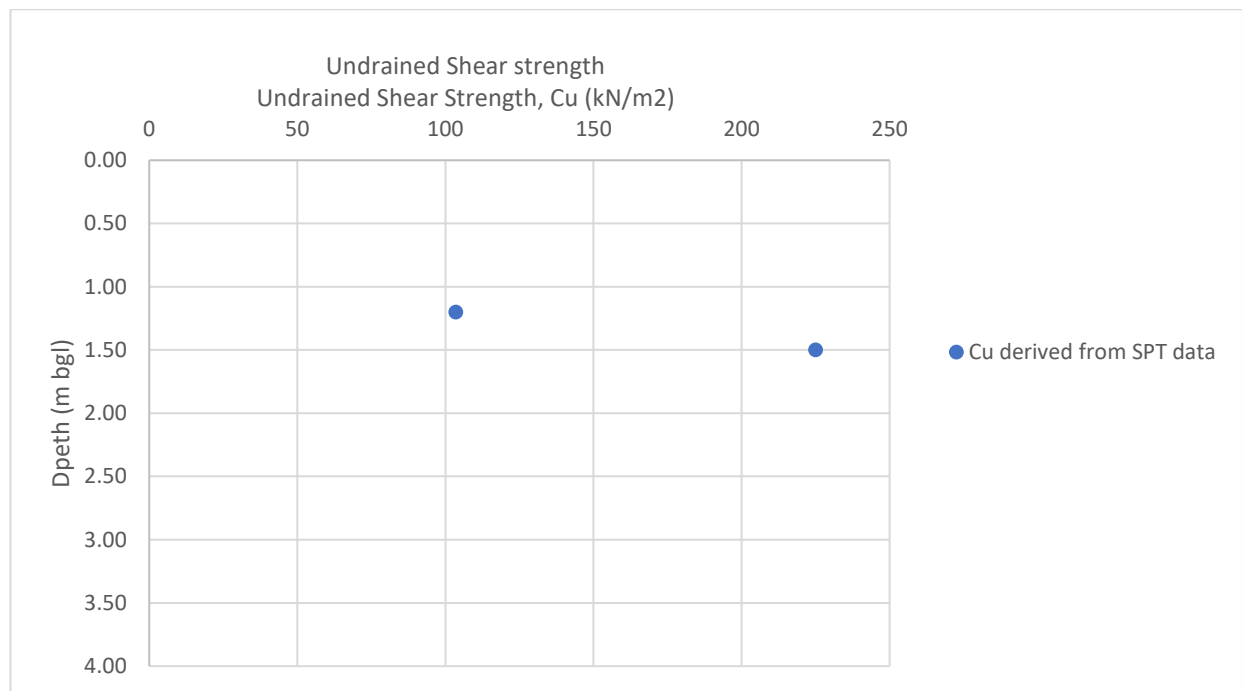
11.4.2 Shear Strength

The undrained Shear Strength of the cohesive layers within the River Terrace Deposits have been determined by using the widely accepted empirical relationship, where f_1 is based on the correlation factor based on the plasticity index of the soil (Stroud, 1974):

$$C_u = f_1 \times SPTN$$

Using a correlation factor of 4.5 gives characteristic undrained shear strengths (C_{uk}) of 104 kN/m² at 1.20m bgl within WS101 and 225kN/m² at a depth of 1.50m bgl within WS102, represented in **Error! Reference source not found.** Table 11-2 below. These values are consistent with the formation becoming medium strength material.

Table 11-2 Shear Strength vs Depth



11.4.3 Bearing Capacities

11.4.3.1 River Terrace Deposits

Indicative Bearing Capacity at 1.20m bgl

At a depth of 1.20m bgl within the coarse-grained soils of the River Terrace Deposits, SPT N values were recorded as N=23 to N=40, indicating medium dense to dense materials. It is considered a traditional strip foundation of 1.00m width at a depth 1.20m bgl provides a presumed bearing capacity of approximately 150-500kN/m².

Within WS102 fine-grained soils of the River Terrace Deposits were encountered at 1.20m bgl, with a recorded SPT N value of N=23, providing undrained shear strengths of 104 kN/m², indicating firm soils. It is considered that a traditional strip foundation at a depth of 1.20m bgl provides a presumed bearing capacity of approximately 200-400kN/m².

Indicative Bearing Capacity at 2.00m bgl

At a depth of 2.00m bgl within the coarse-grained soils of the River Terrace Deposits, SPT N values recorded as N=50 to N=>50, indicating dense to very dense materials. It is considered that a traditional strip foundation at a depth 2.00m bgl provides a presumed bearing capacity of approximately 500-800 kN/m².

Within one (1no.) location (SA101) at a depth of 2.00m bgl. Hand Shear Vane (HSV) data was collected from this location, with undrained shear strengths recorded between 20 and 32 kN/m² indicating very soft to soft soils.

Within the shallow soils of the River Terrace Deposits, it is considered that a traditional strip foundation at a depth 2.00m bgl provides a presumed bearing capacity of approximately 50-100 kN/m².

11.5 Groundwater Levels

Consideration should also be given to shallow groundwater encountered across the site. Groundwater was encountered at 2.60m bgl across the site. If groundwater is below the base of the foundation at a depth of less than the width of the proposed foundation, then groundwater can significantly reduce the bearing capacity of fine-grained soils.

11.6 Building Near Trees

11.6.1 NHBC Minimum Depth to Foundations

The shallow fine-grained soils on site have been shown via laboratory analysis to generally be of low to high plasticity and low to very high volume change potential. Modified plasticity indices range from 8% to 54%, it is considered that a conservative approach is taken, and therefore soils of the Head Deposits are of very high Volume Change Potential.

NHBC guidance offers two foundation depth scenarios dependant on future planting regimes for High Volume Change Soils which utilises Tables 4 and 5 of NHBC Chapter 4.2 – Building Near Trees, summarised in Table 11-3 below.

Table 11-3 Minimum depth of foundations (after NHBC 2021)

Depth of Foundation	Description	No Tree Planting Zone (m)		
		High Water Demand	Moderate Water Demand	Low Water Demand
1.0m	No tree planting within Zone of Influence	1.25m x mature height	0.75 x mature height	0.50 x mature height
1.50m	Restricted tree planting within zone of influence	1.0 x mature height	0.50 x mature height	0.20 x mature height

NHBC guidance indicates a minimum foundation depth of 1.00m bgl for high volume change soils outside of the zone of tree influence (Column B, Table 5) which is dependent on the tree species but may be up to 1.25 x mature tree height. Foundation depths will need to be increased within the zones of influence of existing or recently removed trees, as set out by NHBC Guidance (Chapter 4.2 – Building near Trees).

11.6.2 Lateral pressure and heave

Where foundations are more than 1.5m deep, within the influence of trees which are to remain or be removed, and may be subject to heave, they should be protected by voids, void formers or compressible materials to be take into account the effects of lateral swelling of soils. Minimum thicknesses of voids are set out in Table 7 of NHBC Chapter 4.2 – Building Near Trees.

Guidance is set out in NHBC the basic requirement is that compressible material or void former should be installed on the inside faces of external foundation walls. With piled foundation additional voids are required below ring beams. Position of heave precautions are set out in Table 8 of NHBC Chapter 4.2 – Building Near Trees.

11.7 Shallow Excavations

Particular consideration should be made when excavating due to high groundwater/pit instability being encountered during site works and follow-on monitoring visits, which may cause pit instability within granular deposits. Where sand deposits are encountered with high groundwater, running sands may be encountered, which may require the local deepening of foundations. It is recommended that special construction techniques are utilised, when necessary, when excavating foundations, such as dewatering and pit stabilisation.

11.8 Ground Floor Slabs

Due to the Volume Change Potential of the soil it is considered that ground floor slabs are not considered suitable for adoption and therefore it is recommended that a suspended floor slab should be adopted in accordance with NHBC Chapter 5.2 to mitigate against the effects of differential settlement.

If levels were to be changed on site requiring steps in the substructure, further consideration should be given to the adoption of floor slabs, with reference to NHBC Standards (2011) 5.1 – *Substructure and ground bearing floors*.

11.9 Pavement Construction

CBR values ranged from 7.6% to 68.1% between ground level and 878mmbgl. Using a conservative approach, a CBR value of 7.6% should be adopted across the site at this stage. Notwithstanding these results, confirmatory CBR testing should be carried out at formation level once details are finalised.

11.10 Concrete Durability

Due to the size of the dataset (>10 samples), characteristic pH and SO_4 values were calculated using the highest 20% measured sulphate concentrations and the lowest 20% measured pH value as stated in the BRE Special Digest (2005) producing a site characteristic value for sulphate of 64.4mg/l and a pH value of 4.54.

Soils encountered beneath the site have been classified in accordance with DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-3z with the recommendations provided in BRE Special Digest 1 (2005).

11.11 Discussion

At this stage, It is understood that a Highwood Homes are within the pre-application stage of planning for a Care Home of 70 beds over 3 storeys with associated areas of vehicle parking, access routes and infrastructure to the west of the site.

Presumed bearing capacities at 1.20m bgl within the River Terrace Deposits provide bearing capacities of 150-500kN/m² within the granular deposits across site. In the location of WS102 where cohesive soils of the River Terrace Deposits were encountered, bearing capacities of 200-400 kN/m² have been provided.

Bearing capacities at 2.00m bgl provide bearing capacities of 500-800kN/m² within the granular soils of the River Terrace Deposits across site.

Within the shallow soils of the Wittering Formation, it is considered that a traditional strip foundation of 1.00m width at a depth 2.00m bgl provides a presumed bearing capacity of approximately 50-100 kN/m².

Should loadings exceed those set out above then alternative founding solutions will need to be explored.

Subject to regulatory requirements, the potential requirement exists to calculate bearing capacities and undertaken settlement analysis for foundations through production of a Geotechnical Design Report (GDR) which would provide calculations to current guidance, UK National Annex to EC7. Foundation design should be completed by a suitably qualified Structural Engineer, with specific consideration given to the variability in soil strengths.

A minimum foundation depth of 1.00m bgl is anticipated for a High Change Volume soil within the Wittering Formation outside of the zone of tree influence, in accordance with NHBC. Where foundations are likely to be within the influence of trees foundation depths will require locally deepening. The extent to which they should be deepened should be in accordance with NHBC guidance, Chapter 4.2 – Building Near Trees (Tables 4 and 5). Existing mature trees that are presumed to be remaining along the boundaries of the site and scattered throughout.

12 CONCLUSIONS AND RECOMMENDATIONS

Revised Conceptual Site Model
Following completion of the Tier 1 risk assessment no active pollution pathways have been identified based on a residential end use without homegrown produce.
Waste Acceptance Criteria Testing
WAC assessment of soils analysed at incremental depths across the site material at depths of 0.10-0.20 at (WS102) and 0.40-0.60 (WS105) is classed as Inert Waste for waste disposal purposes based on the analysis and classification with values within the Inert Waste criteria limits. Samples were also screened using Hazwaste software which classified the waste as non hazardous waste for disposal.
Omnia have provided an anticipated Waste Classification of soil derived from values presented within the laboratory results. However, the acceptance criteria for materials are dependent on the license held by the individual landfill site. As a result, waste acceptance criteria may vary between landfill sites and it is therefore recommended that the test results are submitted to the preferred waste disposal site for review.
Concrete Classification
Soils encountered beneath the site have been classified in accordance with DS-1, Aggressive Chemical Environment for Concrete Classification (ACEC) AC-3z with the recommendations provided in BRE Special Digest 1 (2005).
Geotechnical Assessment
Foundations All foundations should be placed beneath any Made Ground or Topsoil to found on the underlying natural strata. Presumed bearing capacities at 1.20m bgl within the Head Deposits provide bearing capacities of 150-500kN/m² within the granular deposits across site. In the location of WS102 where cohesive soils of the Head Deposits were encountered, bearing capacities of 200-400 kN/m² have been provided. Bearing capacities at 2.00m bgl provide bearing capacities of 500-800kN/m² within the granular soils of the Head Deposits across site. Within the shallow soils of the Wittering Formation, it is considered that a traditional strip foundation of 1.00m width at a depth 2.00m bgl provides a presumed bearing capacity of approximately 50-100 kN/m². Ground Floor Slabs Due to the High volume change potential of the ground, it is considered that ground floor slabs are not suitable for adoption and therefore a suspended floor slab should be adopted in accordance with NHBC Chapter 5.2 to mitigate against the effects of differential settlement. Pavement Construction CBR values ranged from 8.0% to 73.2% between ground level and 878mmbgl. Using a conservative approach, a CBR value of 8.0% should be adopted across the site at this stage. Notwithstanding these results, confirmatory CBR testing should be carried out at formation level once details are finalised.
Recommendations
Environmental All monitoring points should be decommissioned in accordance with Environment Agency guidance ahead of site development in order to avoid the creation of preferential pathways. If during the development stage any evidence of contamination is identified, works should be halted, and contact made with a suitably qualified Environmental Consultant. As determined appropriate by the Consultant, further

investigation and sampling may be required to determine the appropriate actions. Upon completion contact should be made with the regulator to achieve sign off of the works.

It is recommended that a further three (3no.) gas monitoring visits are undertaken in line with best practice and guidance provided within CIRIA C665, due to concentrations of CO₂ exceeding the screening value of 5% v/v identified during the monitoring visits on-site.

Geotechnical

Values for foundation are based on approximate ultimate bearing capacity and are given to provide outline options and should be subject to detailed analysis by the Structural Engineer. Should the bearing strength set out above prove to be incompetent for the proposed loading, consideration should be given to a deeper foundation solution. As necessary, and as dictated by the site layout plan this may lead to a requirement for an assessment of deeper soils for a piled foundation.

APPENDIX I - LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between Omnia and the Client as indicated in Section 1.2.
 2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information, it has been assumed it is correct. No attempt has been made to verify the information.
 3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination, which are enforced, by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.
 4. During the site walkover reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not been made known or accessible.
 5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.
 6. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.
 7. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials this is for indicative purposes only and do not constitute or replace full and proper surveys.
 8. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.
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 10. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.
-

APPENDIX II – GLOSSARY

AST	Above Ground Storage Tank
BGS	British Geological Survey
BSI	British Standards Institute
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CIEH	Chartered Institute of Environmental Health
CIRIA	Construction Industry Research Association
CLEA	Contaminated Land Exposure Assessment
CSM	Conceptual Site Model
DNAPL	Dense Non-Aqueous Phase Liquid (Chlorinated Solvents, PCB)
DWS	Drinking Water Standard
EA	Environment Agency
EQS	Environmental Quality Standard
GAC	General Assessment Criteria
GL	Ground Level
GSV	Gas Screening Value
HCV	Health Criteria Value
ICSM	Initial Conceptual Site Model
LNAPL	Light Non-Aqueous Phase Liquid (Petrol, Diesel, Kerosene)
ND	Not Detected
LMRL	Lower Method Reporting Limit
NR	Not Recorded
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Poly-Chlorinated Biphenyl
PID	Photo-Ionisation Detector
QA	Quality Assurance
SGV	Soil Guideline Value
SPH	Separate Phase Hydrocarbon
TPH (CWG)	Total Petroleum Hydrocarbon (Criteria Working Group)
SPT	Standard Penetration Test
SVOC	Semi Volatile Organic Compound
UST	Underground Storage Tank
VCCS	Vibro Concrete Columns
VOC	Volatile Organic Compound
WTE	Water Table Elevation

UNITS

M	Metres
KM	Kilometres
%	Percent
%V/V	Percent Volume in Air
MB	Milli Bars (Atmospheric Pressure)
L/HR	Litres Per Hour
µG/L	Micrograms Per Litre (Parts Per Billion)
PPB	Parts Per Billion
MG/KG	Milligrams Per Kilogram (Parts Per Million)
PPM	Parts Per Million
MG/M ³	Milligram Per Metre Cubed
M BGL	Metres Below Ground Level

M BCL	Metres Below Cover Level
MAOD	Metres Above Ordnance Datum (Sea Level)
KN/M ²	Kilo Newtons Per Metre Squared
μM	Micrometre

APPENDIX III - DRAWINGS

Key

Site Boundary



0 250 500 m



Scale
1:15,456.834879

Paper Size
A4

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Job Title:
Moorhill, Southampton

Client:
Highwood

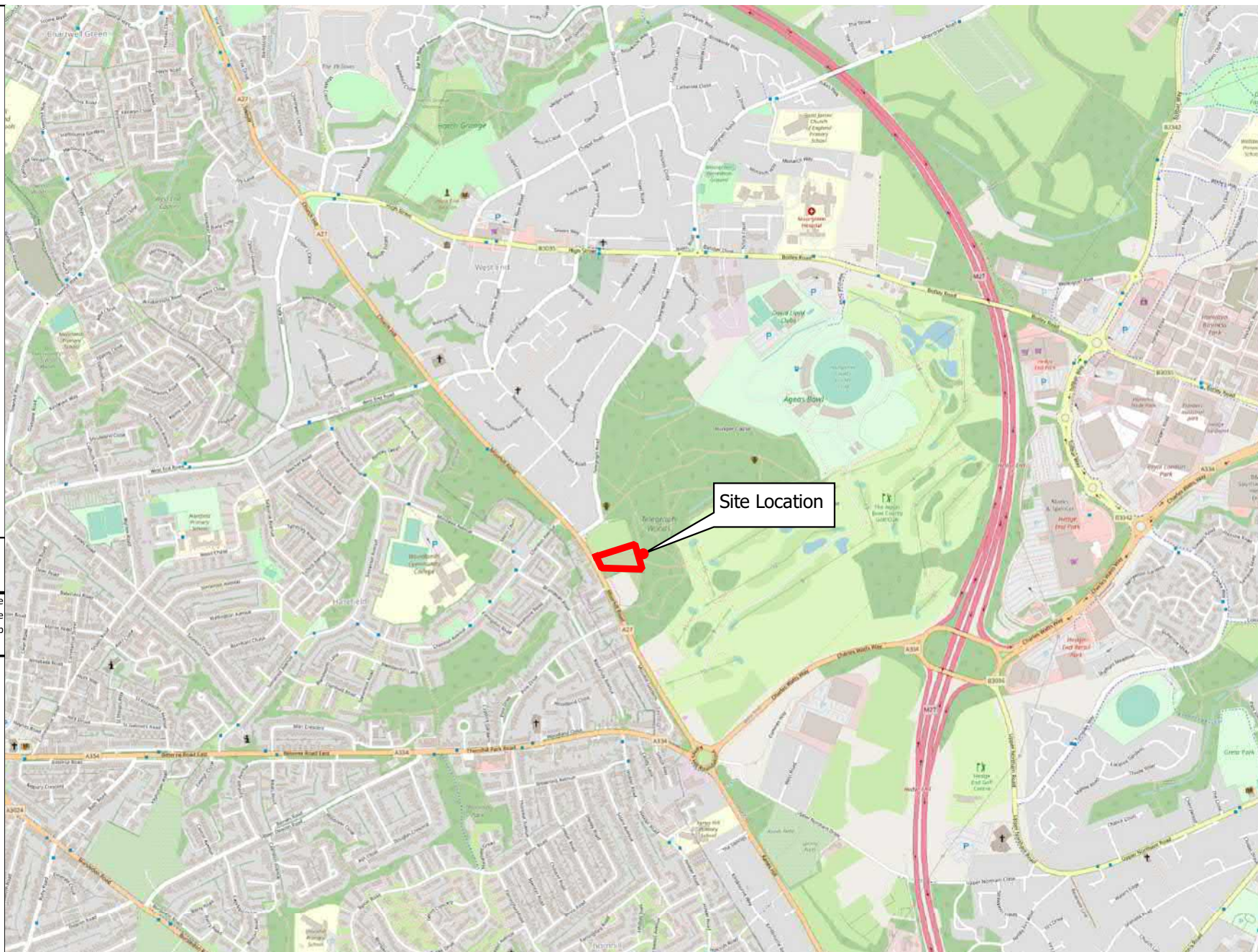
Project Number:
A11641

Drawn By:
T.Holloway

Date:
25/05/2022

Authorised By:
O.Maxwell

Drawing Title:
Figure 1.0
Site Location Map





Red thick line denotes Care Home Site Boundary

0 5 10 15 20 m

Scale
1:600

Paper Size
A4

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Job Title:
Moorhill, Southampton

Client:
Highwood

Project Number:
A11641

Drawn By:
T.Holloway

Date:
07/10/2022

Authorised By:
G. Wass

Drawing Title:
Figure 2.0
Proposed Development Plan



Key

Site walkover fridges



10 0 10 m

Scale
1:580

Paper Size
A4

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three (3no.)
disused fridges

A rusted green tank approximately 1.50x1.50x1.50m, no sign of leaking or staining on the floor, however a tar like substance was noted with the pipe of the tank.

Approximately a 10x5x5 pile of demolition rubble which is presumed to be from the residential house from historical mapping. The demolition rubble contained glass, brick, concrete, and metal and overgrown with grass.

A pile of metal which was rusted, and staining was noted on the hardcore tarmac floor from previous burning. The pile of metal contains, metal racking, corrugated iron roofing approximately 5.00x2.00x2.00m.

Green Electrical substation identified within neighbouring Land, on the southern boundary of the site.

SITE SURVEY
Scale 1:200

Job Title:
Moorhill, Southampton

Client:
Highwood Group

Project Number:
A11641

Drawn By:
H. Spurling

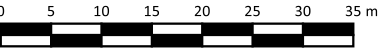
Date:
27/06/2022

Authorised By:
O.Maxwell

Drawing Title:
Figure 3.0
Site Walkover Plan

Key

- Site Boundary
- Window Sample Locations
- Soakaway Locations
- Hand Pit Location
- DCP Locations



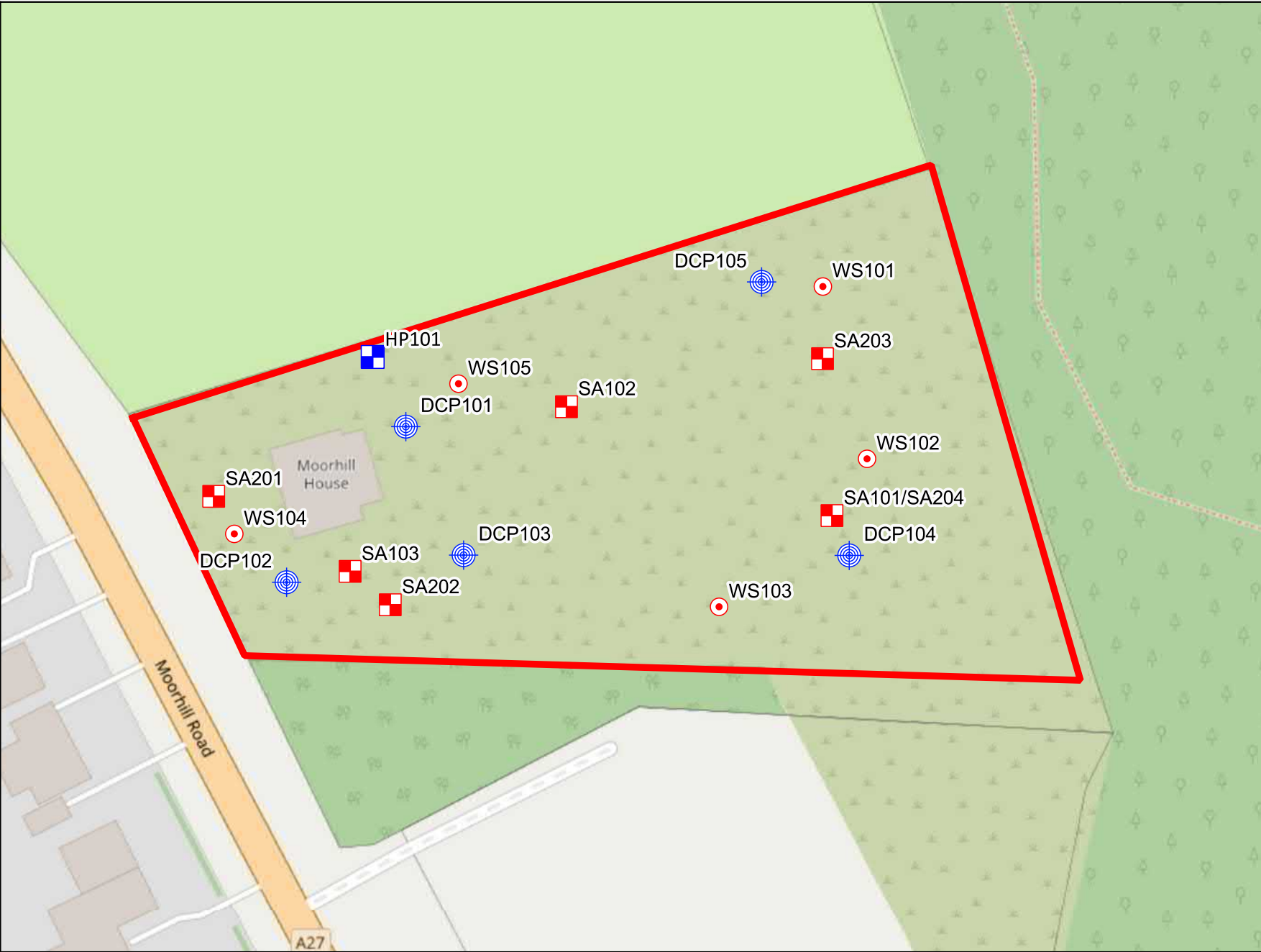
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Job Title:
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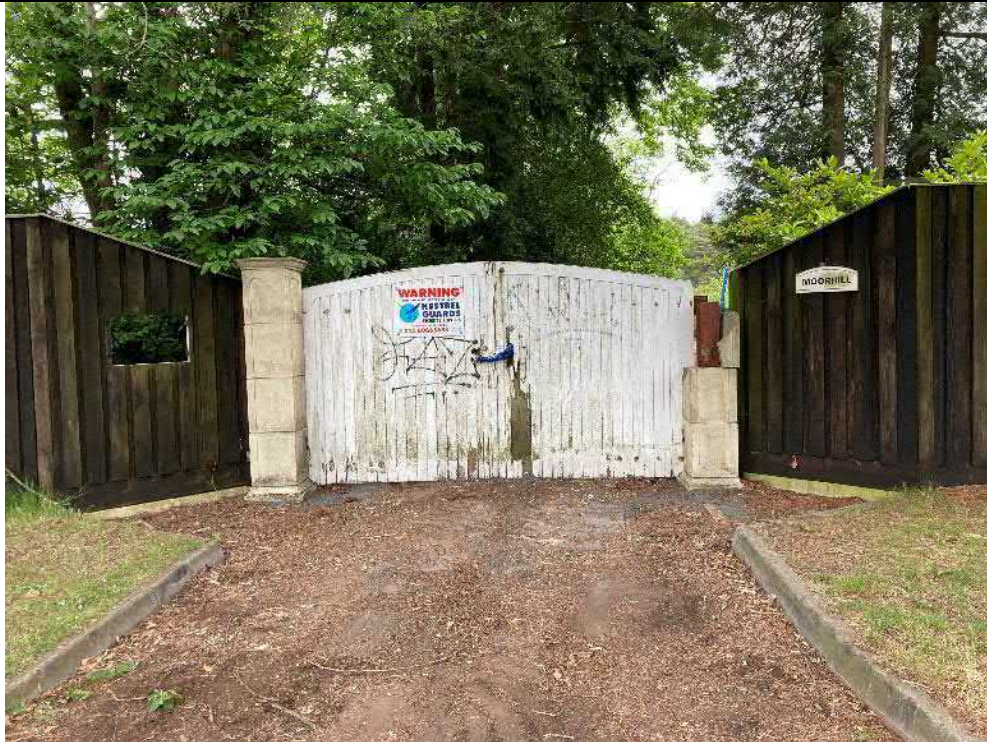
Drawn By:
L. Burnett

Date:
03/08/2022

Authorised By:
O. Maxwell

Drawing Title:
Figure 4.0
Intrusive Location Plan

APPENDIX IV - PHOTOGRAPHS



Photograph 1- Access gate from Moorhill Road, facing east.



Photograph 2- Fridge appliances on the western boundary. Facing southeast.



Photograph 3- Waste storage containing demolition rubble from previous residential house. Facing south.



Photograph 4- Waste storage containing metal. Facing East.



Photograph 5- Rusted Green tank in the northeast of the site. Facing North



Photograph 6- Tar Substance within pipe of rusted green tank on northern boundary. Facing west.



Photograph 7- Electrical substation on the southern boundary of the site, within neighbouring property.
Facing South.

APPENDIX V - HISTORICAL MAPS

Site Details:

MOORHILL, MOORHILL ROAD,
WEST END, SO30 3AZ

Client Ref: A11641
Report Ref: GS-8775594
Grid Ref: 447111, 113541

Map Name: County Series

Map date: 1871

Scale: 1:10,560

Printed at: 1:10,560



Surveyed 1869
Revised N/A
Edition 1871
Copyright N/A
Levelled N/A

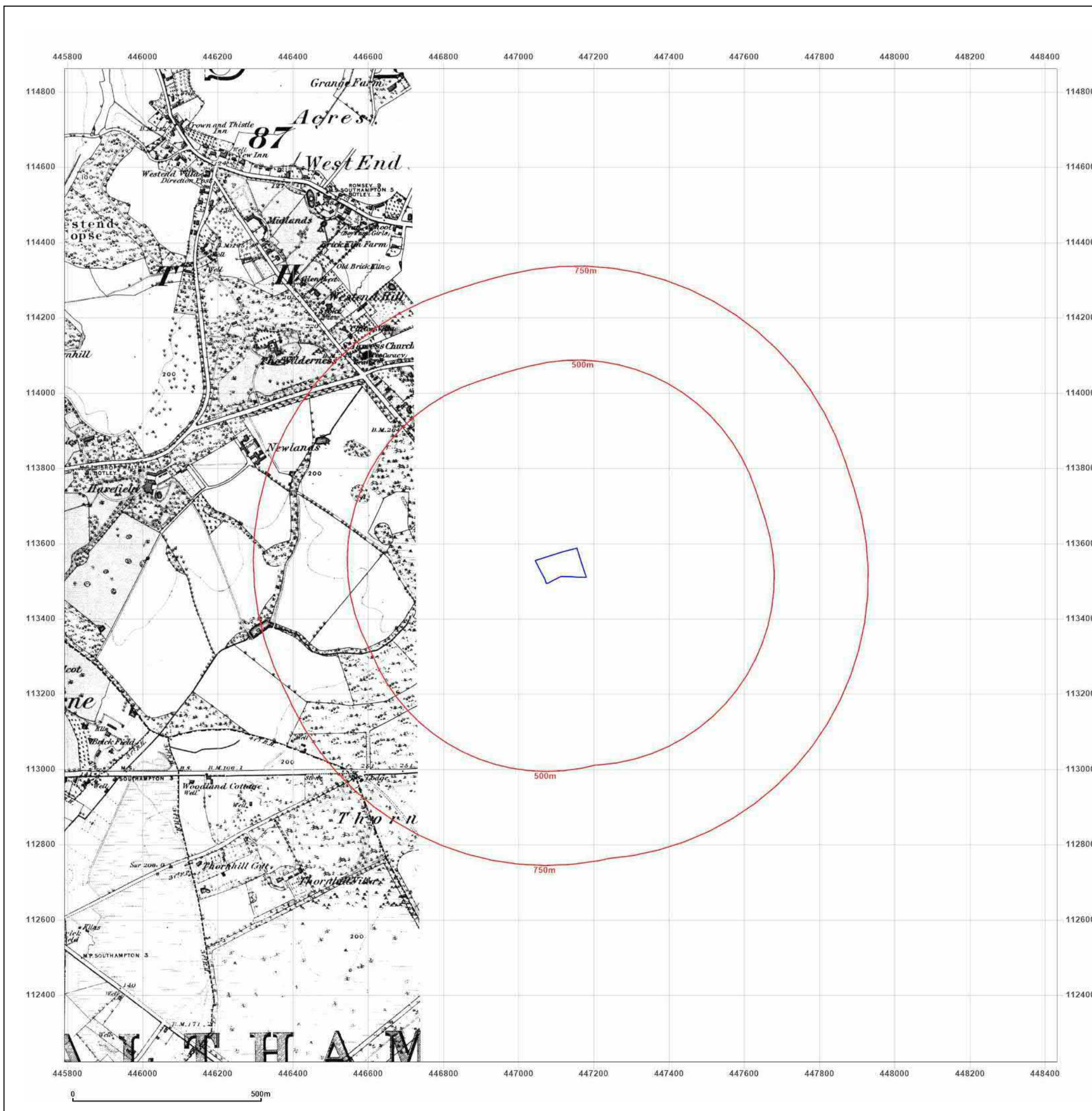


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Site Details:

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WEST END, SO30 3AZ

Client Ref: A11641
Report Ref: GS-8775594
Grid Ref: 447111, 113541

Map Name: County Series

Map date: 1871

Scale: 1:10,560

Printed at: 1:10,560



Surveyed 1869
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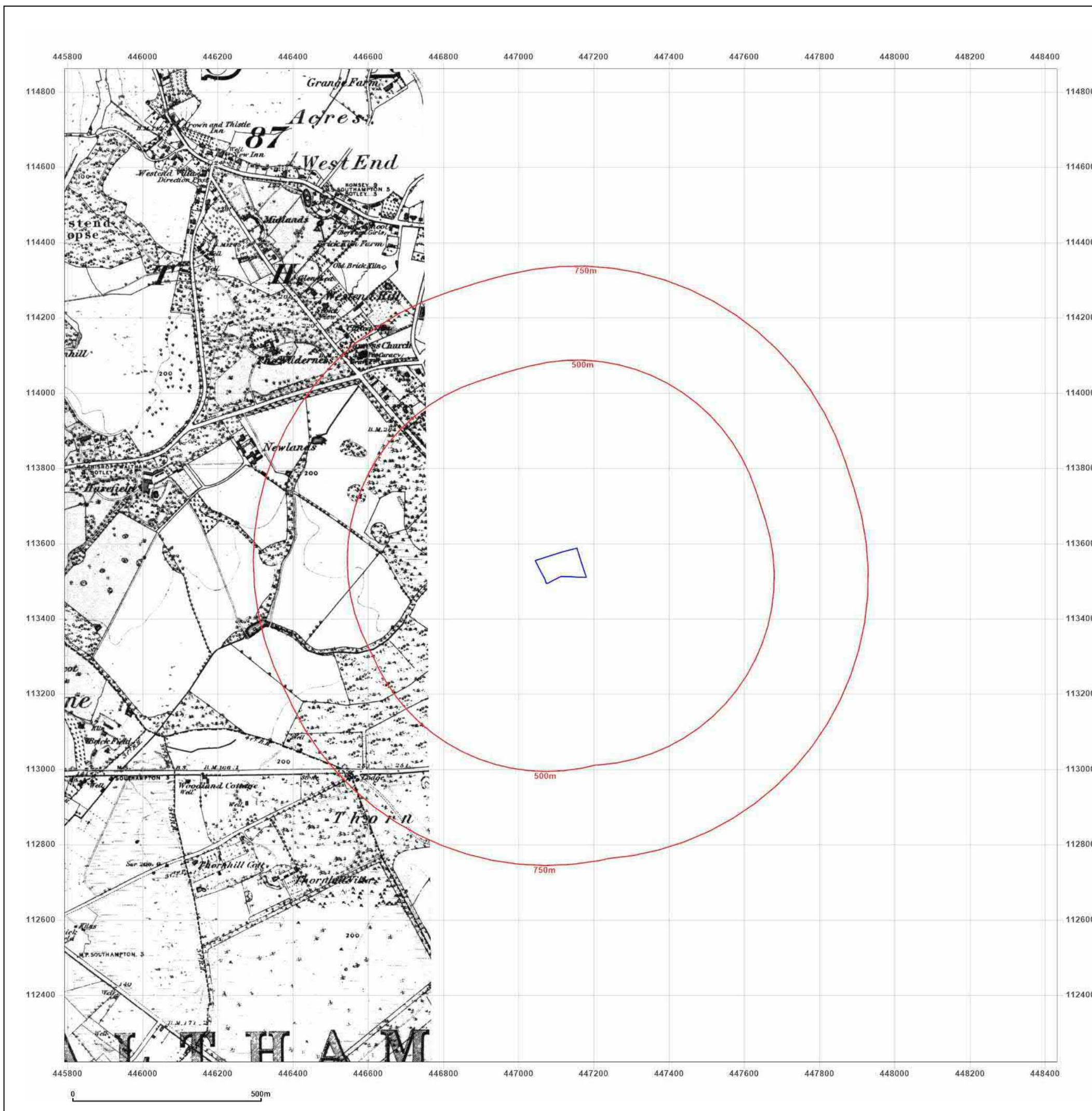


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Site Details:

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WEST END, SO30 3AZ

Client Ref: A11641
Report Ref: GS-8775594
Grid Ref: 447111, 113541

Map Name: County Series

Map date: 1895-1896

Scale: 1:10,560

Printed at: 1:10,560



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Revised 1895
Edition N/A
Copyright N/A
Levelled N/A

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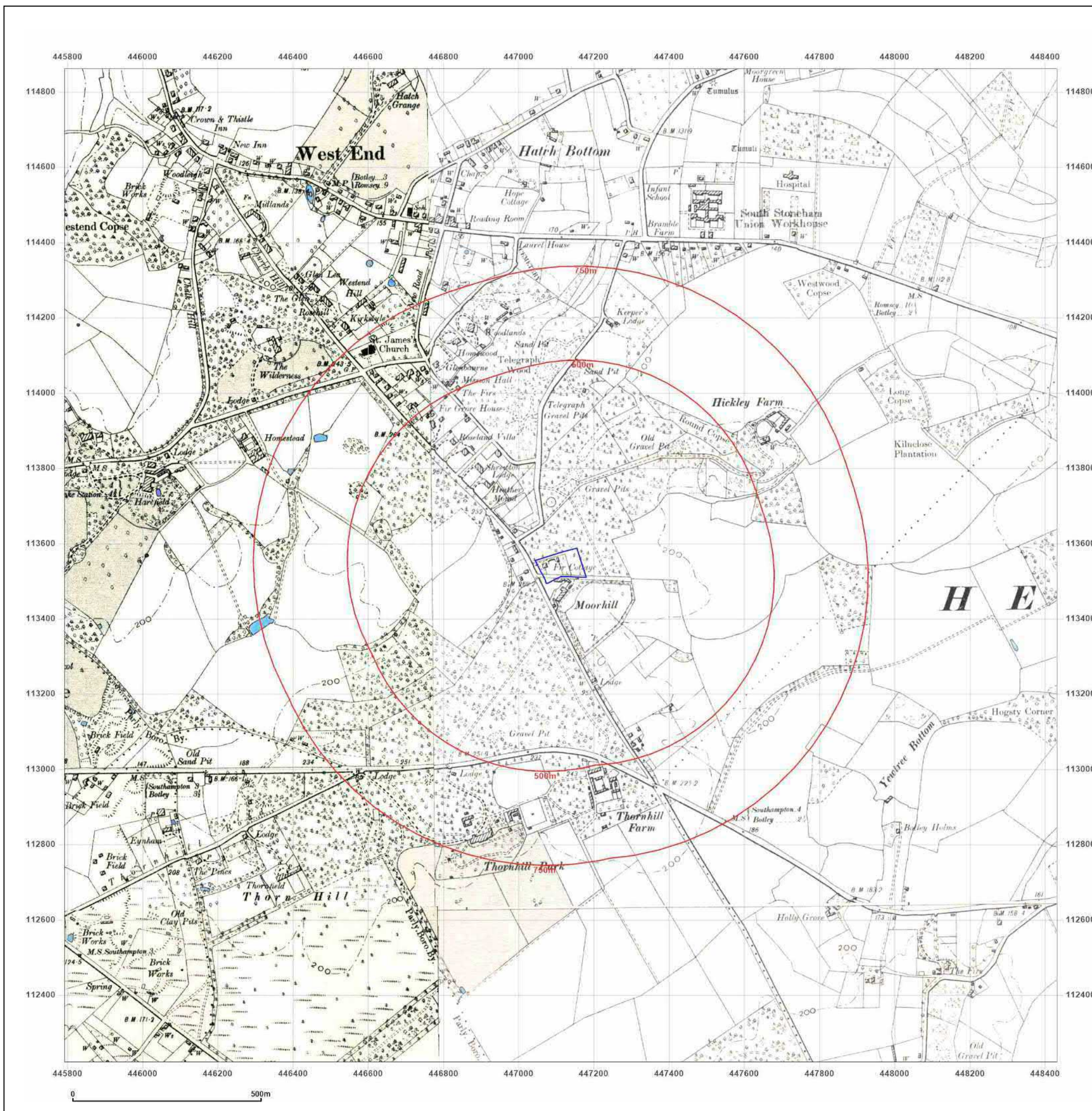


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Site Details:

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WEST END, SO30 3AZ

Client Ref: A11641
Report Ref: GS-8775594
Grid Ref: 447111, 113541

Map Name: County Series

Map date: 1896-1898

Scale: 1:10,560

Printed at: 1:10,560



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Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1868
Revised 1896
Edition N/A
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Levelled N/A

Surveyed 1867
Revised N/A
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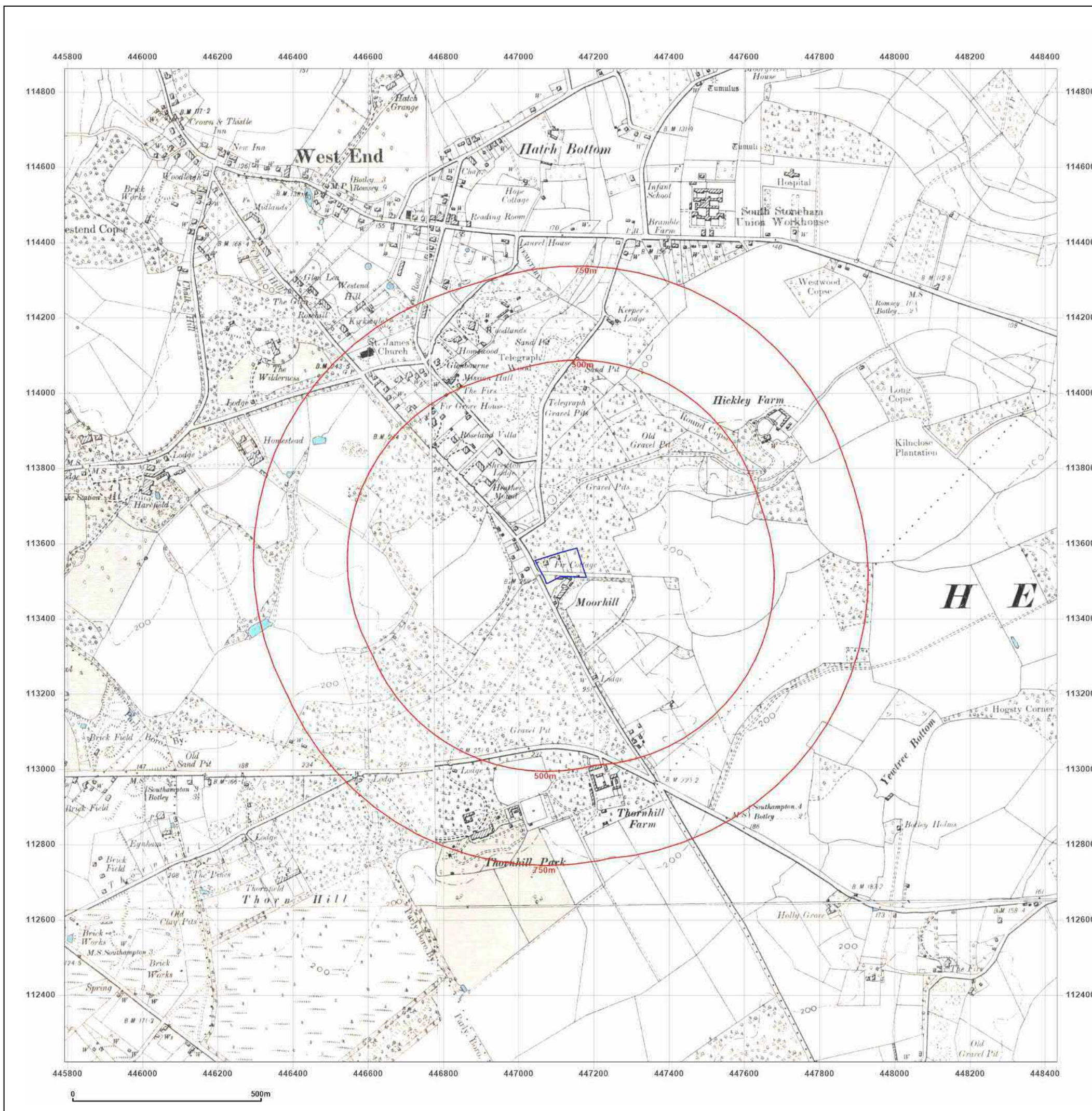


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Site Details:

MOORHILL, MOORHILL ROAD,
WEST END, SO30 3AZ

Client Ref: A11641
Report Ref: GS-8775594
Grid Ref: 447111, 113541

Map Name: County Series

Map date: 1908-1910

Scale: 1:10,560

Printed at: 1:10,560



Surveyed 1867
Revised 1908
Edition 1910
Copyright N/A
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Surveyed 1867
Revised 1910
Edition N/A
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Surveyed 1867
Revised 1908
Edition N/A
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Levelled N/A

Surveyed 1866
Revised 1908
Edition N/A
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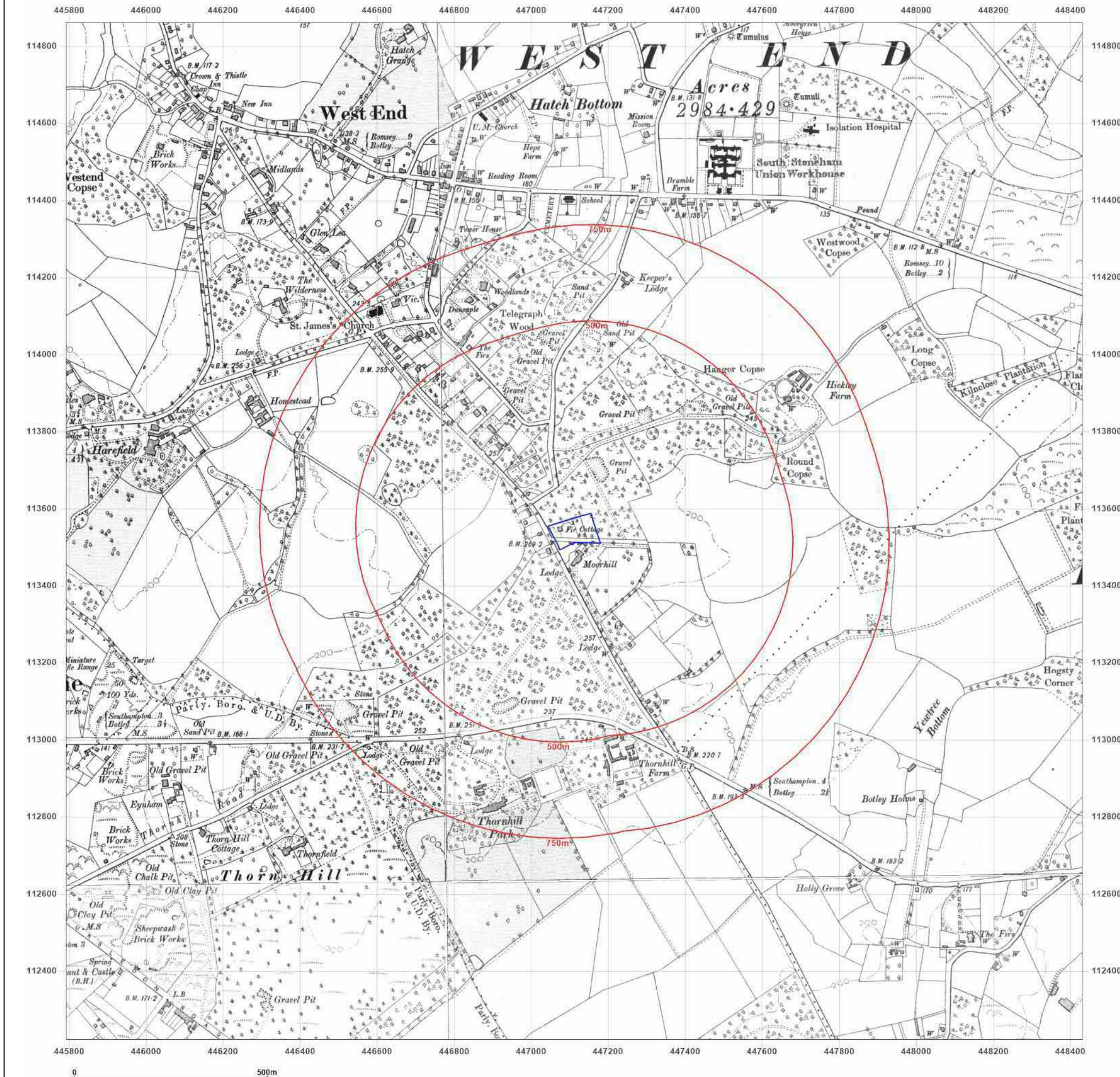


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Site Details:

MOORHILL, MOORHILL ROAD,
WEST END, SO30 3AZ

Client Ref: A11641
Report Ref: GS-8775594
Grid Ref: 447111, 113541

Map Name: County Series

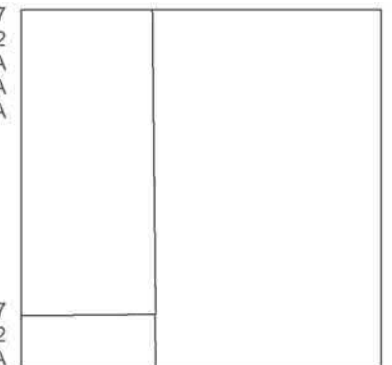
Map date: 1932

Scale: 1:10,560

Printed at: 1:10,560



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Revised 1932
Edition N/A
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Surveyed 1867
Revised 1932
Edition N/A
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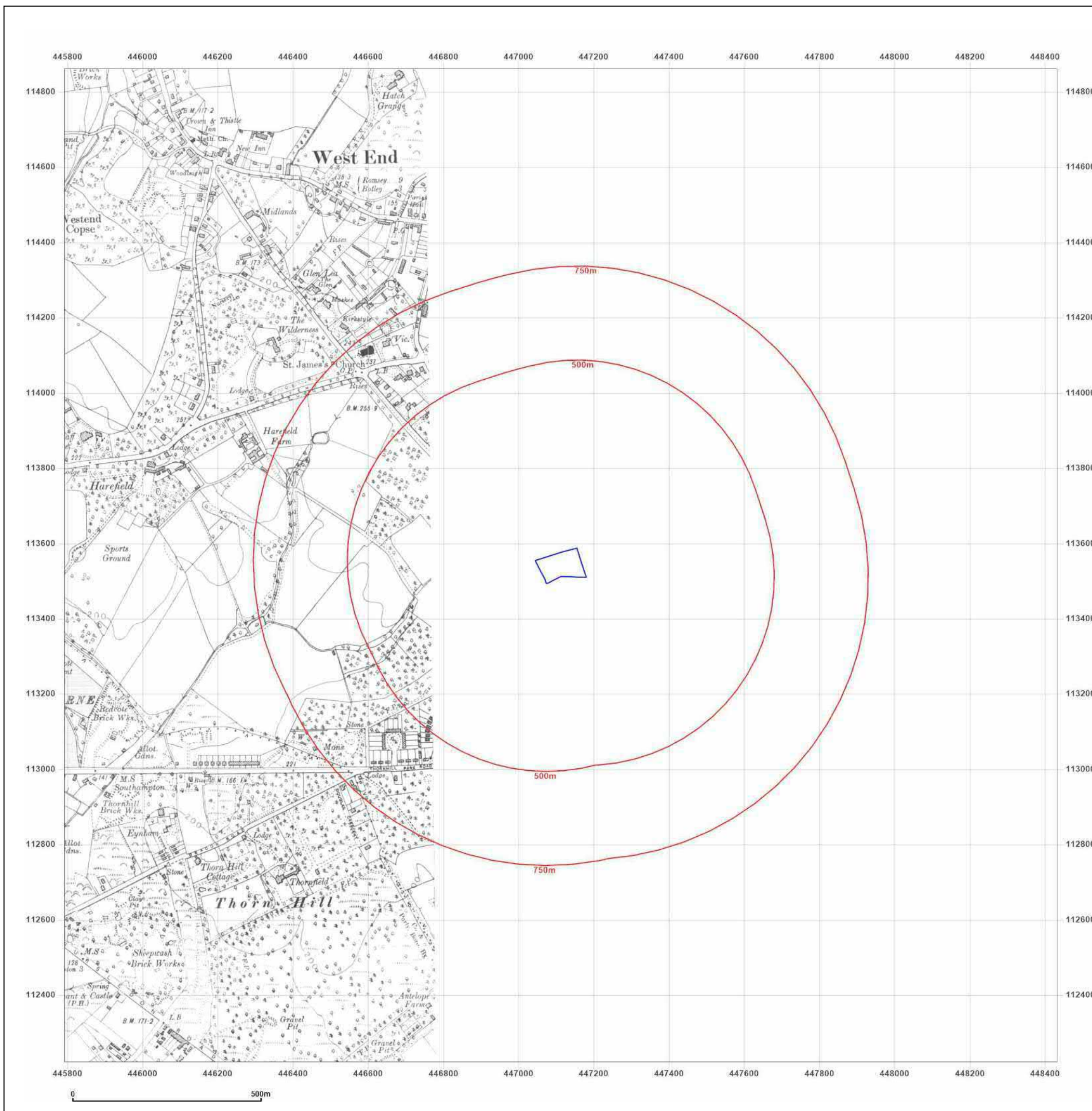


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Site Details:

MOORHILL, MOORHILL ROAD,
WEST END, SO30 3AZ

Client Ref: A11641
Report Ref: GS-8775594
Grid Ref: 447111, 113541

Map Name: County Series

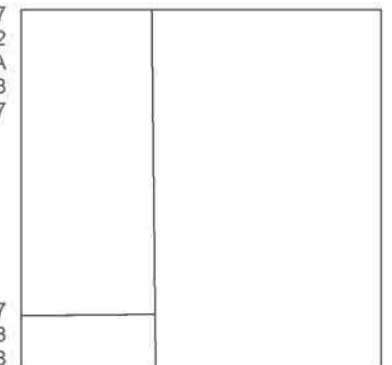
Map date: 1938

Scale: 1:10,560

Printed at: 1:10,560



Surveyed 1867
Revised 1932
Edition N/A
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Levelled 1907



Surveyed 1867
Revised 1938
Edition 1938
Copyright N/A
Levelled N/A

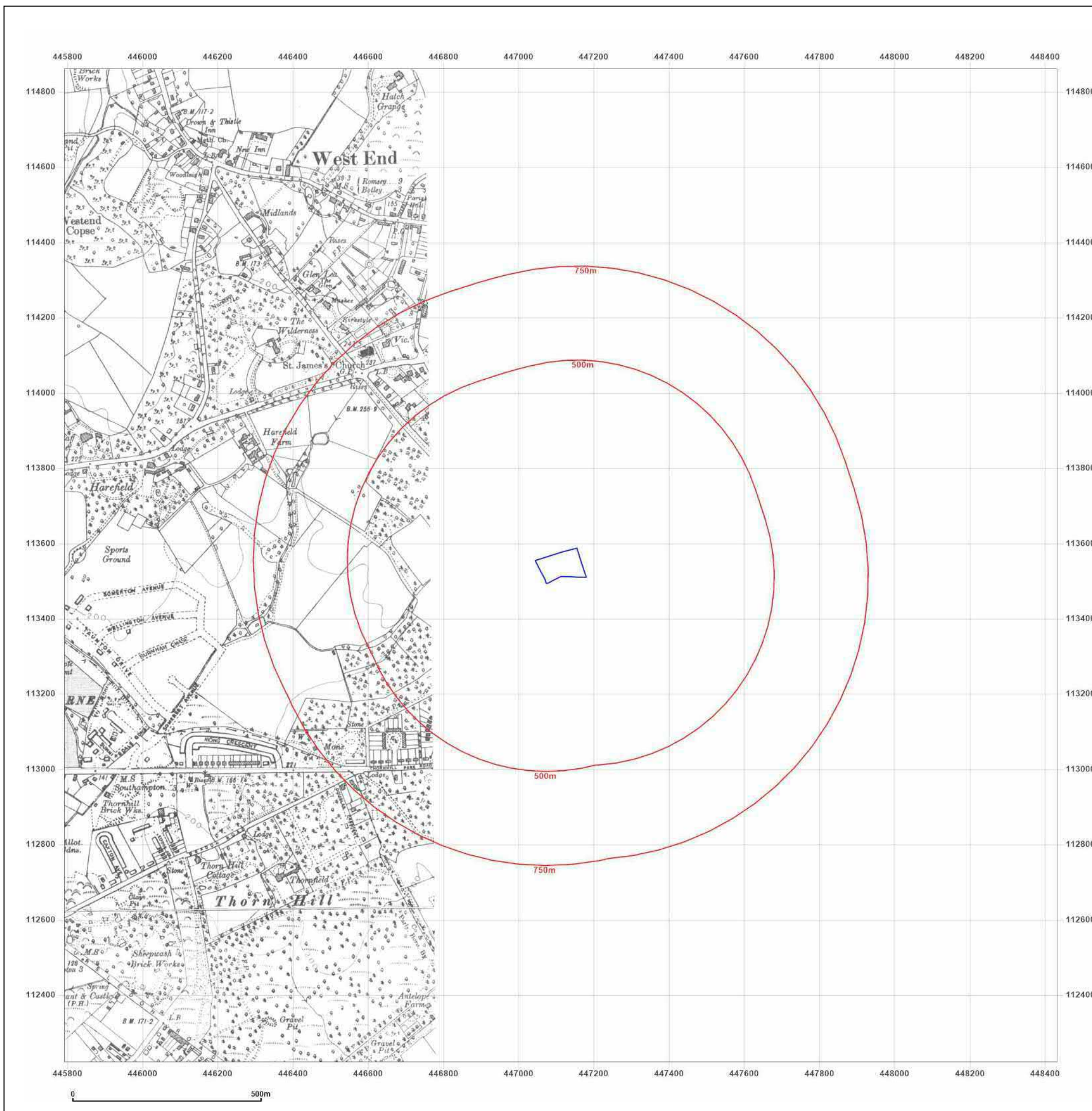


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Site Details:

MOORHILL, MOORHILL ROAD,
WEST END, SO30 3AZ

Client Ref: A11641
Report Ref: GS-8775594
Grid Ref: 447111, 113541

Map Name: County Series

Map date: 1938-1942

Scale: 1:10,560

Printed at: 1:10,560



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Revised 1938
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1866
Revised 1942
Edition N/A
Copyright N/A
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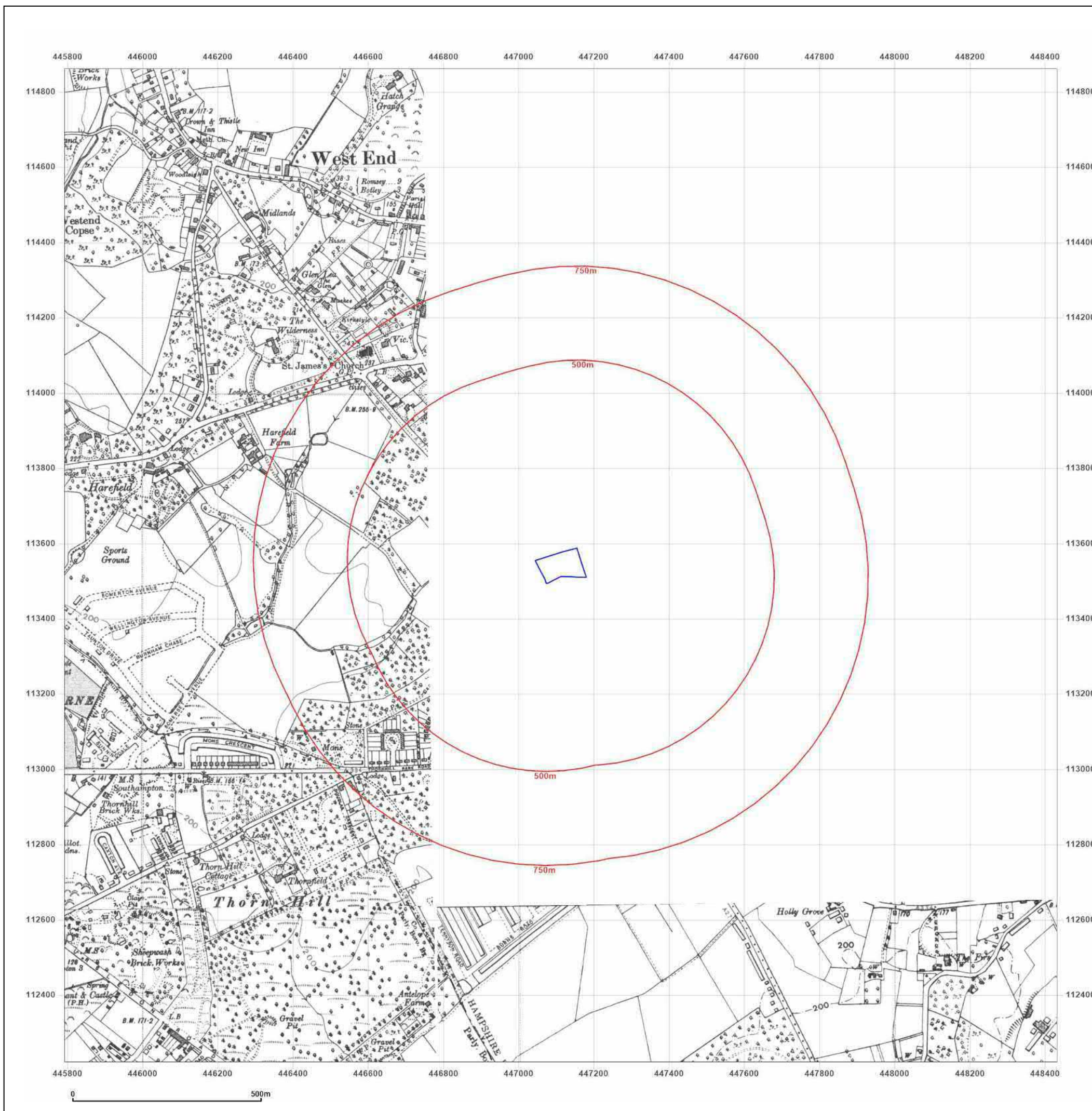


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Site Details:

MOORHILL, MOORHILL ROAD,
WEST END, SO30 3AZ

Client Ref: A11641
Report Ref: GS-8775594
Grid Ref: 447111, 113541

Map Name: Provisional

Map date: 1957

Scale: 1:10,560

Printed at: 1:10,560



Surveyed 1867
Revised 1957
Edition N/A
Copyright N/A
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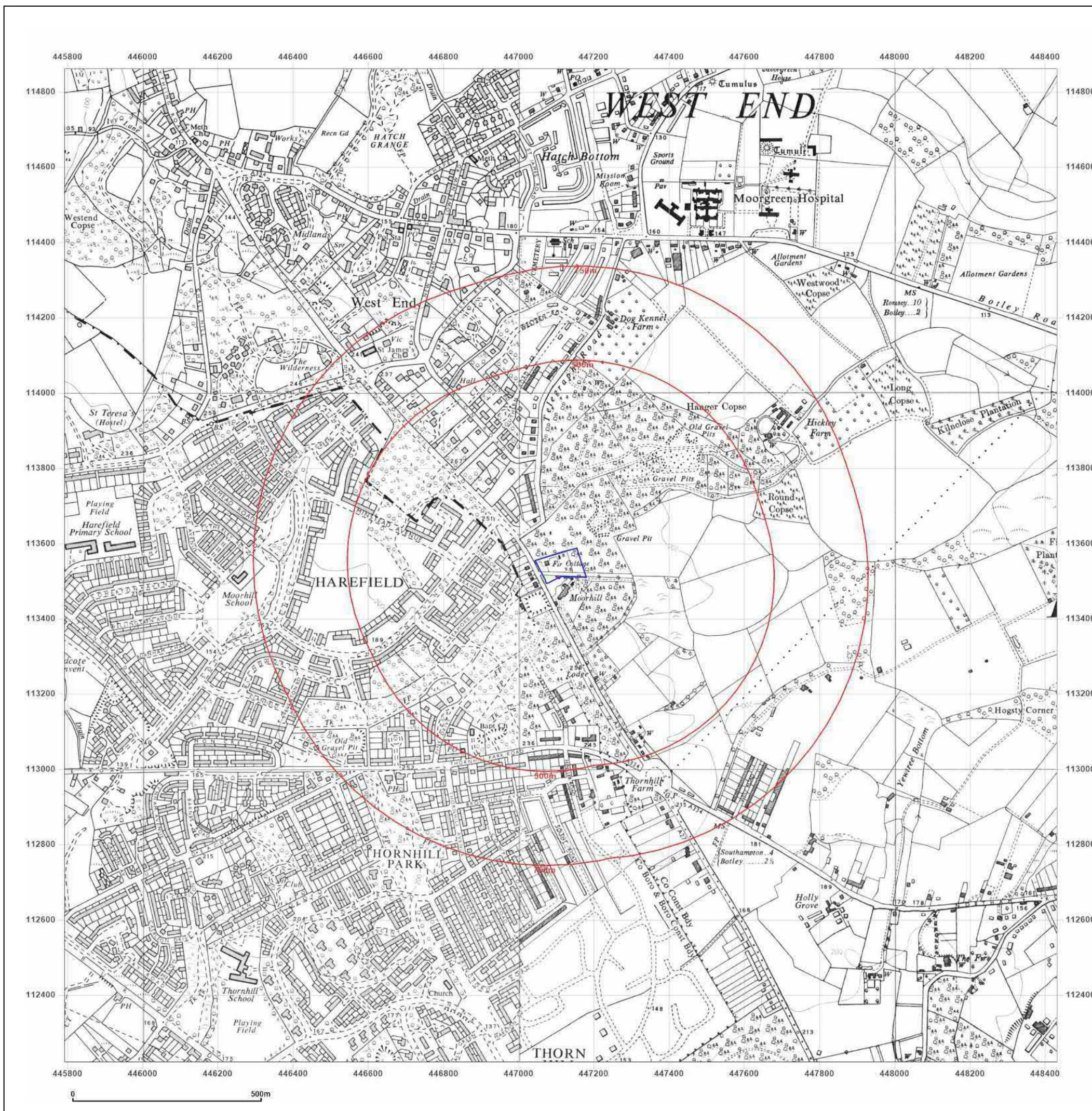


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Site Details:

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WEST END, SO30 3AZ

Client Ref: A11641
Report Ref: GS-8775594
Grid Ref: 447111, 113541

Map Name: Provisional

Map date: 1957

Scale: 1:10,560

Printed at: 1:10,560



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Revised 1957
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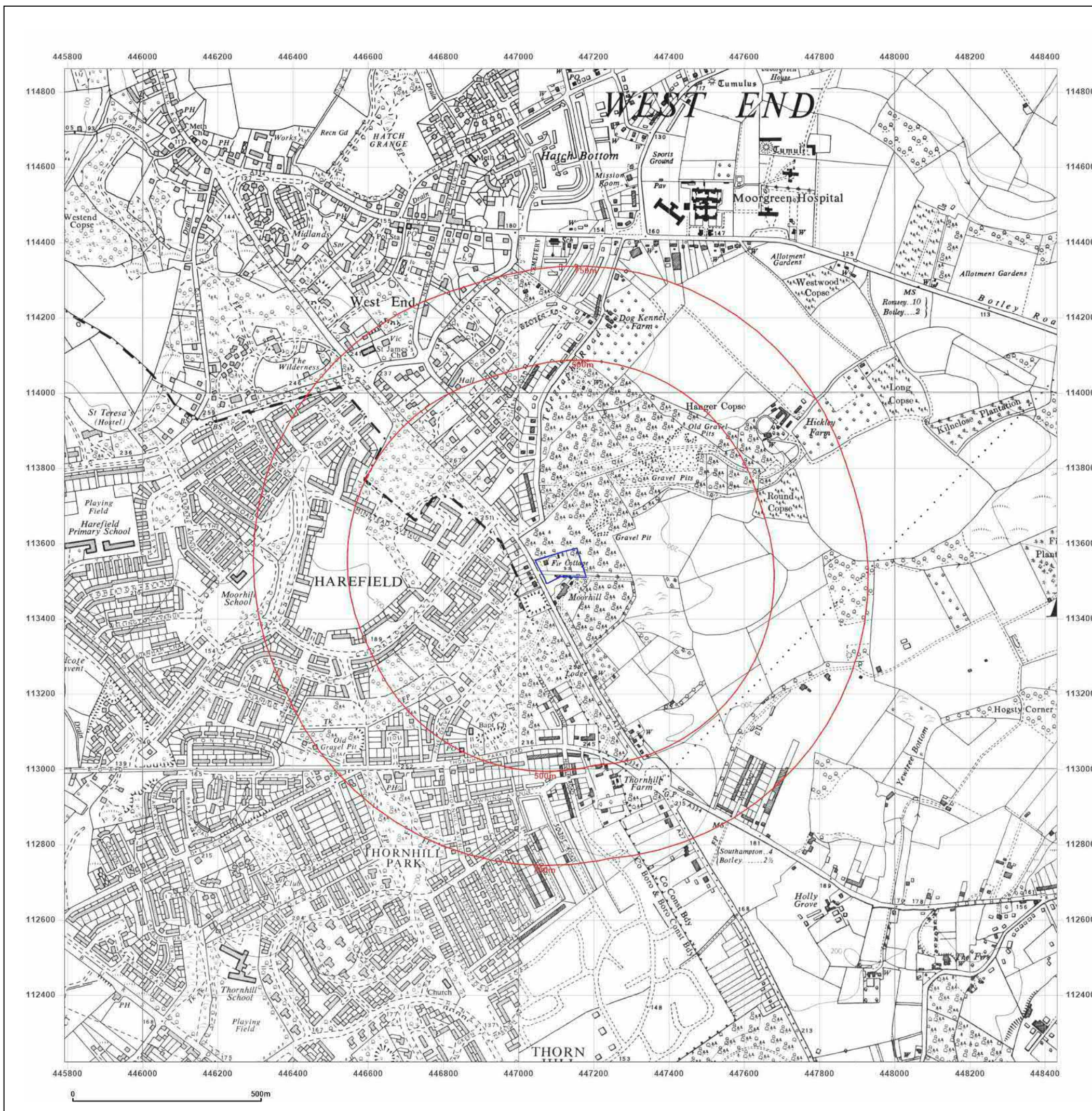


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Site Details:

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WEST END, SO30 3AZ

Client Ref: A11641
Report Ref: GS-8775594
Grid Ref: 447111, 113541

Map Name: Provisional

Map date: 1967

Scale: 1:10,560

Printed at: 1:10,560



Surveyed 1967
Revised 1967
Edition N/A
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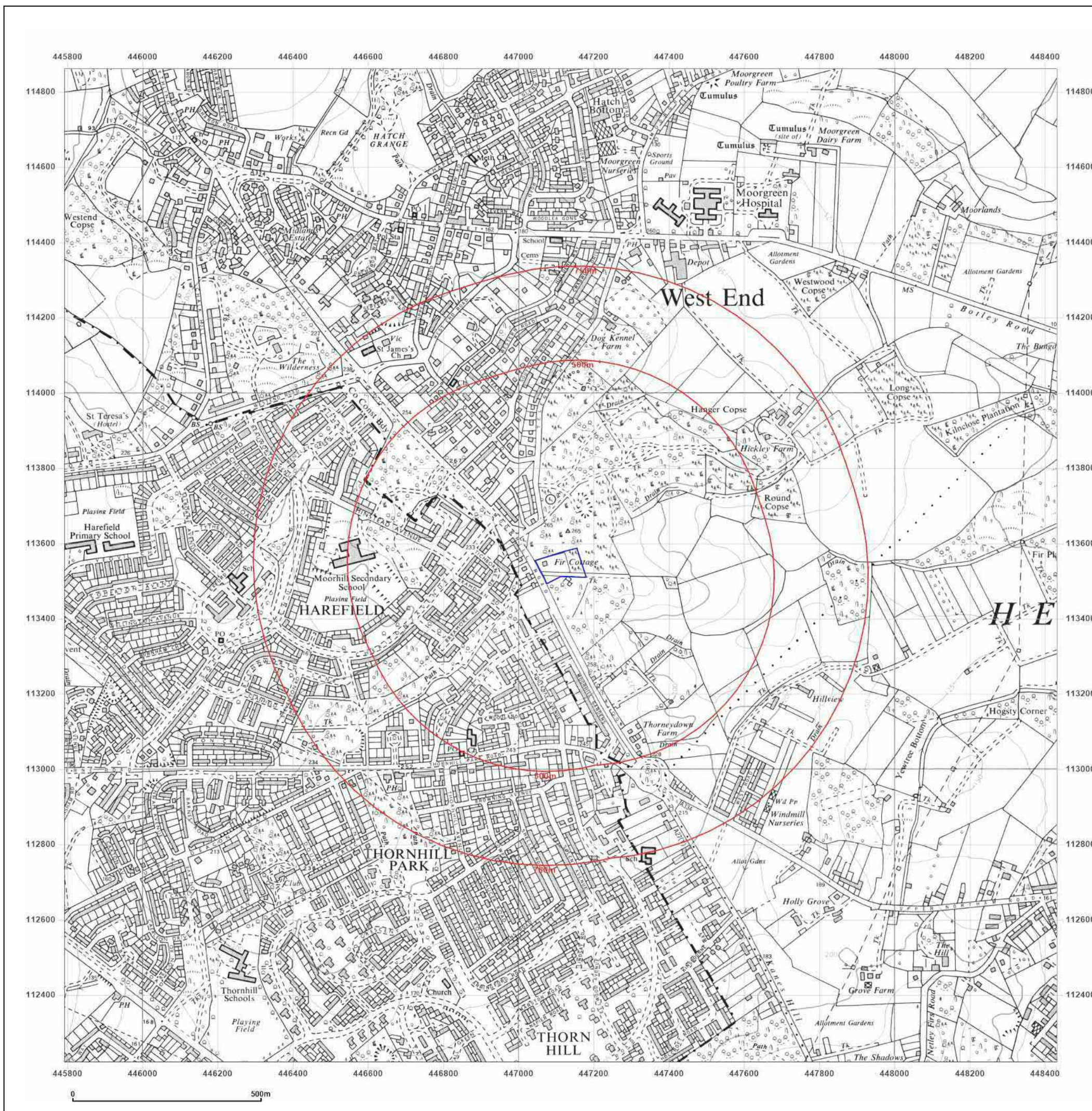


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Site Details:

MOORHILL, MOORHILL ROAD,
WEST END, SO30 3AZ

Client Ref: A11641
Report Ref: GS-8775594
Grid Ref: 447111, 113541

Map Name: National Grid

Map date: 1978

Scale: 1:10,000

Printed at: 1:10,000



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