Hydrock

Rail Central, Milton Malsor

Ground Conditions Desk Study for M1 Junction 15A Improvements

Final Report for

ASHFIELD LAND

July 2017, Updated February 2018

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1	14th July 2017	Original issue.
2	07th February 2018	Updated following EIA review – Site Boundary Change noted.

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Executive Summary and Conceptual Site Model

SITE INFORMATION AND SETTING	
Report Purpose	Phase 1 desk study and preliminary risk assessment.
Client	Ashfield Land.
Site Name and Location	Rail Central, Milton Malsor, M1 Junction 15A improvements. The main development site is located at to the south of the village of Milton Malsor, Northamptonshire. This report relates to proposed infrastructure improvements to Junction 15A of the M1 motorway. The junction is located on the southern side of Northampton at National Grid co-ordinates 472730, 257180.
Proposed Development	The proposed wider development consists of a Strategic Rail Freight Interchange (SRFI) and associated infrastructure improvements. This report relates to improvements at Junction 15A of the M1 motorway.
PHASE 1 (DESK STUDY + WALK-OVER)	
Current Land Use and Description	The site is approximately 72 ha in area. The area generally slopes from south to north, with lower ground along the northern, western and eastern edges associated with watercourses. Levels range between approximately 70m OD and 80m OD sloping from north to south. Current land uses consist of infrastructure (M1 motorway, A43 dual carriageway and the Grand Union Canal), agricultural land, and open land of no specific use. The site is immediately adjacent to Junction 15A of the M1 and Northampton Service Area. The Grand union Canal includes a flight of locks passing through the development area. There are four bridges on site, two carrying the M1 over the canal and A43, and two carrying slip roads over the canal. There is a farm (Shepherd's Lodge) at the eastern edge of the site and a derelict farm (Ham Farm) in the northeast. Land immediately to the southeast of junction 15A was formerly used as a construction compound, with stockpiles of material on the site of the former compound and land in the northeast of the development area at Milton Ham.
Site History	The Grand Union Canal was developed prior to the earliest available mapping. The London and Northwestern Railway was present on site on the earliest maps along the route of the present day A43. This was dismantled by 1980. The M1 was constructed in the mid 1960s.
Unexploded Ordnance	A non-specialist UXO assessment indicates low bomb risk. No further consideration of UXO is required.
Geology	The solid geology over the majority of the site consists of Whitby Mudstone. In the centre and east of the site, the older Marlstone Rock and Dyrham Formation outcrop in the watercourse channels. Alluvium is present along the watercourse channels, Till across the majority of the north and centre of the site and Glaciofluvial Deposits at the southern end of the site. There are small areas in the east, west and centre of the area where drift is absent. Made Ground is anticipated to be present at the site as a legacy of the construction of the various infrastructure elements, beginning with the canal and in turn the railway, the M1 and the A43. In general the Made Ground is likely to consist of reworked natural soils, however imported materials may be present, for example slag which was commonly used in construction of railway embankments.
Mining or Mineral Extraction	Land to the south of the site has been subject of mineral extraction including brick making and sand and gravel extraction since the earliest available mapping. The walkover suggests some topsoil may have been removed or excavated and stockpiled at the Travis Perkins land parcel.
Hydrogeology	The recorded aquifer status of the soils below the site: • Alluvium (Secondary Undifferentiated Aquifer). • Glaciofluvial Deposits (Secondary A Aquifer).

<table>
<tr><td></td><td colspan="2">• Glacial Till (Unproductive Strata).
• Whitby Formation (Unproductive Strata).
• Marlstone Rock Formation (Secondary A Aquifer).
• Dyrham Formation (Secondary Undifferentiated Aquifer).</td></tr>
<tr><td>Hydrology</td><td colspan="2">The site is crossed by two south to north flowing streams which are tributaries of the Wootton Brook and in turn the River Nene.
The Wootton Brook is immediately adjacent to the north of the site.
The River Nene is approximately 110m to the north.</td></tr>
<tr><td>Flood Risk</td><td colspan="2">The majority of the site is within Flood Zone 1 (low risk). The northern edge of the site is within Flood Zone 3 (high risk).</td></tr>
<tr><td>Radon</td><td colspan="2">The site is in a Radon Affected Area (1-3%).</td></tr>
<tr><td>Geotechnical Hazards from Desk Study</td><td colspan="2">The following geotechnical hazards may be applicable to the site:
• Flooding;
• Low strength, compressible ground;
• Attack of buried concrete due to aggressive ground conditions;
• Shrink / swell of clay;
• Running sands and shallow groundwater.</td></tr>
<tr><td rowspan="5">Possible Contaminant Linkages of Moderate or Greater Risk Level - From Desk Study</td><td colspan="2">The possible pollutant linkages on an un-remediated site determined by desk study and walk-over are summarised below for risk levels of moderate or greater.</td></tr>
<tr><td colspan="2">Source(s) ◄ potential Impact on ► Receptor(s)</td></tr>
<tr><td>Metals and other in-organics within Made Ground.</td><td>End users
Groundwater
Plant life</td></tr>
<tr><td>Asbestos within the Made Ground and existing buildings.</td><td>End users
Neighbours</td></tr>
<tr><td>Petroleum hydrocarbons in the Made Ground.</td><td>Groundwater</td></tr>
<tr><td colspan="3">ASSESSMENT AND CONCLUSIONS</td></tr>
<tr><td>Conclusions</td><td colspan="2">Based on historic land uses and its current operational use, the overall risk from land contamination at the site is considered to be low for the current development, and low for a re-developed site, but would need to be confirmed by appropriate intrusive investigation, testing and assessment of the results of the investigation.
Based on the available desk study and walk-over information, the following geotechnical issues need to be addressed in exploratory investigation:
• Extent and depth of low strength, compressible ground.
• Presence of sulphates within the Whitby Mudstone and Dyrham Formation, and potentially the Alluvium and Glacial Till;
• Potential for unstabile ground due to shrinkage and swelling of clay.
• Occurrence of running sands and shallow groundwater.</td></tr>
<tr><td colspan="3">FUTURE CONSIDERATIONS</td></tr>
<tr><td>Uncertainties and Limitations</td><td colspan="2">The desk study has identified soft, compressible soils within the areas of the proposed junction 15A improvements. Until the spatial extent and depth of these deposits are known it will not be possible to finalise geotechnical designs for the new infrastructure elements. However, it can be reasonably assumed at this stage that piled foundations will be required for the new bridges.</td></tr>
</table>

Further Work	In order to confirm the actual risks to receptors and confirm the ground conditions with respect to potential geotechnical and geo-environmental risks, an appropriate intrusive investigation will need to be undertaken. Based on the current data, this site investigation is proposed to comprise: • the excavation of trial pits to allow collection of samples for geotechnical and chemical analysis, to assess trench stability, over break potential, ease of excavation and allow soil infiltration rate testing to be undertaken; • cable percussive boreholes to allow collection of samples for geotechnical and chemical analysis of deeper soils and allow in-situ testing (SPTs) to be undertaken to allow foundation design, and allow the installation of gas and groundwater monitoring wells; • rotary coring to assess the deeper conditions at proposed bridge abutments; • Cone Penetration Testing (CPT) to assess settlement of the bridge approach embankments; • gas and groundwater monitoring installations to allow gas concentrations and groundwater levels to be monitored; • gas concentration and groundwater level monitoring; • geotechnical testing of soils and rock; and • contamination analyses of soil and groundwater.

This Executive Summary forms part of Hydrock Consultants Limited report number R/151171/003 (Issue 2) and should not be used as a separate document.

1.0 INTRODUCTION

1.1 Terms of Reference

In 2015, Hydrock Consultants Limited (Hydrock) are commissioned by Ashfield Land (the Client) to undertake a Desk Study and ground investigation works in relation to a proposed Strategic Rail Freight Interchange (SRFI) near the village of Milton Malsor, Northamptonshire. The development proposals include a number of infrastructure improvements including the layout of junction 15A of the M1 motorway on the southern side of Northampton. The junction includes north and southbound links between the M1 and the A43 as well as access to Northampton Service Area on the M1. A Site Location Plan (drawing 151171/D011) is provided at Appendix A.

It should be noted that the site area as indicated in this report was correct at the time of the desk study commission, walkover and writing, but has since changed. As this desk study covers a wider area than the current site boundary, no changes to the desk study have been included.

1.2 Objectives

The objectives of this investigation are to assess the readily available information on the likely ground conditions at the site.

1.3 Scope

The scope of work for this commission comprises:

- a desk study and site walk-over reconnaissance to determine the nature of the site and its surroundings including current and former land uses, geology, hydrogeology, hydrology and geo-environmental data; and
- reporting on findings.

See Appendix E for detailed reporting methodology.

1.4 Approach

The work has been carried out in general accordance with recognised best practice as detailed in guidance documents such as the CLR 11 M*odel Procedures* (Environment Agency 2004). The technical details of the approach and the methodologies adopted are given in Appendix E.

A recognised phased approach has been followed and this Phase 1 desk study and walk-over provides a preliminary assessment of the site conditions and the important factors that may require further investigation to reduce uncertainty. Recommendations for further work are listed in Section 6.0.

2.0 PRELIMINARY INVESTIGATION (PHASE 1 STUDY)

A number of desk study sources have been used to assemble the following information, including a proprietary environmental data report which has been obtained for the site (dated 19th June, 2017) and is presented in Appendix D.

2.1 Site Referencing

The site is referenced in Table 2.1.

Table 2.1: Site Referencing Information

Item	Brief Description
Site name	Rail Central, Milton Malsor, Junction 15A Improvements.
Site location and grid reference	The main development site is located at to the south of the village of Milton Malsor, Northamptonshire. This report relates to proposed infrastructure improvements to Junction 15A of the M1 motorway. The junction is located on the southern side of Northampton at National Grid co-ordinates 472730E, 257180N. Proposals cover a number of surrounding land parcels under various ownership.

A site location plan is provided in Appendix A (Drawing C151171/D011).

2.2 Site Description and Walk-Over Survey

A walk-over survey was undertaken on 19th June, 2017 to visually assess potential hazards and receptors. A basic site description is resented in Table 2.2 and selected walk-over photographs are presented in Appendix B. Photographs of the most important observations made during the walkover are provided at Appendix B and their locations indicated on drawing 151171/D012 at Appendix A.

Table 2.2: Site Description

Item	Brief Description
Site access	The site is accessed off spurs on the existing roundabouts on the northern and southern sides of the motorway junction. Land in the southwest is accessed via a track from the village of Rothersthorpe.
Site area	Approximately 72 ha.
Elevation, topography and any geomorphic features	The area generally slopes from south to north, with lower ground along the northern, western and eastern edges associated with watercourses. Levels range between approximately 70m OD and 80m OD sloping from north to south.

Item	Brief Description
Land Ownership	Land within the proposed highway improvements boundary is under the ownership of a number of parties: • Travis Perkins (Properties) Limited • Colin Geoffrey Clayton and Embark Services Limited; • Mickleton Limited; • F.J. Robinson and J. M. Beesley; • Aviva Life and Pensions UK Limited; • Highways England; • Canal and Rivers Trust; and • Blue Boar Motorways Limited. The locations of the various land parcels are shown on the appended drawing, reference 1692-7728/000507 (TerraQuest Limited)
Present land use	Land consists of infrastructure (M1 motorway, A43 dual carriageway and the Grand Union Canal), agricultural land, and open land of no specific use (Travis Perkins and Aviva parcels). There are four bridges on site, two carrying the M1 over the canal and A43, and two carrying slip roads over the canal. The Travis Perkins parcel includes derelict structures and a number of stockpiles of material. In addition, there are stockpiles of material on an area of the Mickleton land to the south of the M1. There is a farm (Shepherd's Lodge) in the east of the site. The buildings appeared in a relatively poor state of repair, albeit still in use to some extent. The Grand Union Canal incorporates a flight of locks along the section within the site area. The canal and tow path are used for leisure purposes. The canal passes under the M1 under a bridge immediately north of the bridge carrying the M1 over the A43, with a lock present directly under the motorway bridge.
Vegetation	There are densely wooded areas on land between the M1 carriageway and the slip roads. There is an area of relatively dense woodland within the Mickleton Land immediately to the west of the Grand Union Canal on the southern side of the M1. Elsewhere, trees are predominantly confined to field boundaries.
General site sensitivity	Generally the site is of low environmental sensitivity.
Site boundaries and surrounding land	Surrounding land is rural, with land to the north encroaching on to Northampton and to the southwest on the village of Rothersthorpe.

2.3 Site History

A study of historical Ordnance Survey maps (Appendix C) has been undertaken to identify any former land uses at the site and surrounding areas which may have geotechnical or geo-environmental implications for the proposed development and is summarised in Table 2.3.

Table 2.3: Key Features from Historical Mapping

Map Edition and Scale	Key Features on Site	Key Features off Site
1883 - 1884: 1:10,560	The site is essentially open farmland. The London and Northwestern Railway crosses the	A brickworks is present approximately 750m to the southwest.

Map Edition and Scale	Key Features on Site	Key Features off Site
	site orientated north-south approximately coincident with the present day A43. Ham Farm is shown in the northeast of the site in the present day Travis Perkins parcel (Milton Ham).	
1900 1:10,560	A spring is shown in the west of the site adjacent to the small area of trees.	A gravel pit is shown approximately 500m to the south.
1938 1:10,560	Little significant change.	A sand pit is shown approximately 450m to the south.
1958 1:10,560	Little significant change.	The brickworks to the southwest is no longer marked, although earthworks or clay pits are still shown.
1965 1:10,560	The M1 is now shown crossing the site. The location of the present day services is marked as a maintenance depot.	A sewage works is shown approximately 450m to the east.
1968 1:10,560	Little significant change.	An oil depot is marked at the site of the former brick works. A transport depot is shown where the sand pit was located 450m to the south.
1980 1:10,000	The railway is marked as dismantled.	Little significant change.
1981 1:10,000	Little significant change.	A sand pit is shown approximately 50m from the southwest of the site.
1993 1:10,000	The A43 is now marked on the route of the former railway. The road is single carriageway.	Little significant change.
2002 1:10,000	The A43 is now shown as dual carriageway.	The sand pit 50m to the southwest is marked as disused.

It is apparent from aerial photography available on the internet that an area of the Mickleton land parcel adjacent to the southern roundabout has been used in the past as a construction site compound. This is likely to relate to works on either the M1 or A43.

In summary, the canal and the London and Northwestern Railway were present on site prior to the earliest available mapping. Other areas have predominantly remained as farmland until the construction of the M1 in the mid-1960s. The A43 was constructed on the former railway in the early 1990s, with subsequent work to dual the route taking place in the late 1990s and early 2000s.

Since the last available mapping, Ham Farm has been demolished although demolition arisings remain on site. It is apparent that topsoil has been removed from an area in the north of the Ham Farm land parcel, with material stockpiled adjacent to the excavations. It is anticipated that the stockpiles are of the topsoil removed from the site surface. However, at the time of the walkover the stockpiles were vegetated and therefore it was not possible to determine with certainty what the stockpiled material consists of.

A number of smaller stockpiles are present on the Mickleton Land which are likely to be arisings from the former construction compound. Aside from the stockpiles, this field consisted of open grassland, with some fencing remaining as a legacy of the construction compound.

The surrounding land uses have included potentially contaminative activity including a sewage works, an oil depot and sand and landfilling of former sand pits. Given the proximity of the oil depot and sewage works relative to the site, it is unlikely significant impact has occurred. There is a possibility that ground gas could migrate to site from the nearby landfills where they have been infilled with organic or putrescible material. Whilst this may be significant for development of a building it is unlikely to be of concern in relation to the proposed highway improvements.

2.4 Unexploded Ordnance/Bombs

In general accordance with CIRIA Report C681 (Stone *et al* 2009) non-specialist UXO screening exercise has been carried out for the site. There is no indication of former military use from the desk study. Screening against the Zetica regional bomb risk map (Northamptonshire) indicates the site to be in an area where the bomb risk is low. A copy of the map is presented in Appendix D.

Since the available records of aerial bombing are interpreted by Zetica as low bomb risk, this suggests no further consideration of UXO is required.

2.5 Geology

The general geology of the site area is shown on the 1:50,000 geological map of Towcester (Sheet 202) and is summarised in Table 2.4.

Table 2.4: Geology

Location	Age	Stratigraphic Name	Description
Strip through centre/west of the site and eastern edge	Recent	Alluvium	Normally consolidated sandy clay.
Southern edge of site.	Pleistocene	Glaciofluvial Deposits	Sand and gravel.
Majority of site	Pleistocene	Glacial Till	Over consolidated gravelly clay with associated sand and gravel deposits.
Majority of site	Jurassic	Whitby Mudstone Formation	Dark grey, fossiliferous mudstone and siltstone with fine grained sandstone beds and fossiliferous limestones.
Strips along west and eastern sides of the site	Jurassic	Marlstone Rock Formation	Sandy, ooidal, ferruginous limestone with shell fragments.
Strips along west and eastern sides of the site	Jurassic	Dyrham Formation	Pale to dark grey, silty, sandy mudstone weathering to a yellow clay.

The solid geology over the majority of the site consists of Whitby Mudstone. In the centre and east of the site, the older Marlstone Rock and Dyrham Formation outcrop in the watercourse channels. Alluvium is present along the watercourse channels, Till across the majority of the north and centre of the site and Glaciofluvial Deposits at the southern end of the site. There are small areas in the east, west and centre of the area where drift is absent.

Made Ground is anticipated to be present at the site as a legacy of the construction of the various infrastructure elements, beginning with the canal and in turn the railway, the M1 and the A43. In general the Made Ground is likely to consist of reworked natural soils, however imported materials may be present, for example slag which was commonly used in construction of railway embankments.

2.6 Mining or Mineral Extraction

Mineral extraction has been undertaken in the general area, including the brick works, gravel pit and sand pits to the south and southwest of the site. The pits are shown on recent OS maps as 'disused'. There is no known mineral extraction within the site itself. The sand and gravel pits are associated with the Glaciofluvial Deposits which are present only at the southern edge of the M1 Junction 15A improvements site.

The walkover suggests some topsoil may have been removed or excavated and stockpiled at the Travis Perkins land parcel.

2.7 Hydrogeology

The aquifer designations given in Table 2.5 are based on the Environment Agency interactive aquifer designation map.

Table 2.5: Hydraulic Characteristics of Strata

Stratum	Aquifer Designation	Hydraulic Characteristics
Made Ground	Unclassified	The Made Ground is likely to be limited in extent and therefore received no formal classification. Generally it would be anticipated to consist of either low permeability reworked natural clays, or coarse soils used in the construction of infrastructure, which in turn would be drained to local surface waters. No significant volumes of water is anticipated to be stored within Made Ground.
Alluvium	Secondary A	The Alluvium is likely to consist of low permeability clay, possibly overlying a basal sand and gravel bed, or with discrete layers of sand. As such, lateral permeability is likely to be greater than vertical permeability. Groundwater within the Alluvium is likely to be in hydraulic continuity with the adjacent watercourses.
Glaciofluvial Deposits	Secondary A	The Glaciofluvial Deposits are likely to be coarse in nature and permeable both laterally and vertically.
Glacial Till	Secondary (undifferentiated)	Dominated by low permeability clay which is interbedded with moderate to high permeability layers of sand with occasional gravel;

Stratum	Aquifer Designation	Hydraulic Characteristics
		overall, this unit is likely to be anisotropic in nature with horizontal permeability greater than vertical permeability (i.e. kh>kv).
Whitby Mudstone	Non productive	The Whitby Mudstone is likely to be of low permeability both laterally and vertically. Locally, lateral permeability may be increased due to limestone bands or fissuring.
Marlstone Rock Formation	Secondary A	The Marlstone Rock is likely to consist of fractured limestone with significant permeability, both laterally and vertically. As the deposits of Marlstone Rock are typically a few metres in thickness under and overlain by relatively low permeability deposits, this unit is likely to be confined and groundwater within it may be under subartesian pressure.
Dyrham Formation	Secondary (undifferentiated)	Overall the Dyrham Formation is likely to be of low permeability. Beds of sand may be present within the Dyrham Formation which may increase the permeability, overall the lateral permeability is likely to be greater than the vertical permeability.

The site is not within a within a groundwater Source Protection Zone (SPZ). There are no licensed groundwater abstractions within 1000m of the site.

The majority of the site is covered by soils of high leaching potential.

2.8 Hydrology and Flooding

The surface water features in the vicinity of the site are listed in Table 2.6 and, where appropriate, are marked on the Site Zonation Plan in Appendix A.

Table 2.6: Surface Water Features

Feature	Location Relative to Site
Grand Union Canal	On site, west of A43.
Tributary of Wootton Brook	On site, west of A43 and Grand Union Canal.
Milton Malsor Brook	On site, eastern side.
Wootton Brook	Immediately adjacent to northern edge.
River Nene	1130m to the north.

There is one surface water abstractions for spray irrigation within 1000m of the site. This occurs upstream on the Wootton Brook and is therefore does not constitute a potential receptof from the perspective of contaminated land.

The desk study information indicates the majority of the boundary area of the Junction 15A improvements is in Flood Zone 1 (with low probability of flooding). However, areas of the north and east of the site are in Flood Zones 2 and 3 (with moderate and high probability of flooding respectively).

The environmental data report indicates a high risk of groundwater flooding to surface. This is likely to relate to the floodplain areas and associated Alluvium.

No further consideration of flood risk is undertaken in this report. Specialist flood risk advice should be sought with regards to drainage and flooding.

2.9 Waste Management and Hazardous Substances

Land immediately to the southeast of the site is registered by the Environment Agency as a former landfill site. The site was operated by Weldon Plant and received non-biodegradable wastes. The closure date is not reported.

The former sand pit located 50m to the west of the site is recorded as a former landfill operated by Mixconcrete Aggregates Limited and receiving inert waste. The last date of operation is listed as July 1986. A further historical licence is reported for land immediately to the west of the land pit, approximately 170m from the site. The licence covered deposition of inert waste, liquid waste and sludge and was surrendered in 1979.

There are no waste treatment, transfer or disposal sites within 500m of the site.

2.10 Previous Evidence of Known Contamination Events

There are no pollution incidents recorded on site. There are four minor incidents recorded in the environmental data report as having occurred within 500m of the site. These are considered unlikely to have had any impact on the site.

2.11 Natural Soil Chemistry

Information contained within the environmental data report (Appendix D) gives indicative natural concentration values (estimated) for the natural soils at the site for a selection of Contaminants of Potential Concern (CoPC). These have been reproduced in Table 2.7 below.

Table 2.7: Natural Soil Chemistry

Element	Arsenic	Cadmium	Chromium	Lead	Nickel
Concentration (mg/kg)	15 - 25	<1.8	60 - 120	<100	15 - 45

2.12 Radon

The radon risk has been assessed by reference to the *Indicative Atlas of Radon in England and Wales* (Miles *et a*l 2007) and Annex A maps in BR 211 (Scivyer 2007). This indicates that the site is in a Radon Affected Area where 1-3% of homes are above the action level and no radon protection measures are required for new buildings at this location in line with current guidance.

2.13 BGS Borehole Archive

A number of borehole logs from the BGS archive have been reviewed and indicate the following.

- SP75NW171, located at Milton Ham (Travis Perkins parcel), drilled to a depth of 5.5m. The borehole recorded Made Ground consisting of soil and brick rubble to 0.8m, Glacial Till to 5.0m and Whitby Mudstone (Lias Clay) to 5.5m.
- SP75NW957, located at the eastern end of Milton Ham adjacent to the Milton Malsor Brook, recorded sandy slightly gravelly clay (probably Glacial Till) to 2.7m, stiff silty clay with selenite crystals to 5.1m, a band of limestone to 5.3m, and stiff silty clay with selenite crystals to the base of the borehole at 8.0m. The silty clay is anticipated to be the Dyrham Formation based on geological mapping.
- SP75NW264, located adjacent to the Grand Union Canal and the Aviva Land, recorded silty and sandy slightly gravelly clay Alluvium to 2.5m, clay with ironstone gravel and fossils to 4.0m interpreted to be the Marlstone Rock, and laminated silty clay with pyrite to 10.0m, interpreted as the Dyrham Formation.
- SP75NW419, located adjacent to the canal overbridge on the northbound slip road, recorded soft becoming stiff, sandy slightly silty clay to 2.7m, interpreted as either Alluvium or Glacial Till, Glacial Till consisting of firm and stiff gravelly clay with bands of silt, sand and gravel to 10.8m, and clayey silt to 15.5m, interpreted as Whitby Mudstone.
- SP75NW426 located adjacent to the canal overbridge on the southbound slip road, recorded soft to firm gravelly clay with organic remains to 1.6m interpreted as Alluvium, a basal Alluvial gravel bed to 1.8m, stiff gravelly clay to 2.55m interpreted as Glacial Till, and stiff silty clay with occasional fossil remains to the base of the borehole at 12.0m, interpreted as Whitby Mudstone.
- SP75NW455 (trial pit), located on the route of the A43 approximately level with the minor road to rothersthorpe, records Made Ground consisting of clay and sand fill with pockets of ash to a thickness of 2.5m, relict topsoil to 2.8m overlying Glaciofluvial Sand and Gravel to the base of the pit at 4.0m.

3.0 PRELIMINARY CONCEPTUAL SITE MODEL

3.1 Physical Setting

The preliminary ground model of the site is the basis of the understanding of the ground conditions that will inform the geo-environmental exposure model and the geotechnical hazard assessment.

The site is broadly characterised by Jurassic geology, predominantly of Whitby Mudstone, and two approximately south to north flowing tributary streams of the River Nene, which expose older Jurassic units consisting of the Marlstone Rock and Dyrham Formation along shallow valley features. Deposits of Alluvium are present along the valley bottoms aligning the streams. Elsewhere, Glacial Till is present over the majority of the site, with the exception of the southern end which is overlain by Glaciofluvial sand and gravel.

The site has been extensively developed in terms of infrastructure but has remained as agricultural land elsewhere. Infrastructure consists of the canal, formerly a railway, now the A43, and the M1 and associated service station. The various infrastructure elements converge at Junction 15A, including the canal which is carried under the motorway infrastructure via bridges.

There are a number of stockpiles of material on site including demolition arisings and, probably, topsoil.

There are several landfilled sand pits adjacent to the southern end of the site. These primarily received inert materials, according to the terms of the licences.

The main details of the site and potential hazards are summarised on the Site Zonation Plan (Appendix A).

3.2 Geo-environmental Exposure Model

The preliminary exposure model is used for geo-environmental hazard identification and establishing potential contaminant linkages based on the contaminant-pathway-receptor approach.

3.2.1 Potential Contaminants

For the purpose of this assessment the potential contaminants have been separated according to whether they are likely to have originated from on-site or off-site sources.

Potential On-Site Sources of Contamination

- Made Ground possibly including metals, metalloids, asbestos, PAH and petroleum hydrocarbons.
- Demolition arisings including metals, metalloids, PAH and asbestos.
- Material in the existing buildings at Shepherd's Lodge including metals, metalloids, PAH and asbestos.

- Elevated metals within natural soils.

Potential Off-Site Sources of Contamination

- Adjacent landfills consisting of infilled sand pits.
- Petroleum hydrocarbons from filling stations at the service area.

3.2.2 Potential Receptors

- Development end use (buildings, utilities and landscaping).
- Surface waters.
- Groundwater (Secondary Aquifers)

It should be noted that health and safety risks to site contractors and maintenance workers have not been assessed during these works and will need to be considered separately.

3.2.3 Potential Pathways

- Humans: ingestion, skin contact, inhalation of dust and outdoor air.
- Plant life: root uptake.
- Surface water: overland flow.
- Surface water: drainage discharge.
- Surface water: base flow from groundwater.

3.2.4 Summary of Potential Contaminant Linkages

Table 3.1 lists the plausible contaminant linkages which have been identified. These are considered as potentially unacceptable risks in line with guidelines published in CLR 11 and additional risk assessment is required.

Linkages has been assessed in general accordance with guidance in CIRIA Report C552 (Rudland *et al* 2001) but with the addition of a 'no linkage' category. More details are given in Appendix E including descriptions of typical examples of probability and consequences.

It should be noted that whilst the risk assessment process undertaken in this report may identify potential risks to site demolition and redevelopment workers, consideration of occupational health and safety issues is beyond the scope of this report and need to be considered separately in the Construction Phase Health and Safety Plan.

		Consequence			
	product	**Severe**	**Medium**	**Mild**	**Minor**
Probability	**High Likelihood**	Very high risk	High risk	Moderate risk	Low risk
	Likely	High risk	Moderate risk	Low risk	Very low risk
	Low Likelihood	Moderate risk	Low risk	Low risk	Very low risk
	Unlikely	Low risk	Very low risk	Very low risk	Very low risk
	No Linkage	No risk			

Table 3.1: Exposure Model – Preliminary Risk Assessment of Source-Pathway-Receptor Contaminant Linkages

Source(s)	Possible Pathway(s)	Receptor(s)	Probability	Consequence	Risk Level	Comments
Metals, metalloids, PAH and asbestos present within the Made Ground, demolition arisings or stockpiled materials on site	Ingestion, inhalation or direct contact. Inhalation of fugitive dust. Leaching through unsaturated zone. Surface run-off, base flow from contaminated groundwater.	End users of the site. Neighbours. Groundwater and possible abstractors. Aquatic ecosystems. Surface water and possible abstractors.	Likely	Mild	Low	Whilst it is likely that these sources of contamination exist on site, the development proposals relate to infrastructure improvements which have limited scope for exposing receptors to linkages in the long term. Construction works will be considered separately under Risk Assessments and Method Statements prepared by the Contractor appointed to undertake the work.
	Root uptake.	Landscape planting.	Likely	Mild	Low	Landscaping to be designed by a specialist taking soil chemistry into consideration.
Metals, metalloids, PAH and asbestos present within existing buildings	Ingestion, inhalation or direct contact. Inhalation of fugitive dust.	End users of the site. Neighbours.	Likely	Minor	Very low	It is not known at this stage whether proposals would necessitate demolition of Shepherd's Lodge. Metals, metalloids, PAH and asbestos present within existing buildings can be removed safely at the demolition stage.
	Root uptake.	Landscape planting.	Likely	Minor	Very low	

Source(s)	Possible Pathway(s)	Receptor(s)	Probability	Consequence	Risk Level	Comments
Organic chemicals in the Made Ground.	Ingestion, inhalation or direct contact. Inhalation of fugitive dust. Leaching through unsaturated zone. Surface run-off, base flow from contaminated groundwater.	End users of the site. Neighbours. Groundwater and possible abstractors. Aquatic ecosystems. Surface water and possible abstractors.	Low likelihood	Medium	Low	The site includes a motorway service station and major trunk road, therefore it is possible that organic contaminants are present within the Made Ground. Organic contaminants are (if present) likely to be present as discrete plumes as opposed to pervasive contamination. There is no documentation of any spills or ongoing contamination issue as having taken place.
	Root uptake.	Landscape planting.	Low likelihood	Medium	Low	
Organic chemicals in the Made Ground.	Direct contact or contact with vapours.	Plastic etc. building products (degradation).	Low likelihood	Medium	Low	Any plumes of organic contamination present are likely to be removed or remediated during the development works. Post construction concentrations of organic contamination are unlikely to pose a significant vapour risk.
Sulphates present in the Made Ground, Whitby Mudstone and Dyrham Formation	Direct contact with dissolved sulphates.	Buried concrete.	Likely	Severe	High	Design sulphate class for concrete to be assessed in accordance with BRE Special Digest 1 (2005).
Asbestos fibres from asbestos-containing materials in the Made Ground	Fugitive dust.	End users of the site.	Low likelihood	Medium	Low	Proposals will not create any significant exposure pathways for end users. There are no densely populated areas immediately surrounding the site. Normal construction practice for controlling dust emission will mitigate temporary exposure during construction.
		Neighbours.	Low likelihood	Medium	Low	
	Fugitive dust.	End users of the site.	Low likelihood	Medium	Low	Asbestos may be present in old buildings.

Source(s)	Possible Pathway(s)	Receptor(s)	Probability	Consequence	Risk Level	Comments
Asbestos fibres from asbestos-containing materials in the buildings.		Neighbours.	Low likelihood	Medium	Low	Removal will be required. However, removal under controlled conditions should limit off-site emissions
Elevated concentrations of ground gases (methane & carbon dioxide) from biodegradable matter in the Made Ground, Alluvium or off-site source	Migration through soils or groundwater to indoor air.	End users of new buildings (asphyxiation or explosion).	No linkage	No linkage	No linkage	The Made Ground and Alluvium may be a source of ground gases, albeit significant gas concentrations associated with such materials would not be anticipated. There nearby off-site landfills to the south of the site. Gases are not significant to the proposed infrastructure improvement.
		Users of off-site properties (asphyxiation or explosion).	No linkage	No linkage	No linkage	
		New buildings (damage by explosion).	No linkage	No linkage	No linkage	The Made Ground and Alluvium may be a source of ground gases, albeit significant gas concentrations associated with such materials would not be anticipated
		Neighbouring properties (damage by explosion).	Unlikely	Severe	Low	
Radon	Migration through soils or groundwater to indoor air.	End users of new buildings.	No linkage	No linkage	No linkage	BR 211 (2007) radon advice indicates no radon protection measures are required, but considering the site is in a Radon Affected area (1-3%) consideration should be given to basic protection measures. Gases are not significant to the proposed infrastructure improvement.

3.3 Geotechnical Hazard Identification

Potential geotechnical hazards based on the expected ground conditions are listed below.

- Flooding - the site is within a known flood plain.
- Low strength, compressible ground – excessive settlement of foundations, roads and infrastructure elements.
- Attack of buried concrete by aggressive ground conditions – the development site may contain unknown Made Ground and potentially sulfate bearing soils. The Whitby Mudstone and Dyrham Formation are known to be high in naturally occurring sulphates and may have influenced local superficial deposits.
- Shrink / swell of clay – settlement / heave of foundations when located within the influence of trees and vegetation.
- Running sands and shallow groundwater, leading to difficulty with excavation due to trench collapse.

4.0 DESK STUDY CONCLUSIONS

Table 3.1 is a summary of the geo-environmental risks identified and the overall risk associated with the site has been designated using qualitative judgement according to the risk categories given in Table 4.1.

Based on historic land uses and its current operational use, the overall risk from land contamination at the site is considered to be **low** for the current development, and **low** for the proposed Junction Improvements, but would need to be confirmed by appropriate intrusive investigation, testing and assessment.

It is considered that it is unlikely that the site would be classified as Contaminated Land under Part 2A of the EPA 1990.

Table 4.1: Assessed Overall Risk Categories for the Site from Land Contamination

Risk Category	Definition
Very High Risk	A significant contaminant linkage, including actual evidence of significant harm or significant possibility and significant harm, is clearly identifiable at the site (e.g. from visual or documentary evidence) under current conditions, with potential for legal and/or financial consequences for the site owner or other Responsible Person. Remediation advisable based on acute impacts being likely. Immediate action should be considered.
High Risk	A contaminant linkage is identifiable at the site under current and future use conditions. Although likely, there is no obvious actual evidence of significant harm or significant possibility and significant harm under current conditions. Extent of risk is therefore subject to confirmation by investigation and risk assessment and most likely to be deemed significant. Realisation of the risk is likely to present a substantial liability to the site owner or other Responsible Person. Remediation required for redevelopment and may also be required under Part 2A for existing receptors.
Moderate Risk	A contaminant linkage is identifiable at the site under current and future use conditions. However, it is not likely to be a significant linkage under current conditions. It is either relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely, that the harm would be relatively mild. Actual extent of risk subject to confirmation by additional investigation and risk assessment and most likely to lie between no possibility of harm (under current conditions) and significant possibility of significant harm (under conditions created by new use). Remediation may be required for redevelopment.
Low Risk	Potential pathways and receptors exist but history of contaminative use or site conditions indicates that contamination is likely to be of limited extent and below the level of possibility of harm. It is unlikely that the site owner or other Responsible Person would face substantial liabilities from such a risk. Precautionary investigations and risk assessment advisable on change of use. Any subsequent remedial works are likely to be relatively limited.
Very Low Risk	No contaminant linkage likely to exist under current or future conditions, but this cannot be completely discounted. If harm is realised, it is likely at worst to be mild or minor. Site not capable of being determined under Part 2A where the Local Authority inspects the site. Precautionary investigations and risk assessment advisable on change of use. Otherwise no further action recommended.
No Risk	No contaminant linkage exists.

5.0 UNRESOLVED ISSUES, UNCERTAINTIES AND LIMITATIONS

5.1 Site-Specific Comments

The Phase 1 investigation has highlighted a number of issues that require intrusive investigation and assessment to inform the design of the proposed development. The main risks are in the ground conditions, specifically the extent and depth of the soft, compressible Alluvium and the presence of sulphates in the Whitby Mudstone and Dyrham Formation (and possibly the superficial deposits also).

It will be necessary to undertake intrusive work prior to finalising the designs of the infrastructure elements. However, it can be reasonably assumed that piled foundations will be required for the new bridges.

It should be noted that the site area as indicated in this report was correct at the time of the desk study commission, walkover and writing, but has since changed. As this desk study covers a wider area than the current site boundary, no changes to the desk study have been included.

Works will have to be undertaken in accordance with Highways England design procedures, including preparation of a Ground Investigation Report (GIR) and Geotechnical Design Report (GDR) in accordance with HD22/08. The Canal and Rivers Trust will also require consultation with regard to any engineering works proposed in the vicinity of the Grand Union Canal.

5.2 General Comments

This report details the findings of work carried out in June 2017. The report has been prepared by Hydrock on the basis of available information obtained during the study period. Although every reasonable effort has been made to gather all relevant information, all potential environmental constraints or liabilities associated with the site may not have been revealed.

The report has been prepared for the exclusive benefit of Ashfield Land and those parties designated by them for the purpose of providing geotechnical and geo-environmental recommendations for the site. The report contents should only be used in that context. Furthermore, new information, changed practices or new legislation may necessitate revised interpretation of the report after the date of its submission.

Information provided by third parties has been used in good faith and is taken at face value; however, Hydrock cannot guarantee its accuracy or completeness. It is assumed that previous reports provided have been assigned to the Client and can be relied upon. Should this not be the case Hydrock should be informed immediately as additional work may be required.

The work has been carried out in general accordance with recognised best practice. The various methodologies used are explained in Appendix E. Unless otherwise stated, no assessment has been made for the presence of radioactive substances or unexploded ordnance. Where the phrase ‘suitable for use’ is used in this report, it is in keeping with the terminology used in planning control and does not imply any specific warranty or guarantee offered by Hydrock.

The preliminary risk assessment process may identify potential risks to site demolition and redevelopment workers. However, consideration of occupational health and safety issues is beyond the scope of this report.

Please note that notwithstanding any site observations concerning the presence or otherwise of archaeological sites, asbestos-containing materials or invasive weeds such as Japanese knotweed, this report does not constitute a formal survey of these potential hazards.

Any site boundary line depicted on plans does not imply legal ownership of land.

6.0 RECOMMENDATIONS FOR FURTHER WORK

In order to confirm the actual risks to receptors and confirm the ground conditions with respect to potential geotechnical and geo-environmental risks, an appropriate intrusive investigation will need to be undertaken. Based on the current data, this site investigation is proposed to comprise:

- the excavation of trial pits to allow collection of samples for geotechnical and chemical analysis, to assess trench stability, over break potential, ease of excavation and allow soil infiltration rate testing to be undertaken;
- cable percussive boreholes to allow collection of samples for geotechnical and chemical analysis of deeper soils and allow in-situ testing (SPTs) to be undertaken to allow foundation design, and allow the installation of gas and groundwater monitoring wells;
- rotary coring to assess the deeper conditions at proposed bridge abutments;
- Cone Penetration Testing (CPT) to assess settlement of the bridge approach embankments;
- gas and groundwater monitoring installations to allow gas concentrations and groundwater levels to be monitored;
- gas concentration and groundwater level monitoring;
- geotechnical testing of soils and rock; and
- contamination analyses of soil and groundwater.

7.0 REFERENCES

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Appendix A

Drawings

Drawings included in this report:

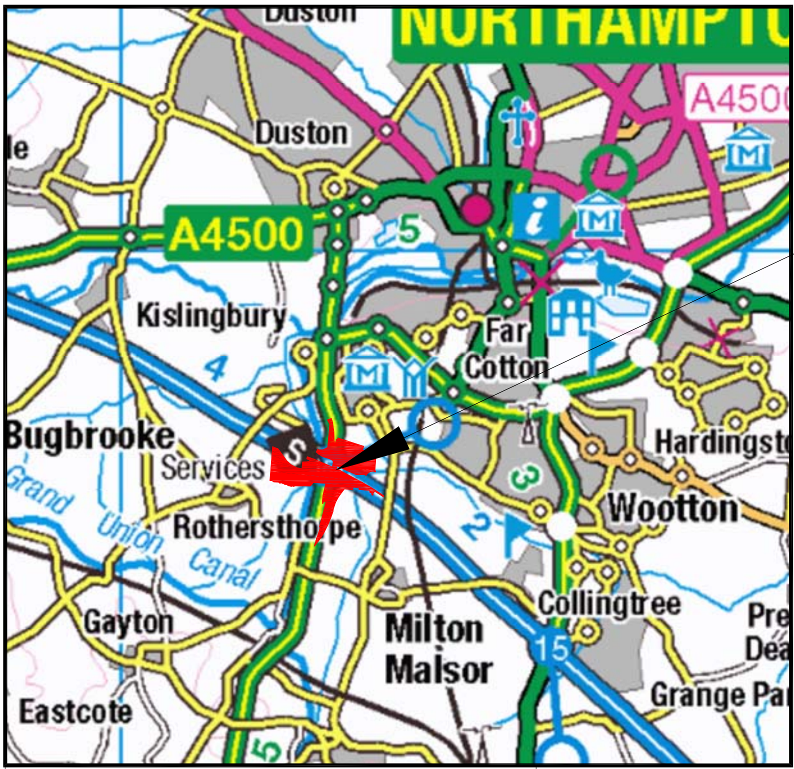
151171/D009 – Junction 15A Improvements, Geology Plan

151171/D010 – Junction 15A Improvements, Site Zonation Plan

151171/D011 – Junction 15A Improvements, Site Location Plan

151171/D012 – Junction 15A Improvements, Photograph Location Plan

Notes:
1. Contains Ordnance Survey data © Crown copyright and database right 2014



THE SITE

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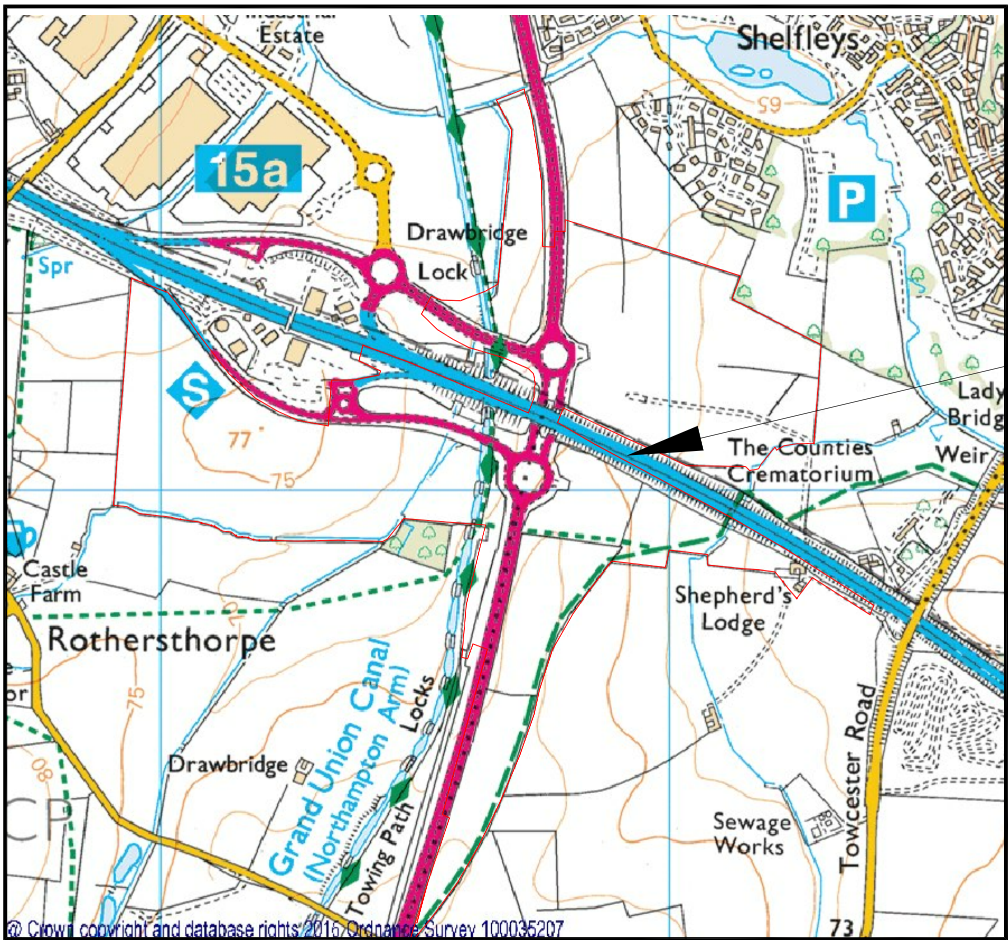

THE SITE

0m 200m 400m 600m 800m 1000m Scale = 1:15,000

Rev	Date	Description	By	Ckd

Architect :

Hydrock

www.hydrock.com

Client :

ASHFIELD LAND

Project Title:

RAIL CENTRAL, MILTON MALSOR

Drawing Title:

Junction 15A Improvements - Site Location Plan

Drawing Status:

FINAL

Hydrock Job No: C151171

Drawn	Checked	Scale @ A4	Date	Issue Date
RB	AB	See Drawing	27/06/17	27/06/17

Drawing Number: C151171/D011 Revision: -

Notes:

1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.

2. This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications.

LEGEND

Site Boundary

Photograph location and orientation

Rev	Date	Description	By	Ckd

Architect :

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Holdenby Road
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NN6 8LD
T +44 (0)1604 842888
northampton@hydrock.com
www.hydrock.com

Client :

ASHFIELD LAND

Project Title:

RAIL CENTRAL, MILTON MALSOR

Drawing Title:

Junction 15A Improvements - Photograph Location Plan

Drawing Status:

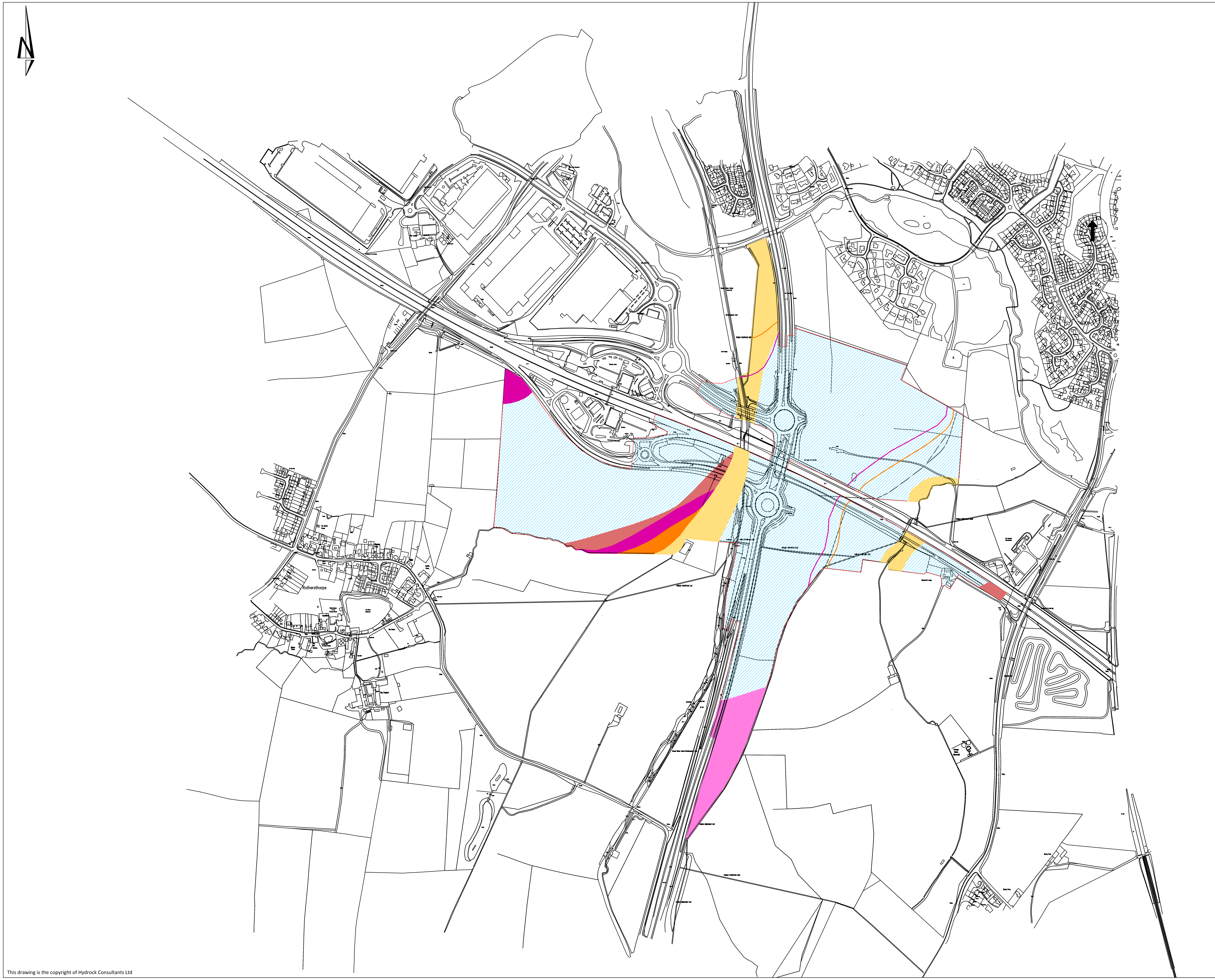
INFORMATION

Hydrock Job No: C151171

Drawn	Checked	Scale @ A1	Date	Issue Date
RB	AB	1:5000	27/06/17	27/06/17

Drawing Number: C151171/D012

Revision: -



Notes:

1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.

2. This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications.

LEGEND

- Site Boundary
- Alluvium
- Glaciofluvial Deposits
- Glacial Till
- Whitby Mudstone
- Marlstone Rock
- Marlstone Rock (subcrop under drift)
- Dyrham Formation
- Dyrham Formation (subcrop under drift)

Rev	Date	Description	By	Ckd

Architect :

Hydrock

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Holdenby Road
Spratton, Northampton
NN6 8LD
T +44 (0)1604 842888
northampton@hydrock.com
www.hydrock.com

Client :

ASHFIELD LAND

Project Title:

RAIL CENTRAL, MILTON MALSOR

Drawing Title:

Junction 15A Improvements - Site Geology Plan

Drawing Status:

INFORMATION

Hydrock Job No: C151171

Drawn	Checked	Scale @ A1	Date	Issue Date
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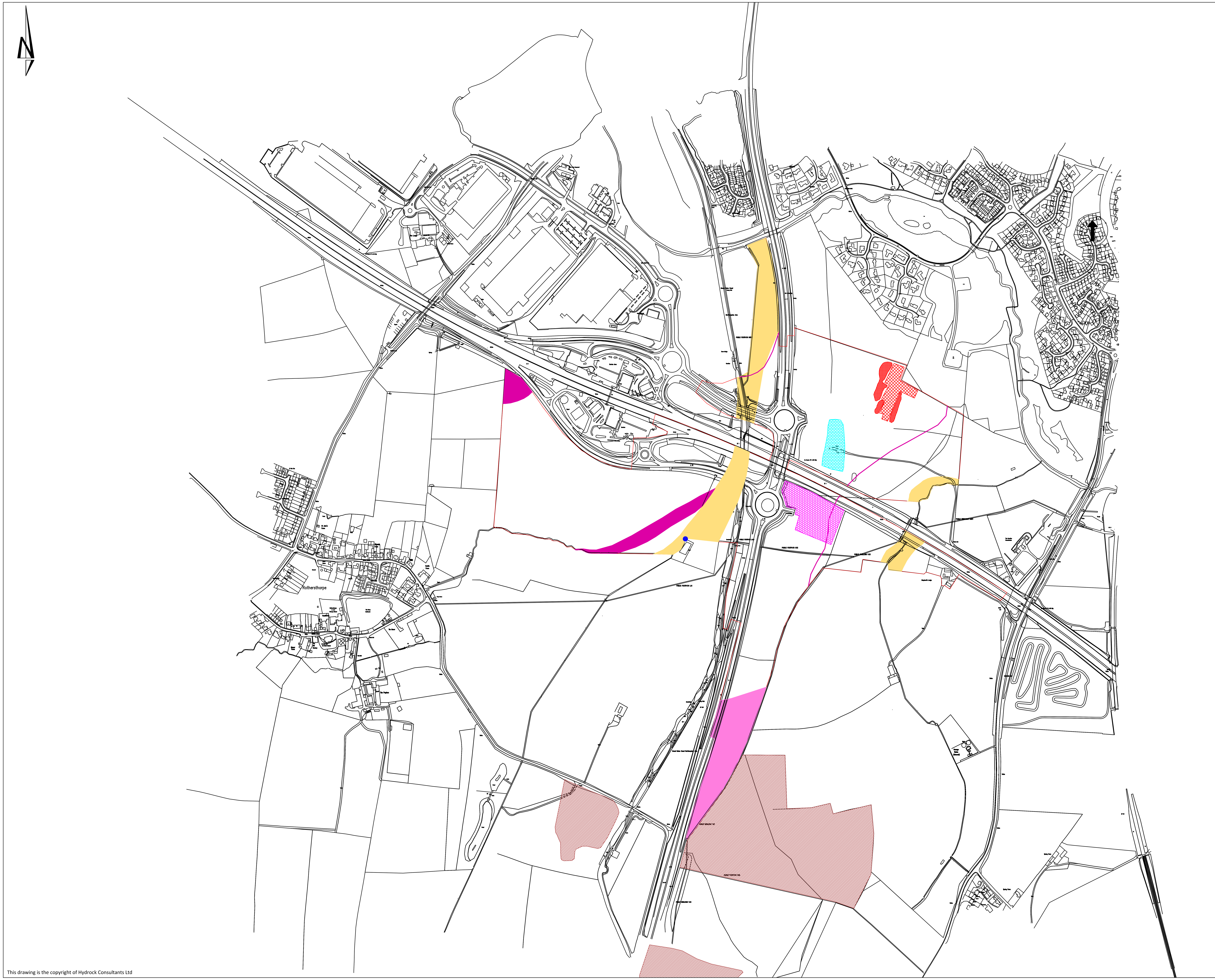
Drawing Number:	Revision:
C151171/D009	-



Notes:

1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.
2. This drawing is to be read in conjunction with all relevant Engineers' and Service Engineers' drawings and specifications.

LEGEND

- Site Boundary
- Alluvium (high groundwater, compressible deposit)
- Glaciofluvial Deposits (running sand, unstable excavations)
- Marlstone Rock (potential occurrence of springs or groundwater ingress into excavations)
- Marlstone Rock (subcrop under drift)
- Area where Topsoil removed
- Stockpiled material
- Former Milton Ham farm, demolition stockpiles
- Former construction compound
- Former sand and gravel workings
- Spring indicated on historic mapping

Rev	Date	Description	By	Ckd

Architect :

Hydrock

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northampton@hydrock.com
www.hydrock.com

Client :

ASHFIELD LAND

Project Title:

RAIL CENTRAL, MILTON MALSOR

Drawing Title:

Junction 15A Improvements - Site Zonation Plan

Drawing Status:

INFORMATION

Hydrock Job No:

C151171

Drawn	Checked	Scale @ A1	Date	Issue Date
RB	AB	1:5000	27/06/17	27/06/17

Drawing Number:	Revision:
C151171/D010	-

Appendix B

Site Walkover Photographs

Figure 1: stockpiles of material in Travis Perkins land parcel at Milton Ham. The material appears to be topsoil removed from an area in the north of the Travis Perkins land. The stockpiles are heavily overgrown so this could not be confirmed.

Figure 2: Topsoil removed in the vicinity of the stockpiles.

Figure 3: Demolition arisings at Ham Farm in the Travis Perkins land parcel at Milton Ham.

Figure 4: demolition arisings on the southeast side of Junction 15A in the Mickleton land parcel. This field was the site of a construction compound.

Figure 5: Further stockpiled arisings or materials at the former construction compound.

Figure 6: Shepherd's Lodge in the east of the site.

Figure 7: View facing north under the bridge carrying the M1 over the Grand Union Canal.

Figure 8: View facing south from the same location showing the bridge carrying the northbound slip road in the background.

Figure 9: view facing south under the bridge carrying the southbound slip road.

Figure 10: Low lying ground on the Alluviual floodplain beyond the Canal on the southern side of the M1.

Appendix C

Historical Ordnance Survey Maps

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_1
Grid Ref: 471402, 255729

Map Name: County Series

Map date: **1883-1884**

Scale: 1:10,560

Printed at: 1:10,560

N
W E
S

Surveyed 1883
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1883
Revised 1883
Edition N/A
Copyright N/A
Levelled N/A

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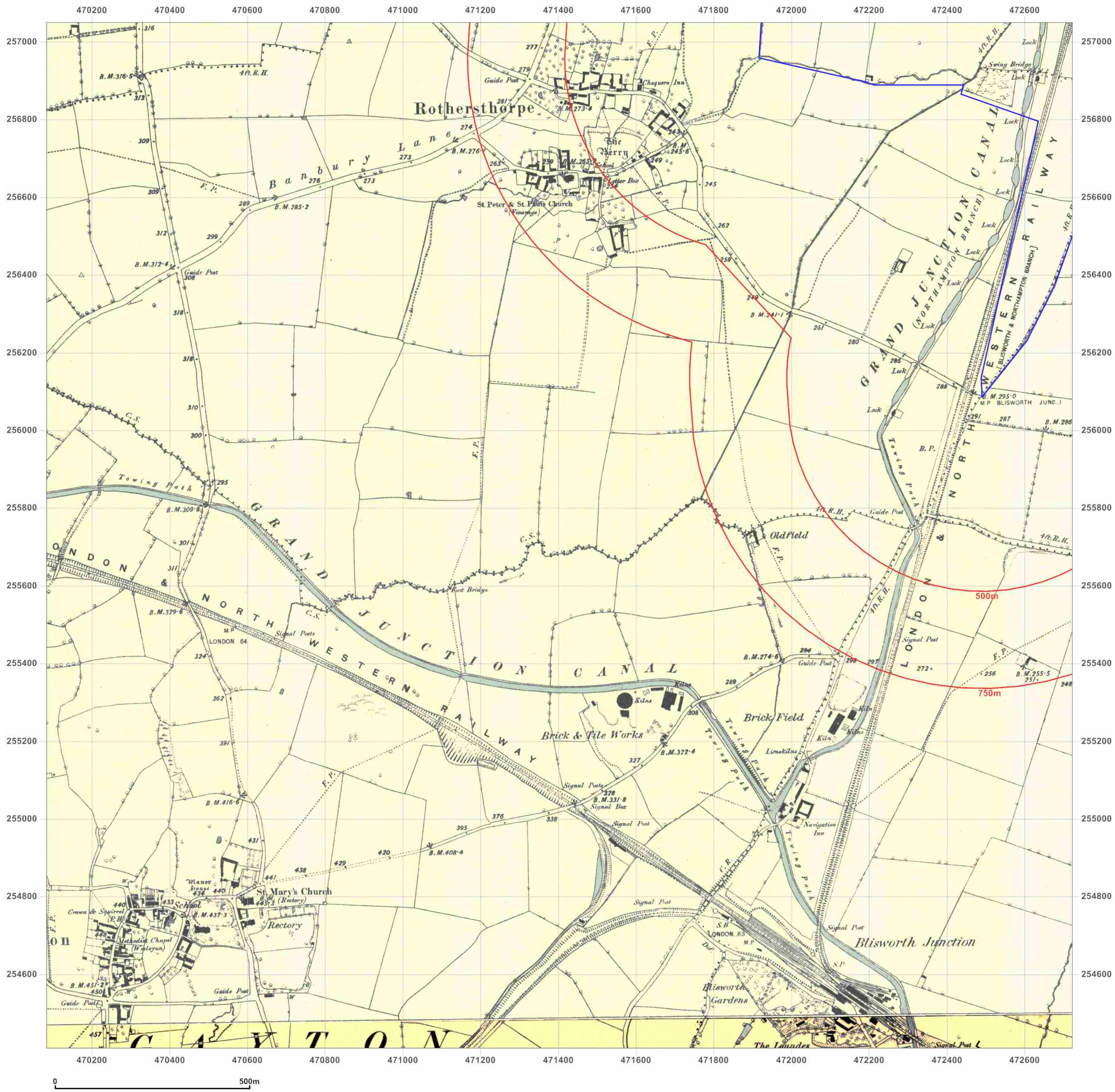
Groundsure Insights
T: 08444 159000
E: info@groundsure.com
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



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Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_1
Grid Ref: 471402, 255729

Map Name: County Series

Map date: **1883-1884**

Scale: 1:10,560

Printed at: 1:10,560

N
W E
S

Surveyed 1883
Revised 1883
Edition N/A
Copyright N/A
Levelled N/A

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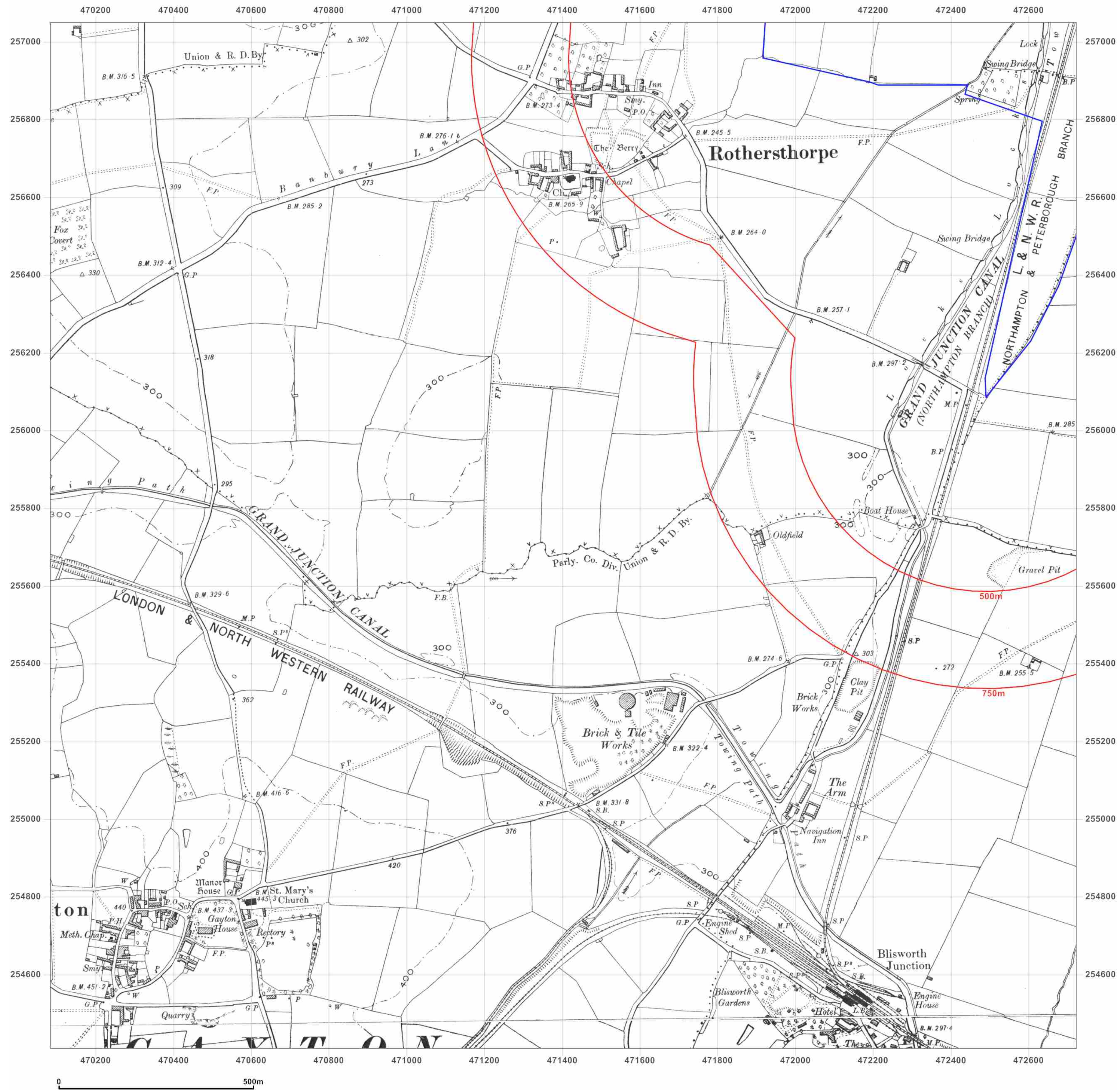

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Site Details:

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Client Ref: POP009664
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Map Name: County Series

Map date: **1899-1900**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1883
Revised 1900
Edition 1900
Copyright N/A
Levelled N/A

Surveyed 1883
Revised 1899
Edition N/A
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Production date: 19 June 2017

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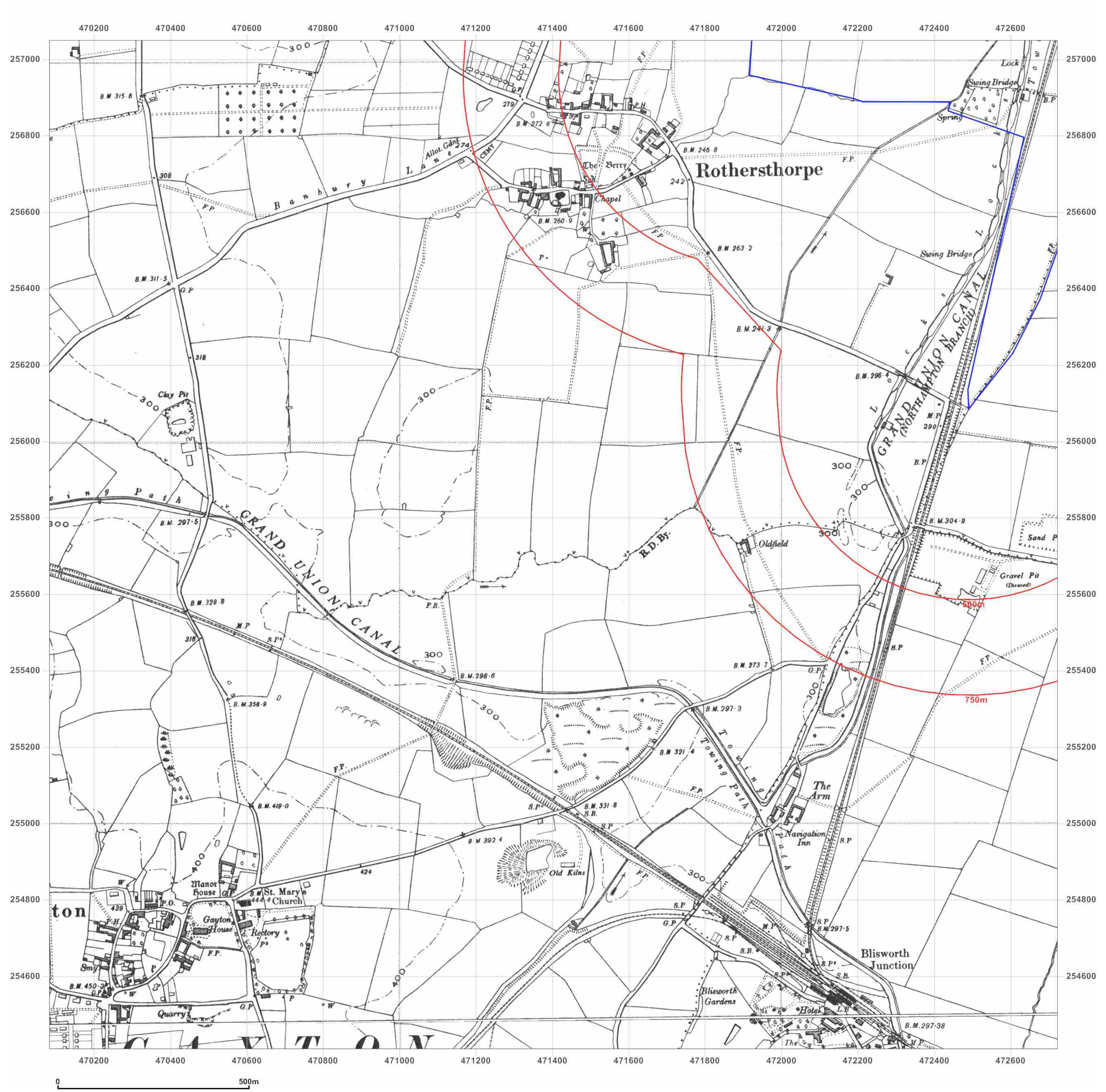

Groundsure INSIGHTS

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472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_1
Grid Ref: 471402, 255729

Map Name: County Series

Map date: 1950

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1883
Revised 1950
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1883
Revised 1950
Edition N/A
Copyright N/A
Levelled N/A

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Production date: 19 June 2017

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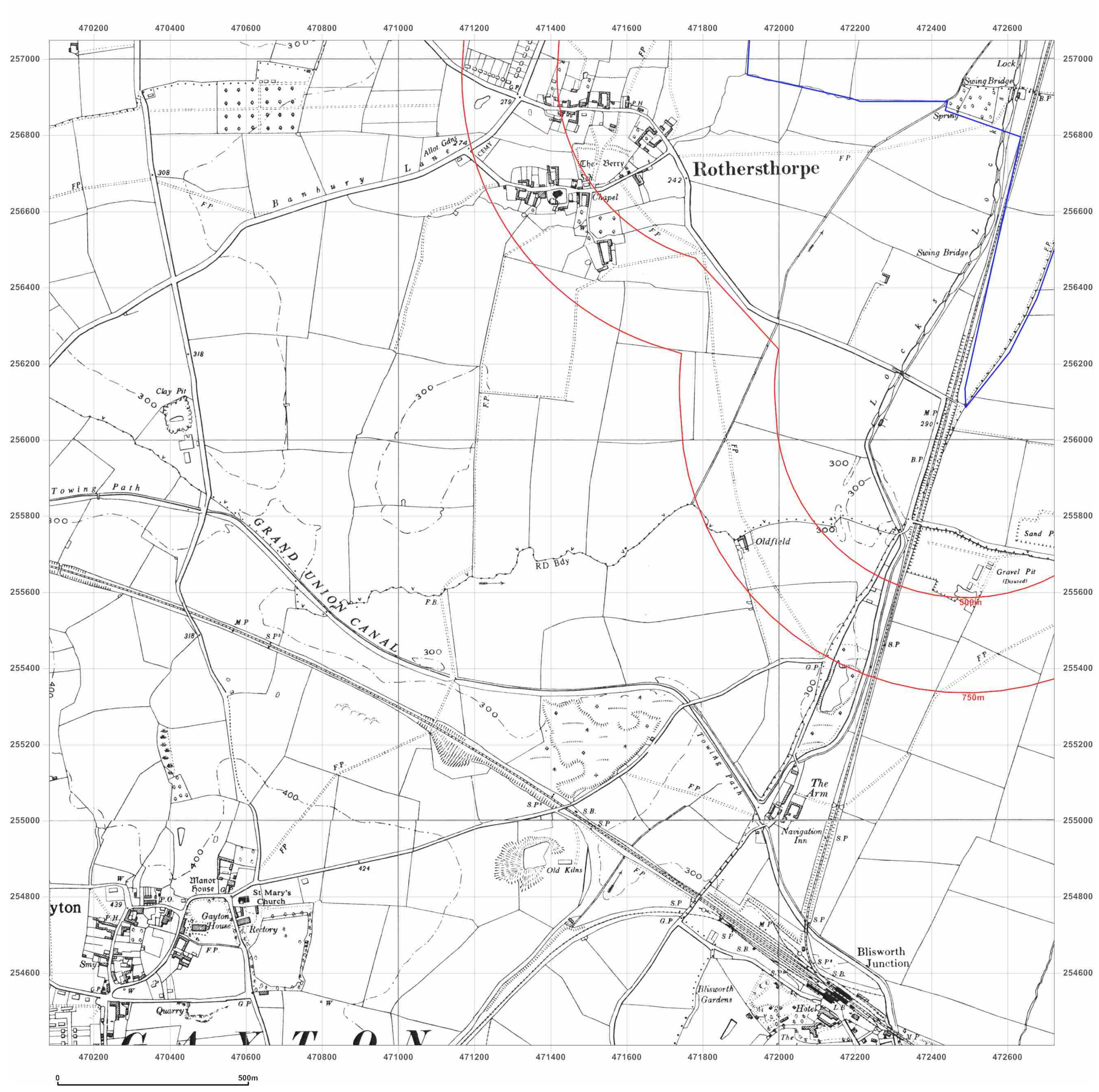

Groundsure INSIGHTS

Site Details:

472716, 257183

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Report Ref: GS-4001370_SS_1_1
Grid Ref: 471402, 255729

Map Name: Provisional

Map date: **1958**

Scale: 1:10,560

Printed at: 1:10,560

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Surveyed N/A
Revised 1957
Edition N/A
Copyright 1958
Levelled N/A

Surveyed N/A
Revised 1957
Edition N/A
Copyright 1958
Levelled N/A

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Production date: 19 June 2017

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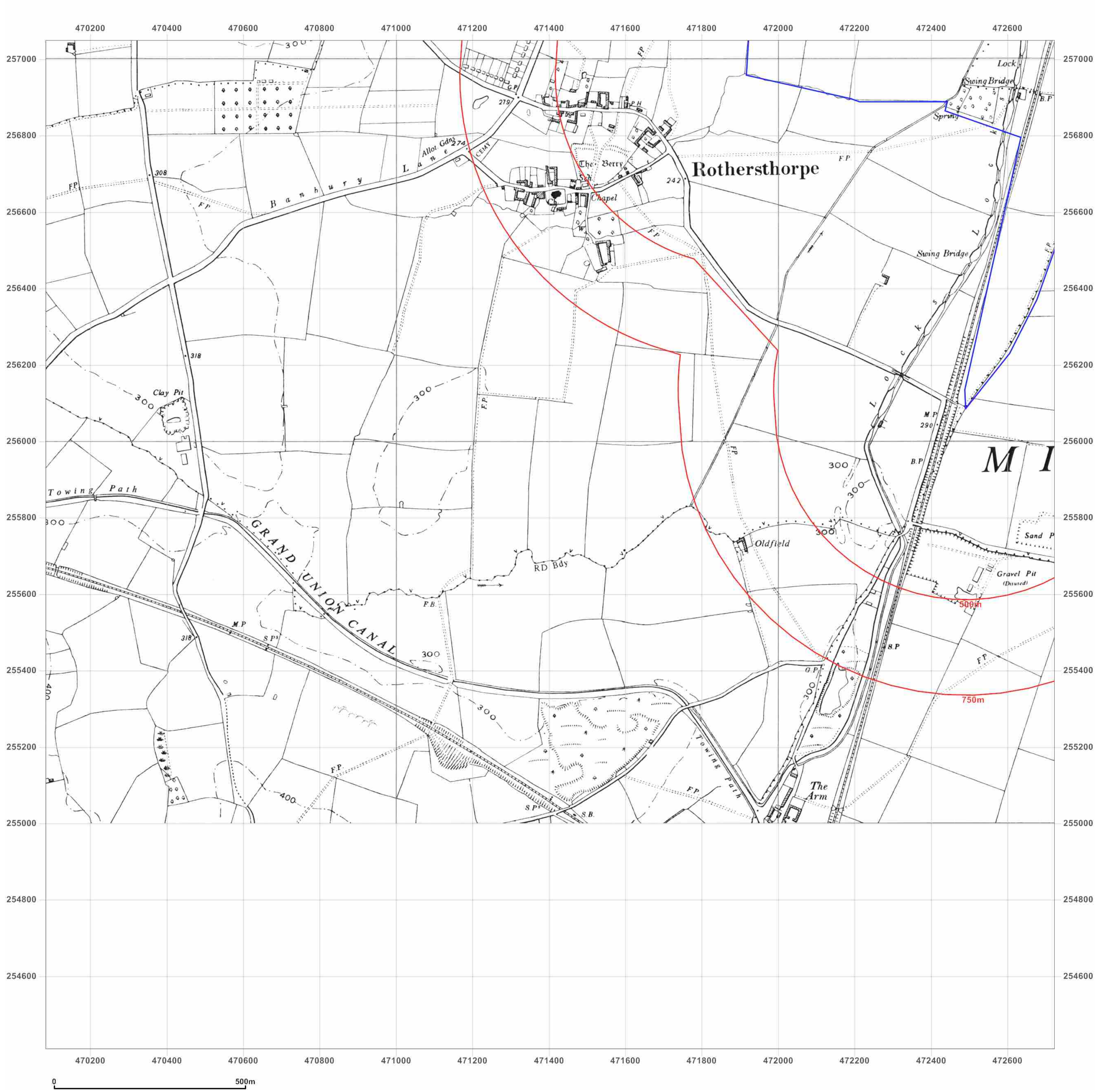

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_1
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Map Name: Provisional

Map date: **1965**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed N/A
Revised 1964
Edition N/A
Copyright 1965
Levelled N/A

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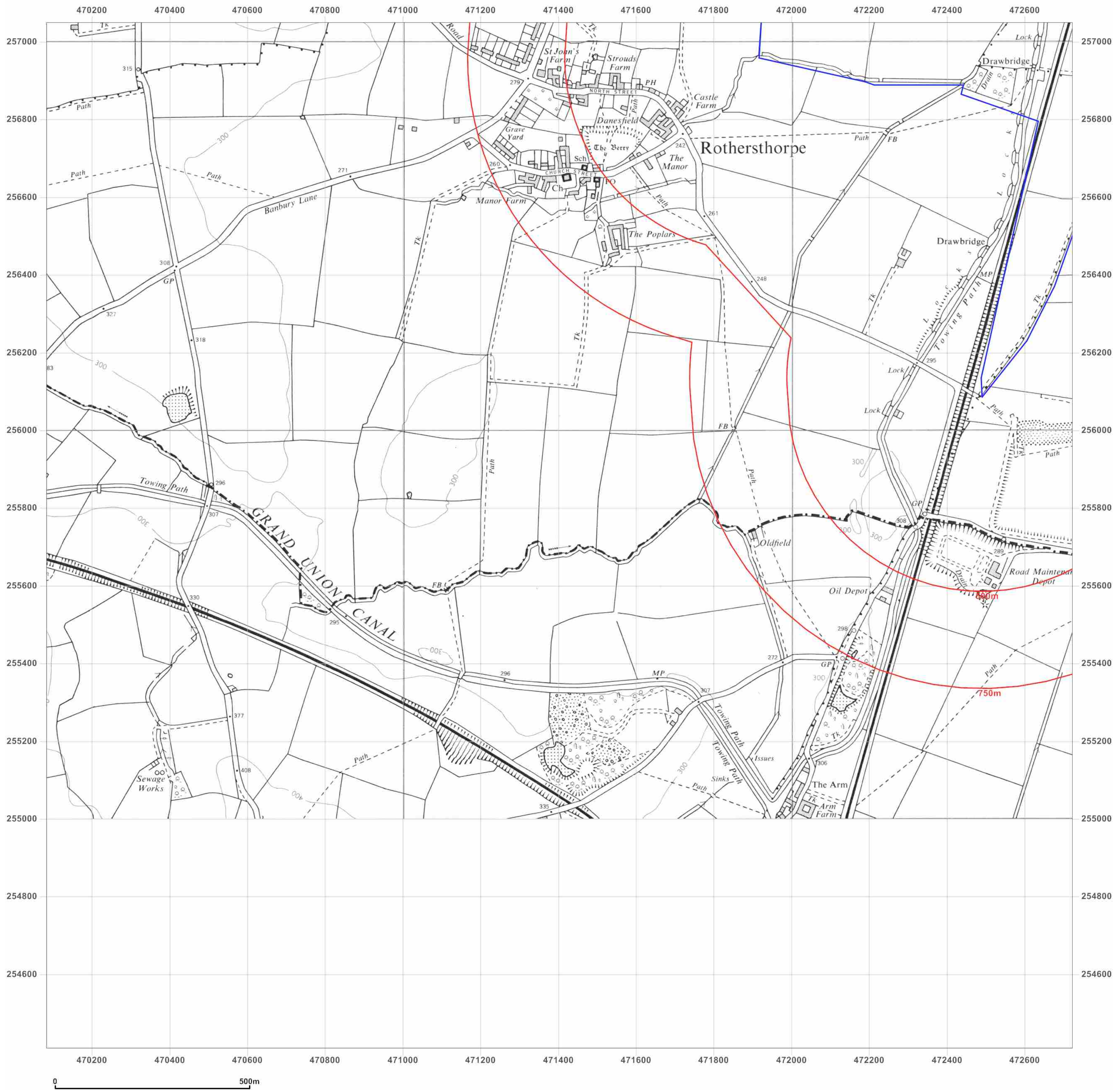
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_1
Grid Ref: 471402, 255729

Map Name: Provisional

Map date: **1968**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1968
Revised 1968
Edition N/A
Copyright N/A
Levelled N/A

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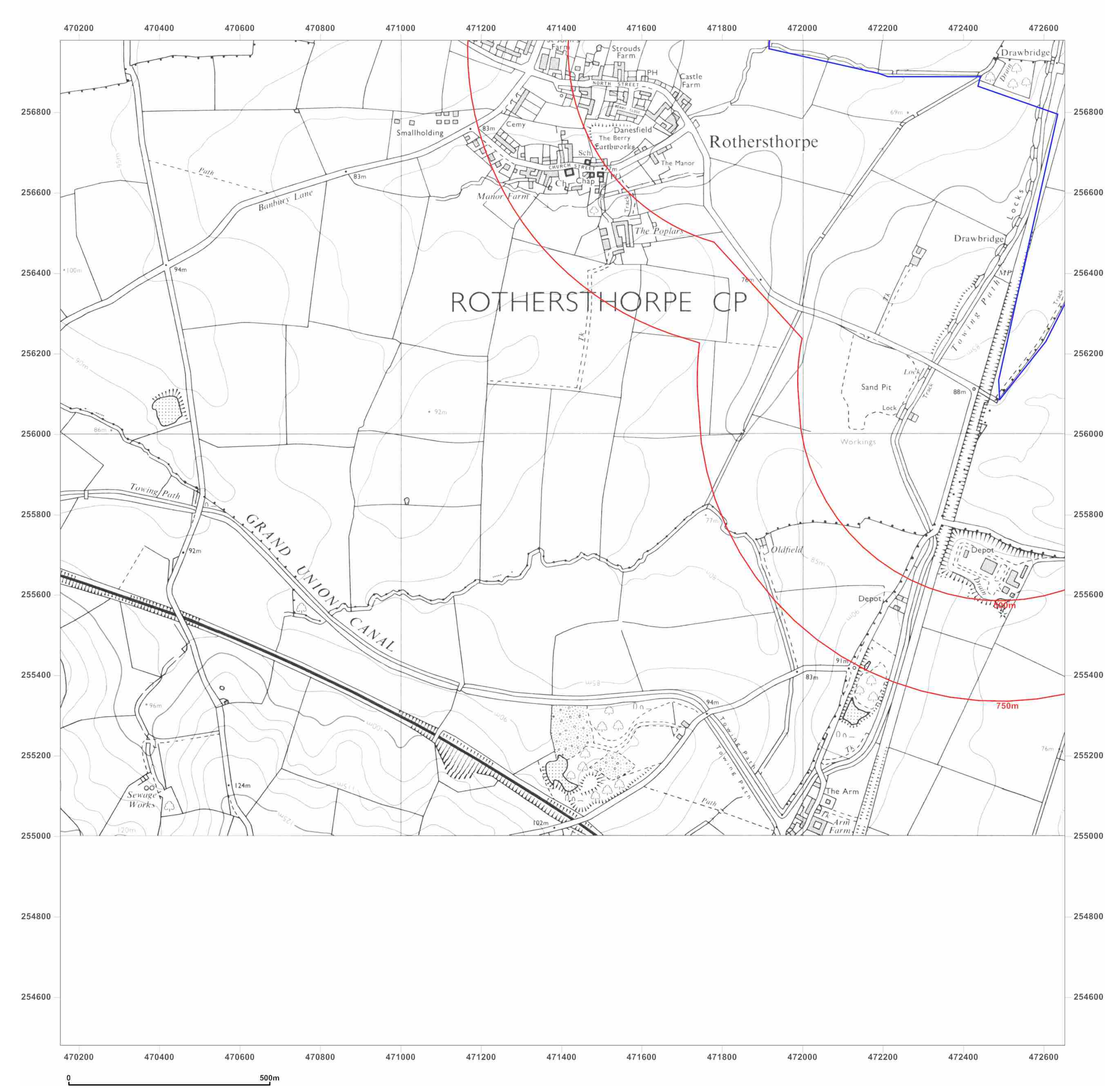
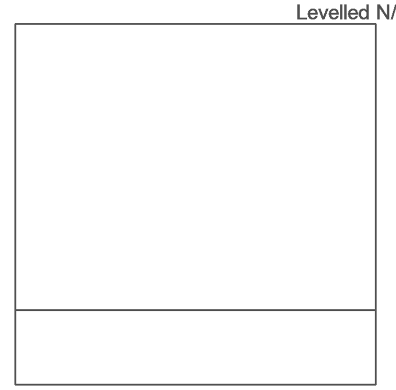
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*





Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_1
Grid Ref: 471402, 255729

Map Name: National Grid

Map date: **1981**

Scale: 1:10,000

Printed at: 1:10,000

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Production date: 19 June 2017

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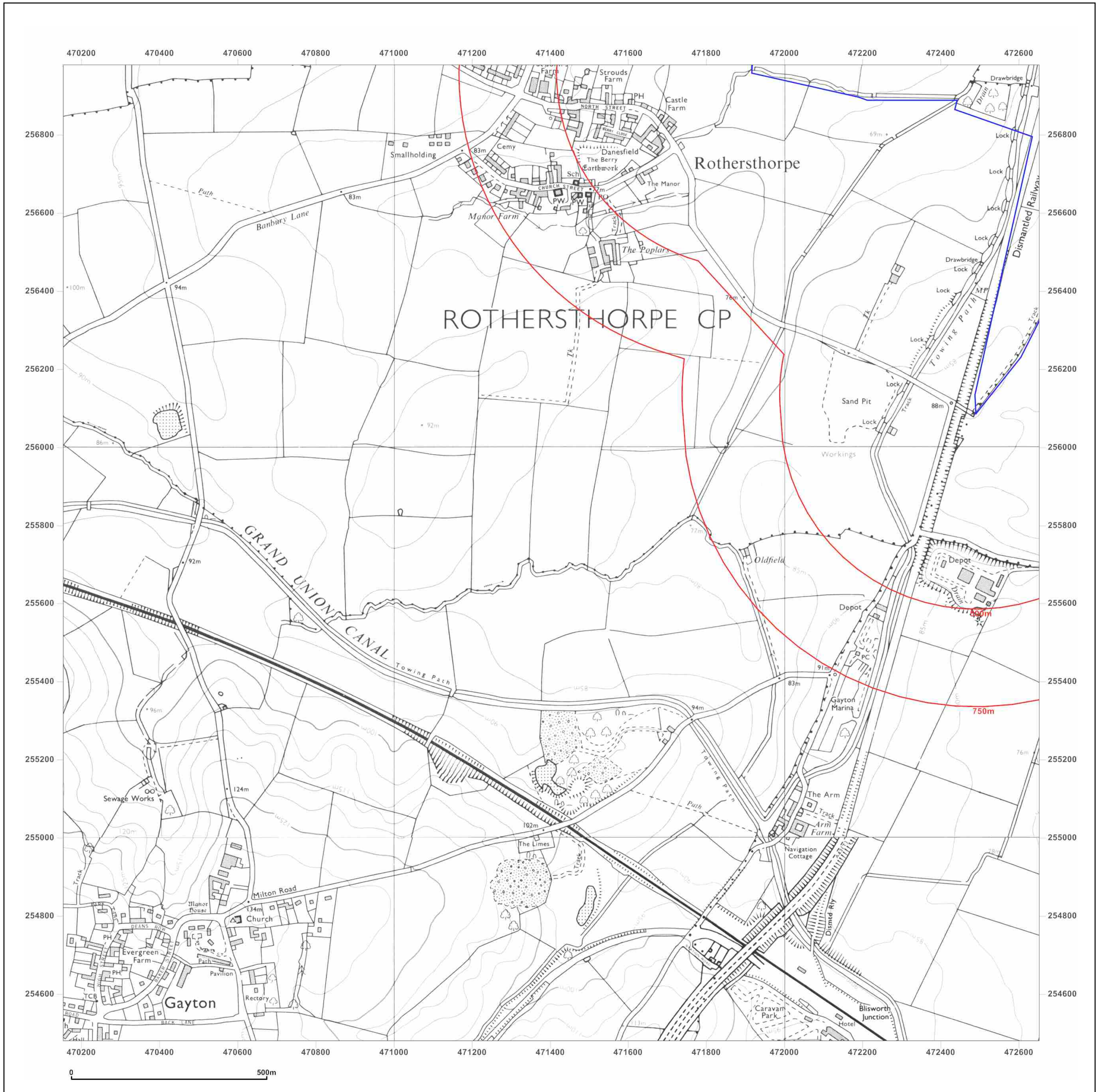

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_1
Grid Ref: 471402, 255729

Map Name: National Grid

Map date: 1989-1992

Scale: 1:10,000

Printed at: 1:10,000

N
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Surveyed 1988
Revised 1989
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1977
Revised 1992
Edition N/A
Copyright N/A
Levelled N/A

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Production date: 19 June 2017

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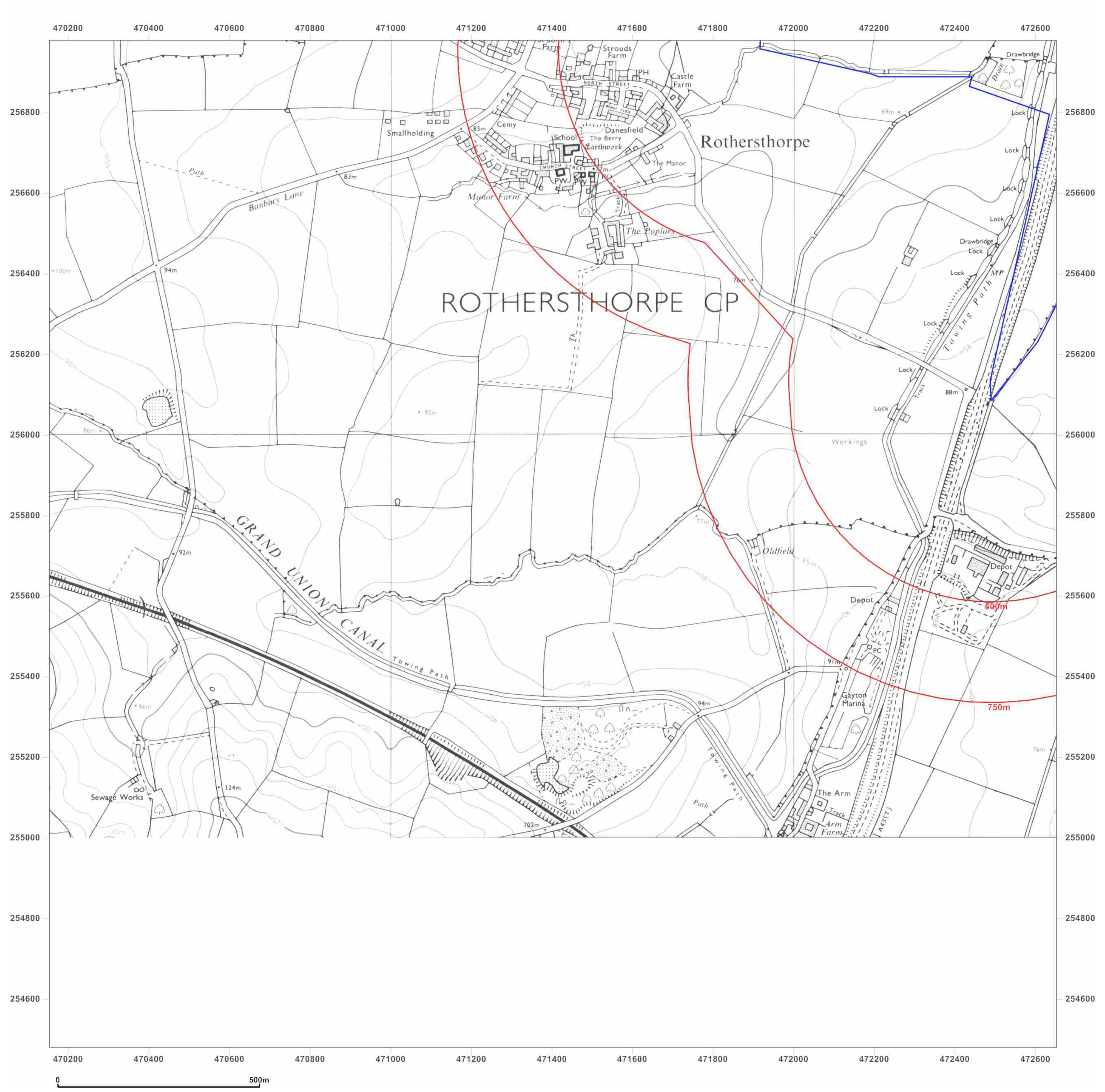

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_1
Grid Ref: 471402, 255729

Map Name: National Grid

Map date: 1992

Scale: 1:10,000

Printed at: 1:10,000

N
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Surveyed 1988
Revised 1992
Edition N/A
Copyright N/A
Levelled N/A

Powered by OS

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Production date: 19 June 2017

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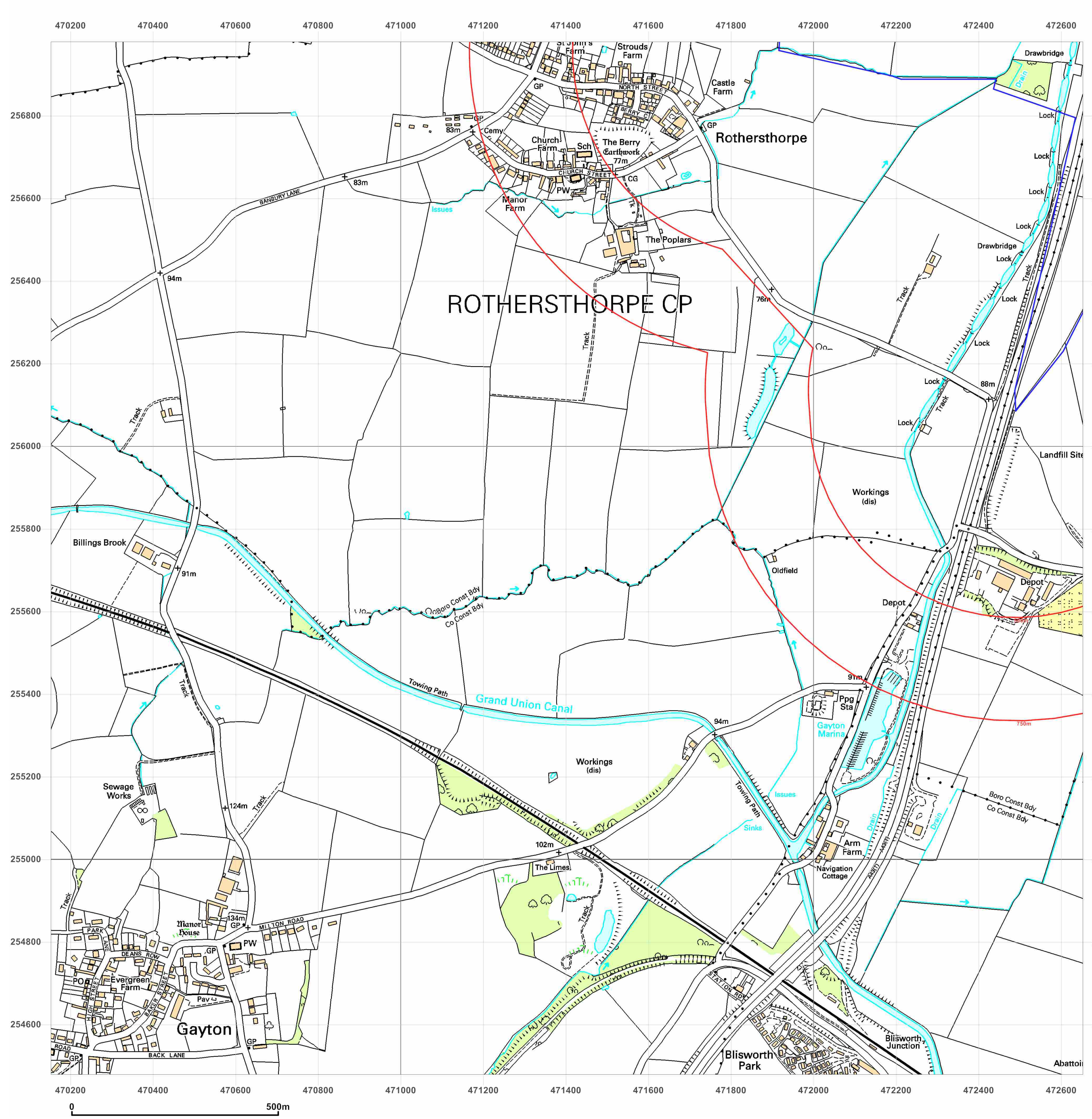
Groundsure INSIGHTS



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_1
Grid Ref: 471402, 255729

Map Name: 1:10,000 Raster

Map date: **2002**

Scale: 1:10,000

Printed at: 1:10,000

N
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2002

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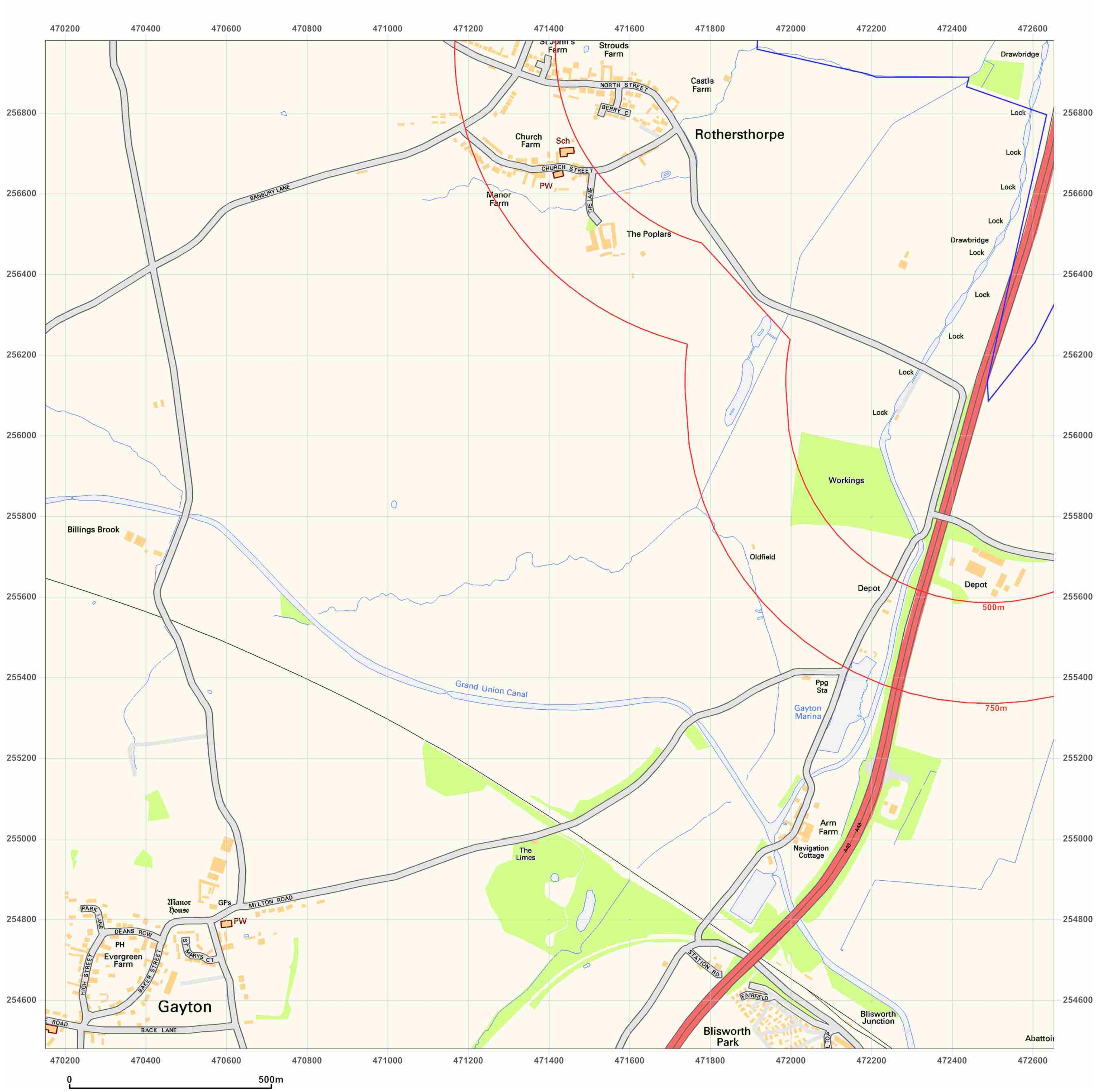
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_1
Grid Ref: 471402, 255729

Map Name: National Grid

Map date: **2010**

Scale: 1:10,000

Printed at: 1:10,000

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2010

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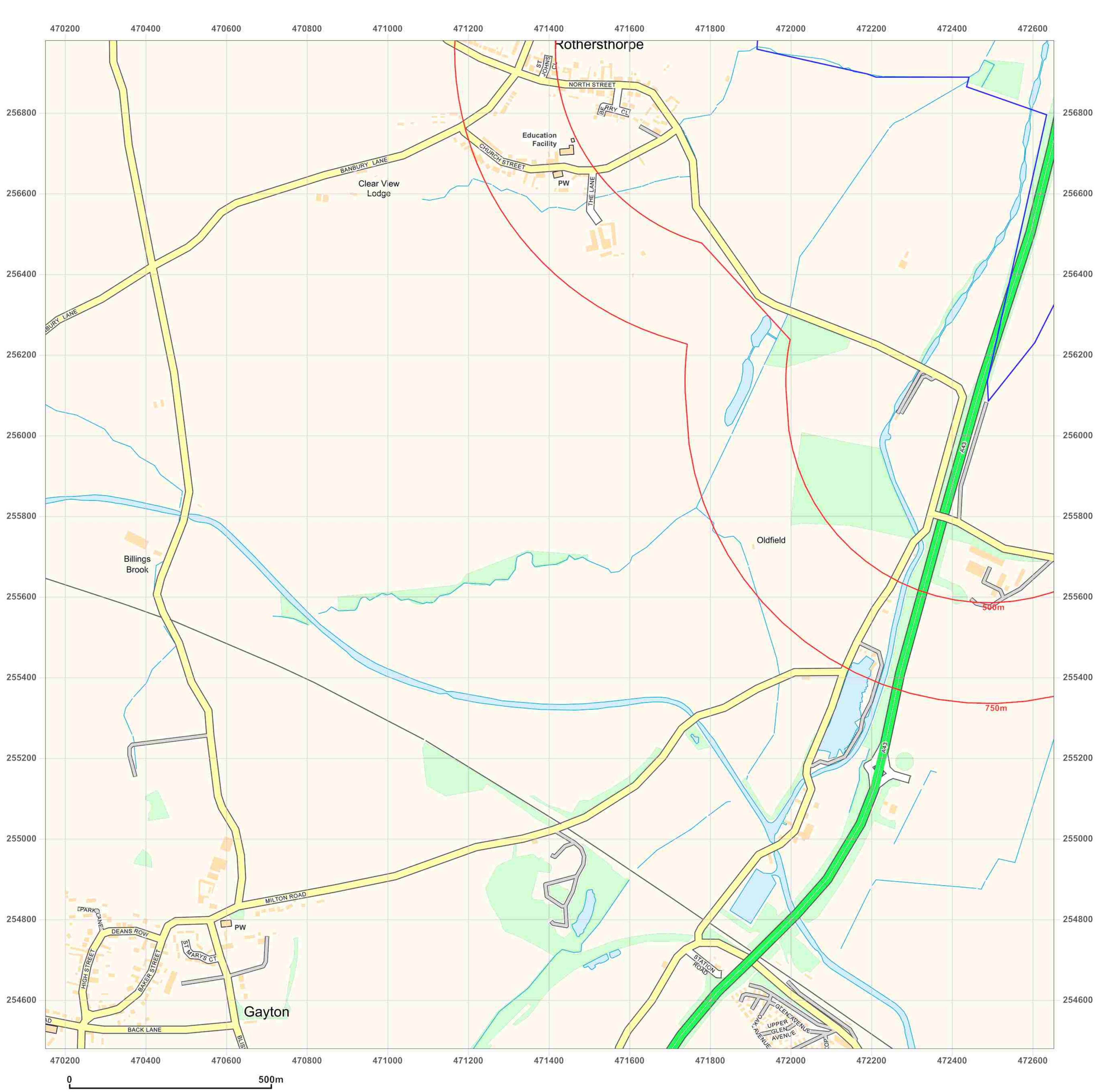
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_1
Grid Ref: 471402, 255729

Map Name: National Grid

Map date: 2014

Scale: 1:10,000

Printed at: 1:10,000

N W E S

2014

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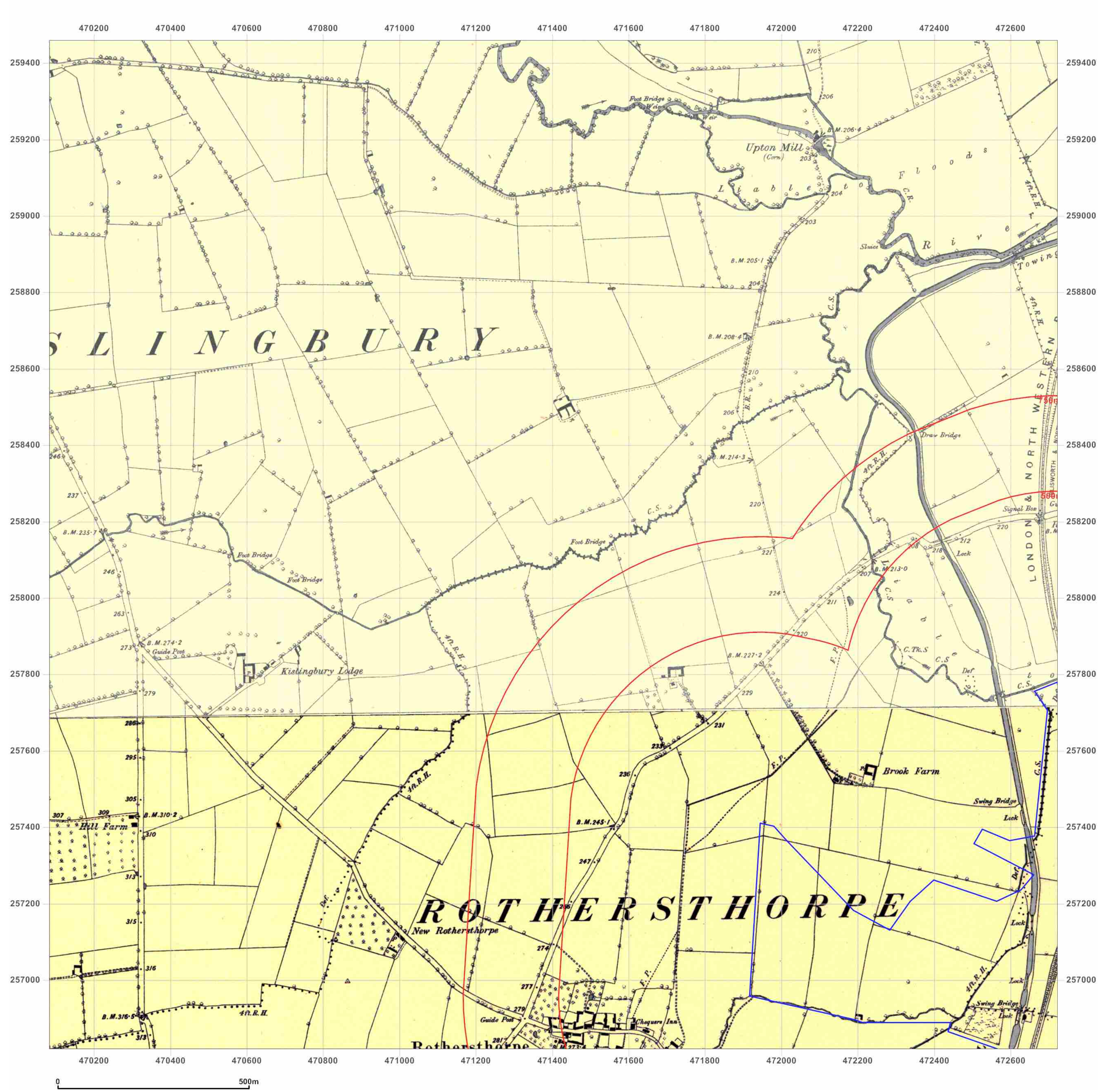
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_2
Grid Ref: 471402, 258139

Map Name: County Series

Map date: 1884

Scale: 1:10,560

Printed at: 1:10,560

N W E S

Surveyed 1884
Revised 1884
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1883
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Powered by OS

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W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_2
Grid Ref: 471402, 258139

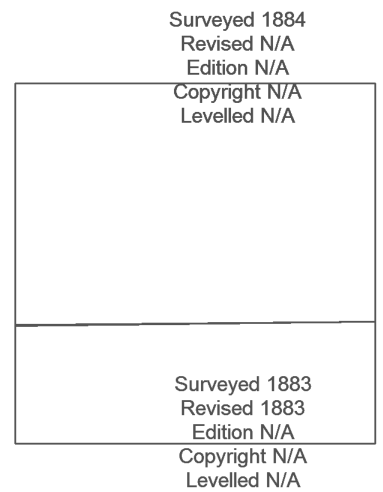
Map Name: County Series

Map date: **1883-1885**

Scale: 1:10,560

Printed at: 1:10,560

N W E S



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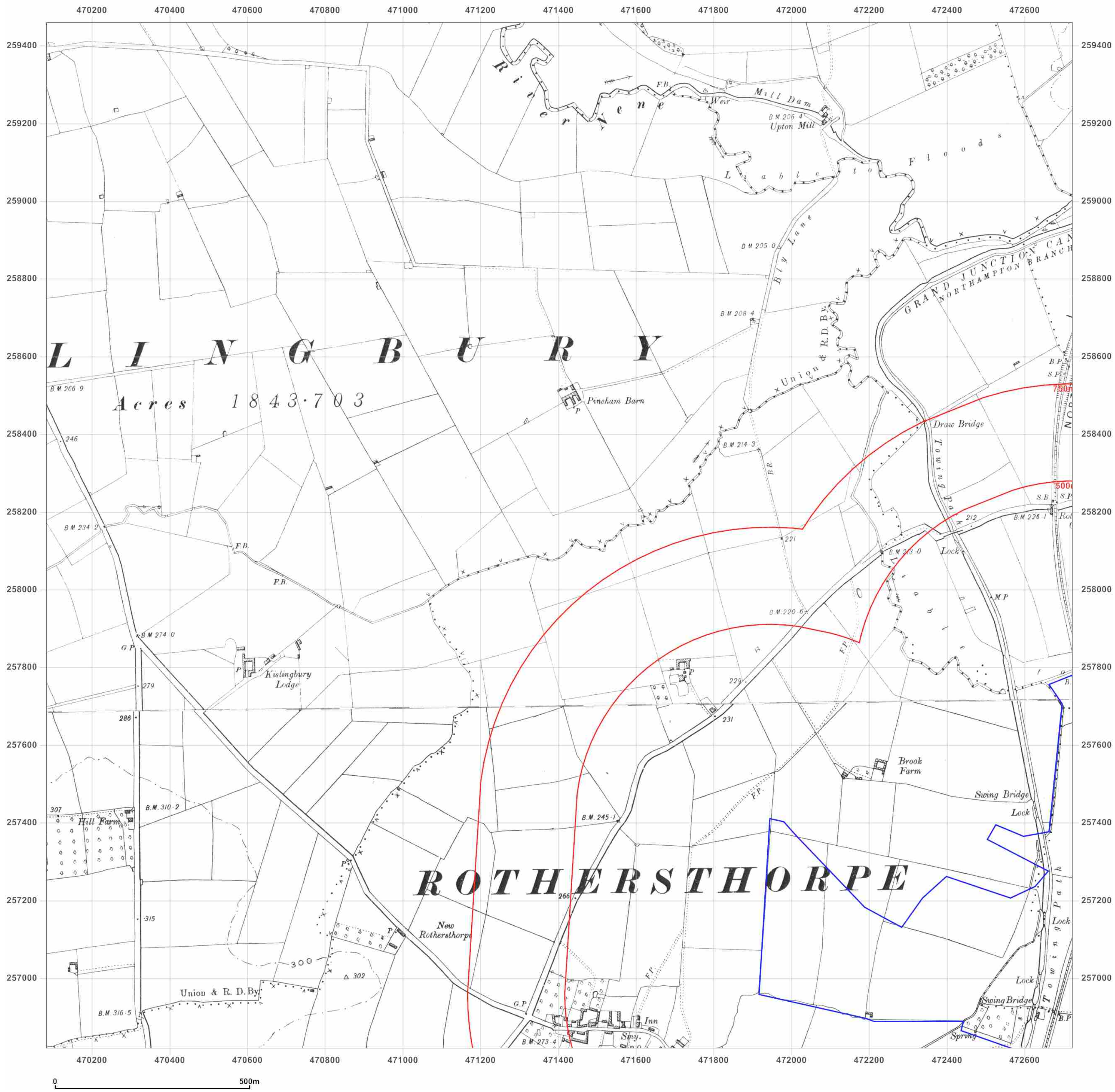
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*

Groundsure INSIGHTS



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_2
Grid Ref: 471402, 258139

Map Name: County Series

Map date: **1899-1900**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1883
Revised 1899
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1883
Revised 1900
Edition 1900
Copyright N/A
Levelled N/A

Powered by

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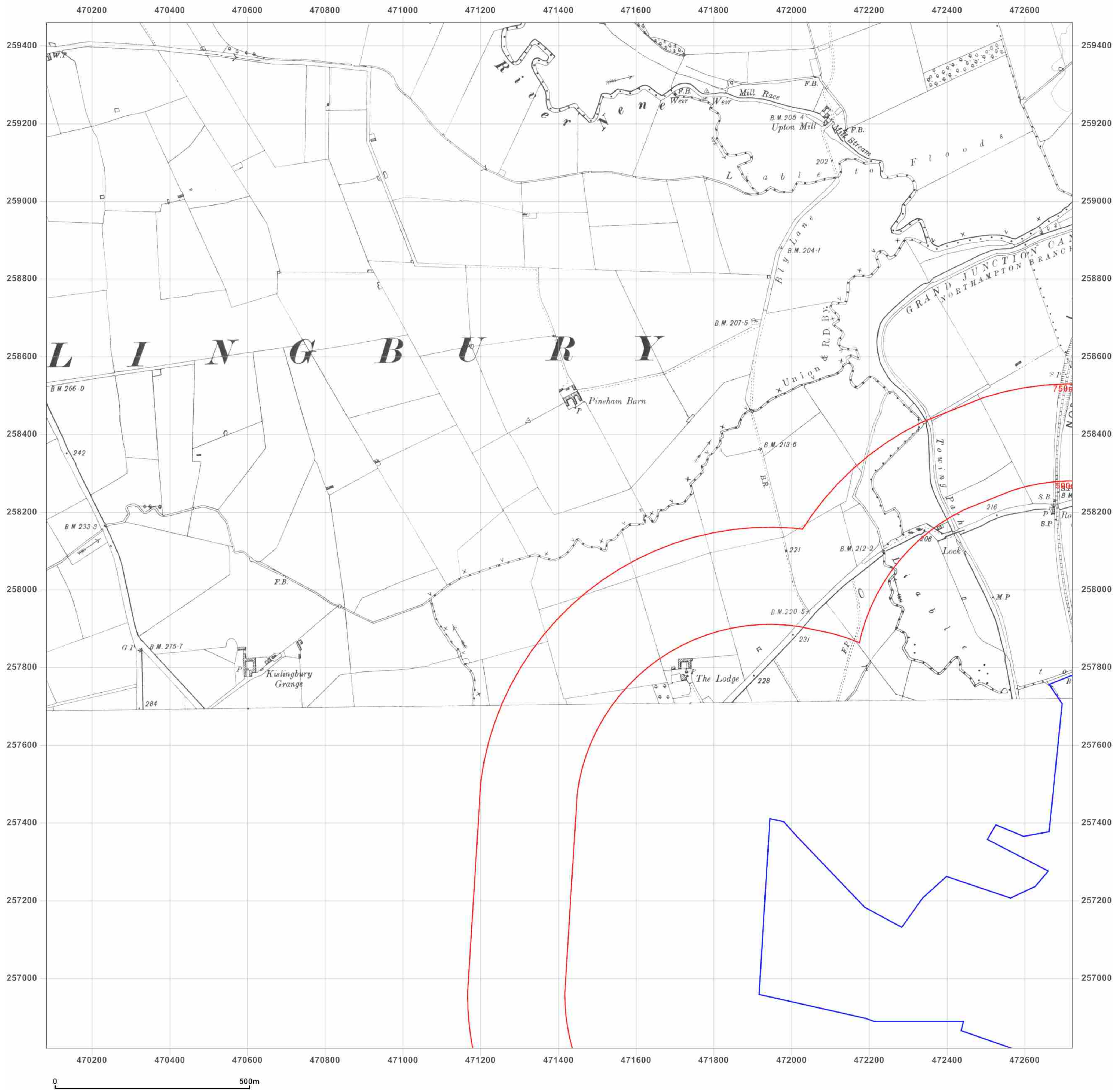
Production date: 19 June 2017

To view map legend click here *Legend*



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_2
Grid Ref: 471402, 258139

Map Name: County Series

Map date: **1923**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1883
Revised 1923
Edition N/A
Copyright N/A
Levelled N/A

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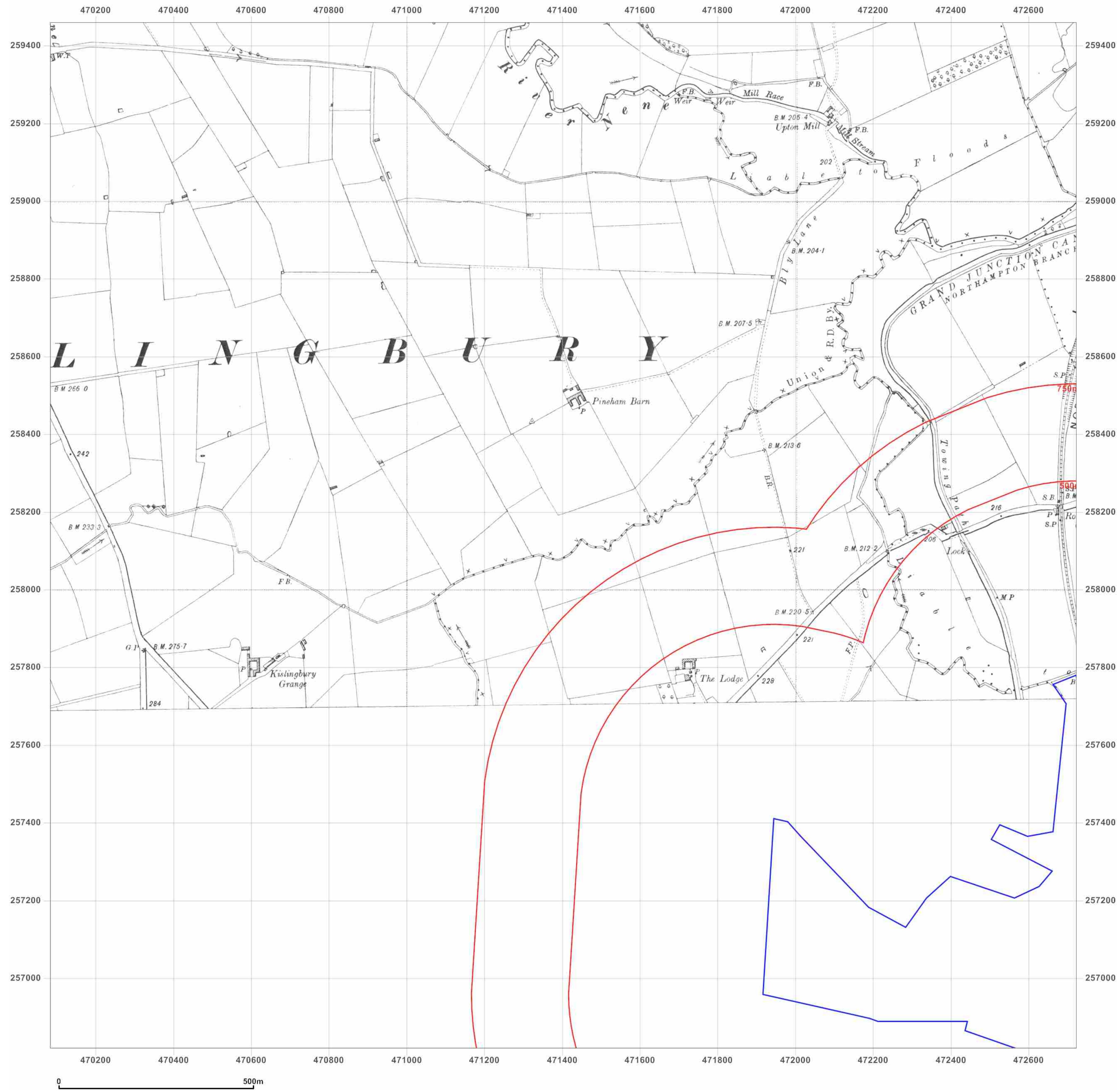
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_2
Grid Ref: 471402, 258139

Map Name: County Series

Map date: **1938**

Scale: 1:10,560

Printed at: 1:10,560

N W E S

Surveyed 1883
Revised 1938
Edition N/A
Copyright N/A
Levelled N/A

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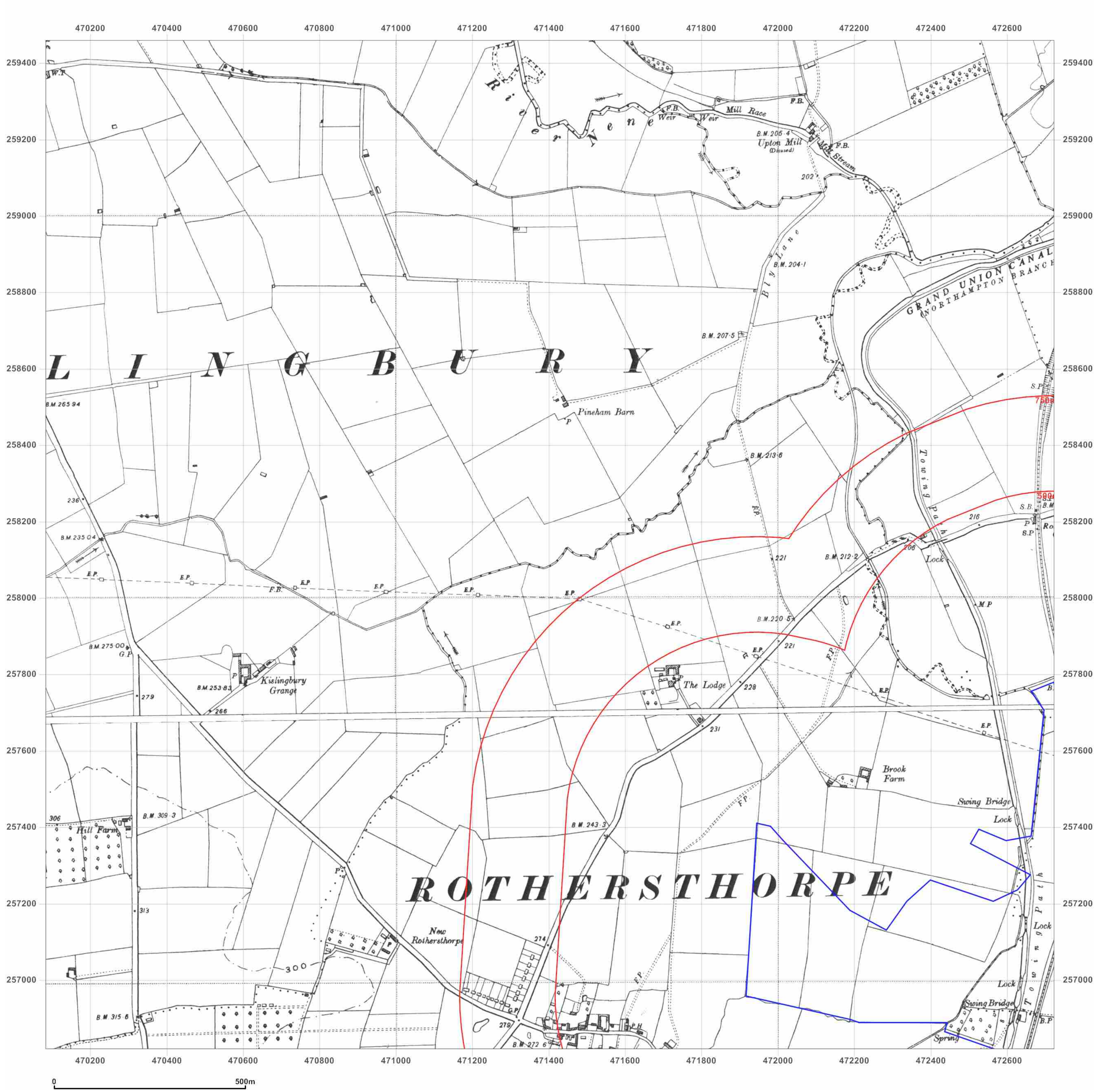
Production date: 19 June 2017

To view map legend click here Legend



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_2
Grid Ref: 471402, 258139

Map Name: County Series

Map date: **1950**

Scale: 1:10,560

Printed at: 1:10,560

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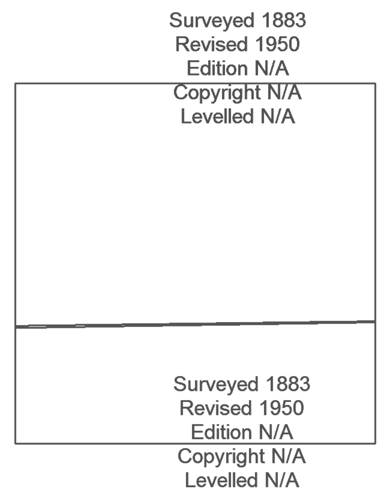

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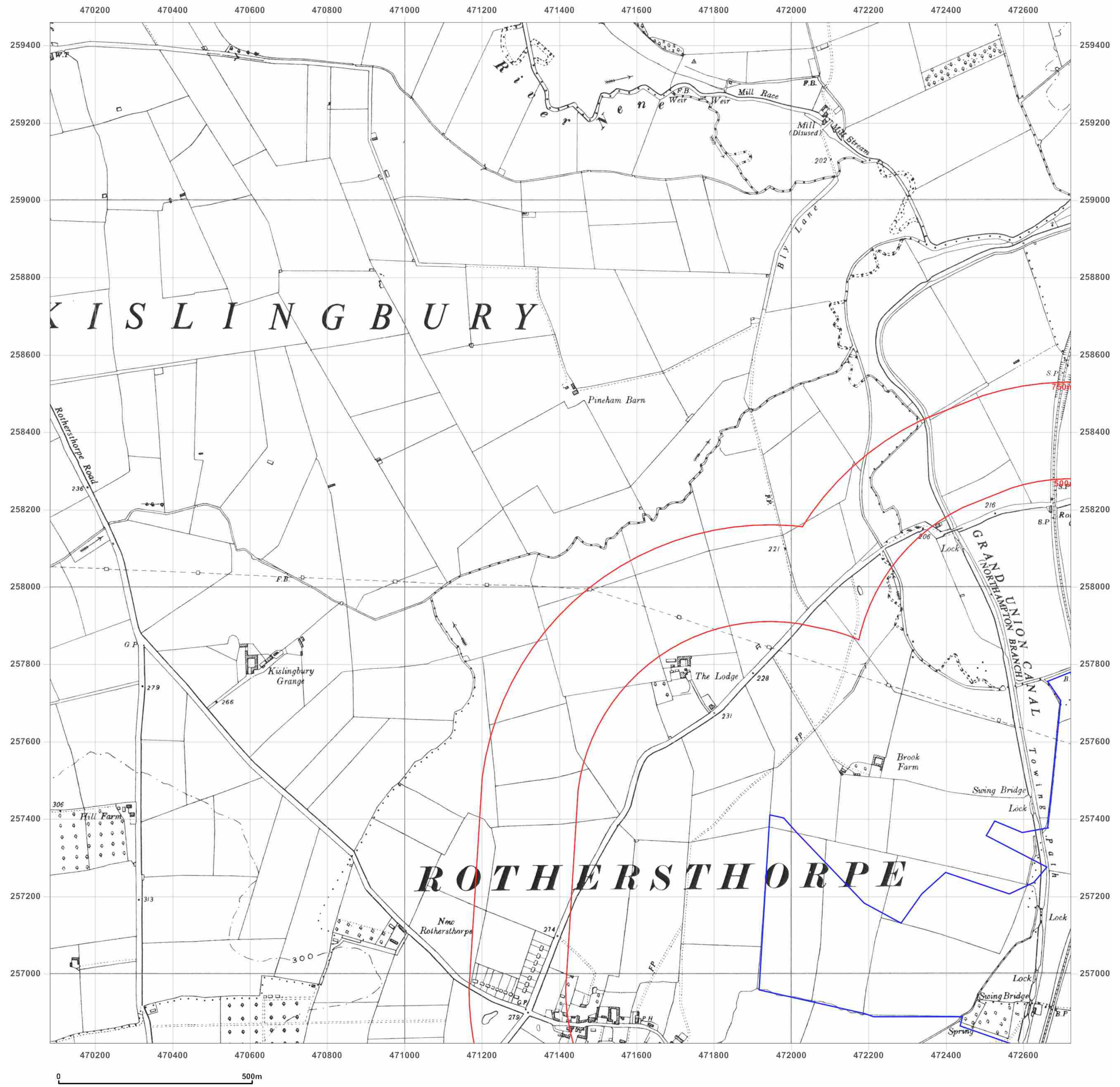
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_2
Grid Ref: 471402, 258139

Map Name: Provisional

Map date: 1958

Scale: 1:10,560

Printed at: 1:10,560

Surveyed N/A
Revised 1957
Edition N/A
Copyright 1958
Levelled N/A

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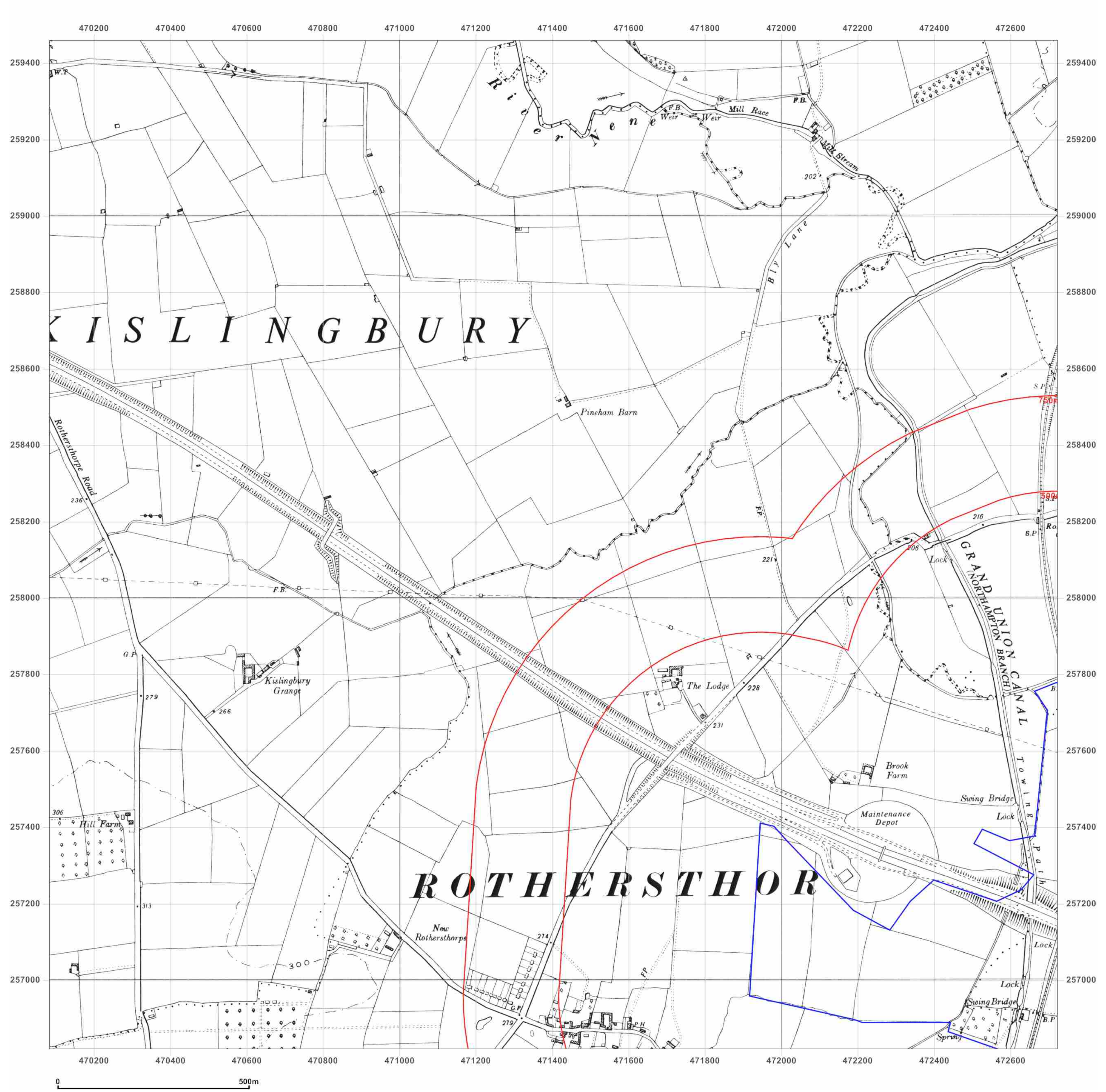
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_2
Grid Ref: 471402, 258139

Map Name: Provisional

Map date: 1965

Scale: 1:10,560

Printed at: 1:10,560

N W E S

Surveyed N/A
Revised 1964
Edition N/A
Copyright 1965
Levelled N/A

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Production date: 19 June 2017

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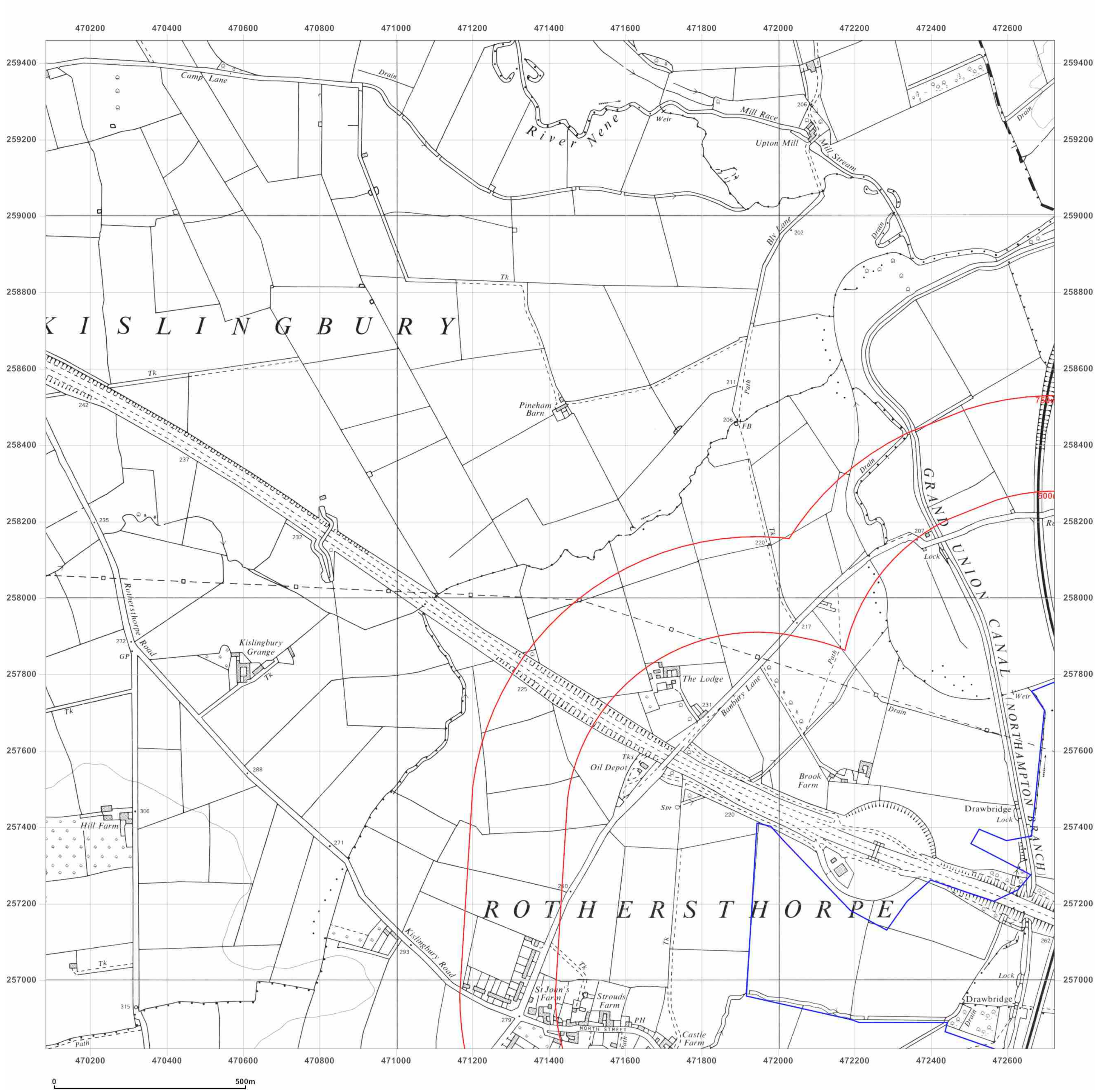

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_2
Grid Ref: 471402, 258139

Map Name: Provisional

Map date: **1968**

Scale: 1:10,560

Printed at: 1:10,560

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Surveyed 1968
Revised 1968
Edition N/A
Copyright N/A
Levelled N/A

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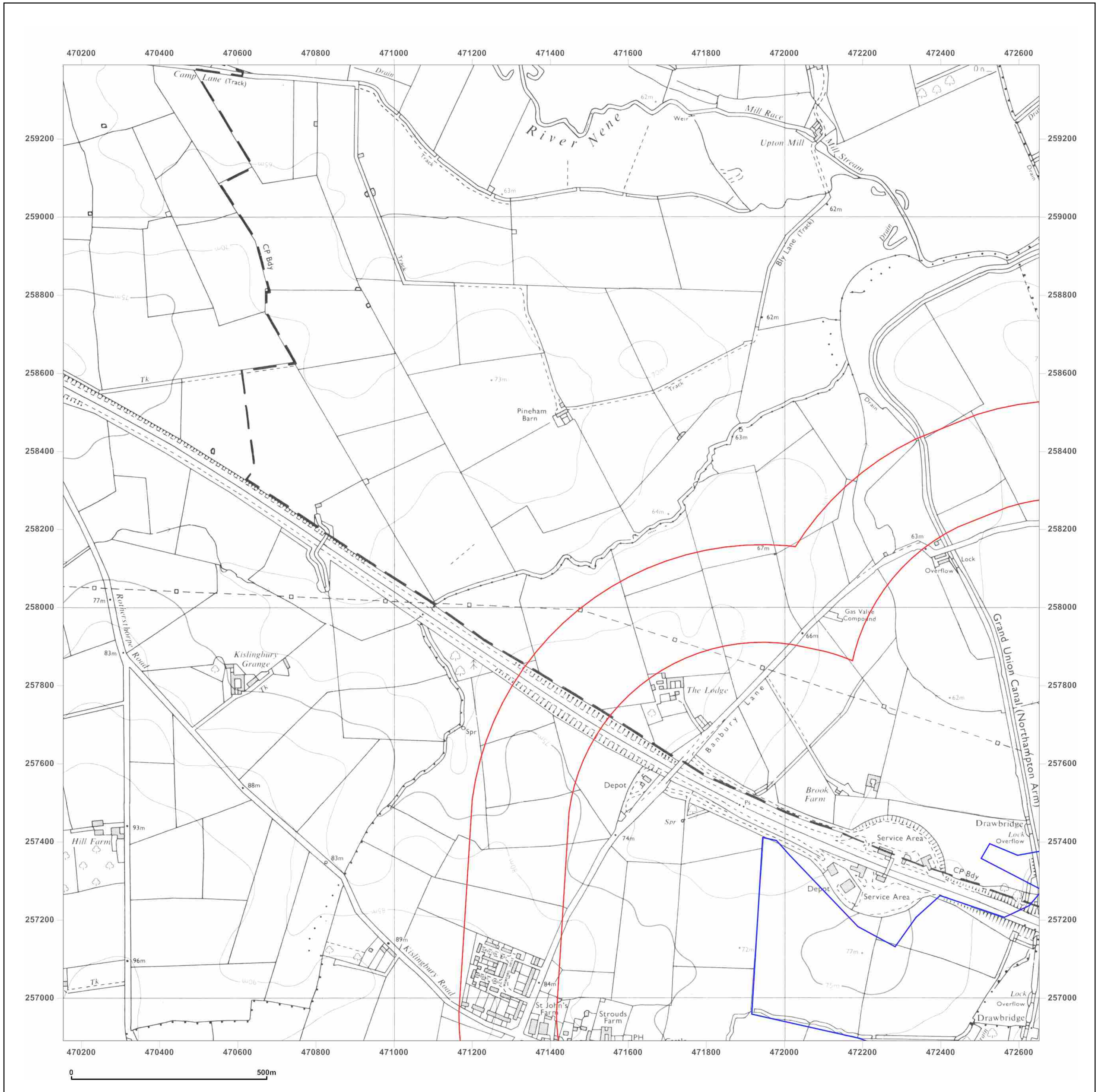
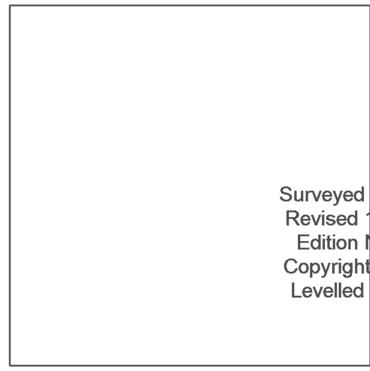
Production date: 19 June 2017

To view map legend click here *Legend*





Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_2
Grid Ref: 471402, 258139

Map Name: National Grid

Map date: **1981**

Scale: 1:10,000

Printed at: 1:10,000

N
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Surveyed 1977
Revised 1981
Edition N/A
Copyright N/A
Levelled N/A

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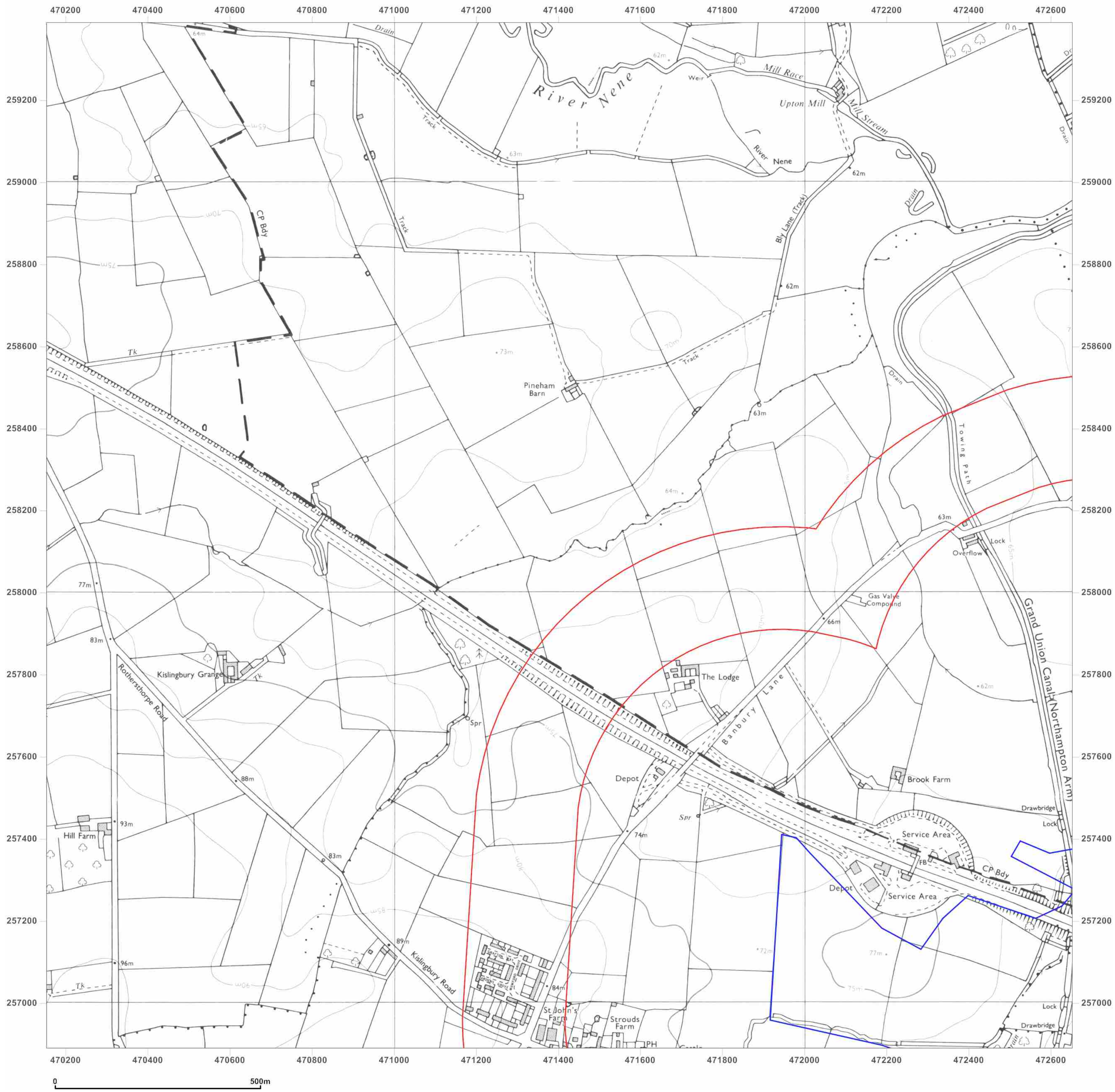
Production date: 19 June 2017

To view map legend click here *Legend*



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_2
Grid Ref: 471402, 258139

Map Name: National Grid

Map date: 1989

Scale: 1:10,000

Printed at: 1:10,000

N
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Surveyed 1988
Revised 1989
Edition N/A
Copyright N/A
Levelled N/A

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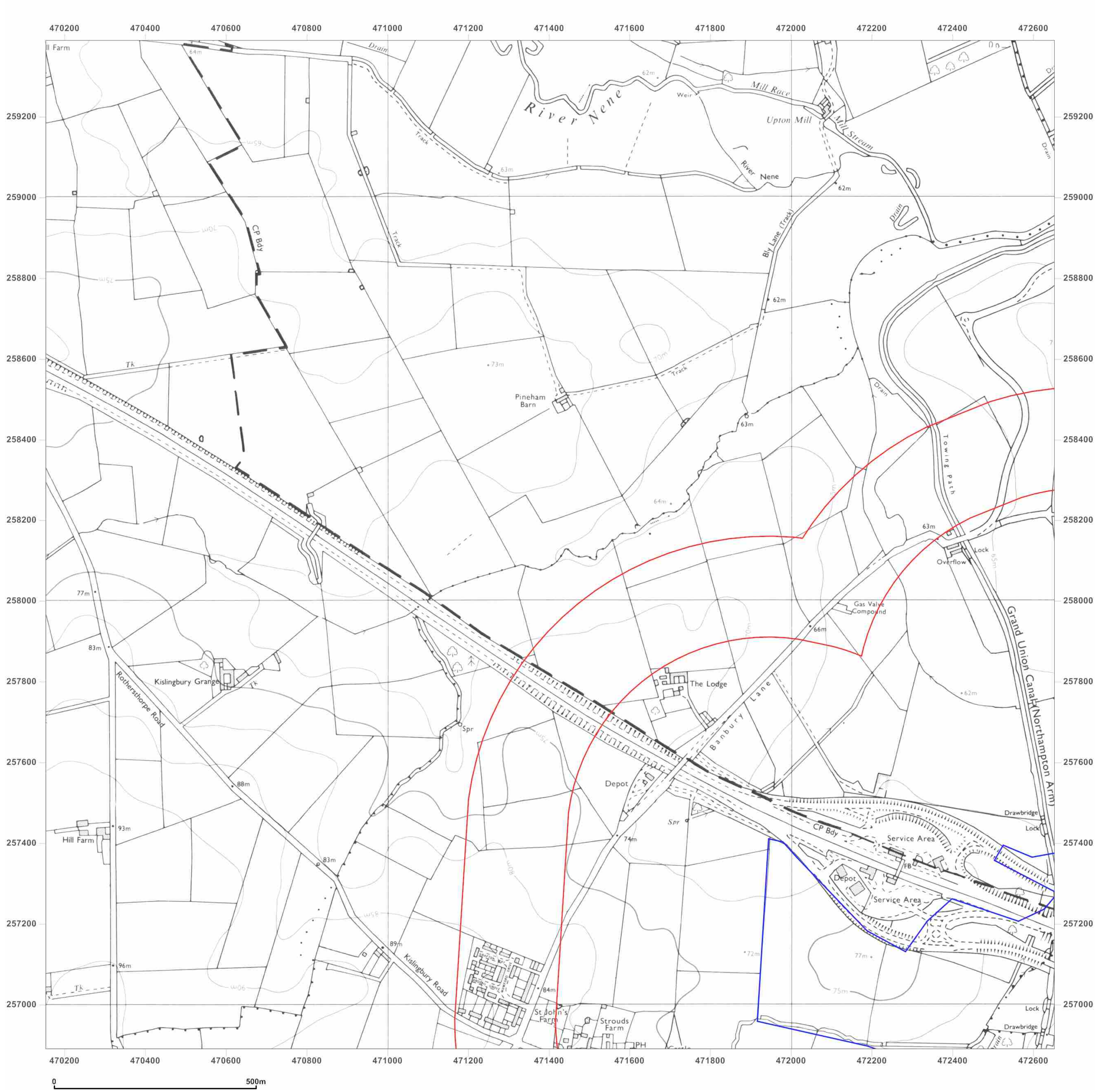
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_2
Grid Ref: 471402, 258139

Map Name: National Grid

Map date: **1992**

Scale: 1:10,000

Printed at: 1:10,000

N
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Surveyed 1988
Revised 1992
Edition N/A
Copyright N/A
Levelled N/A

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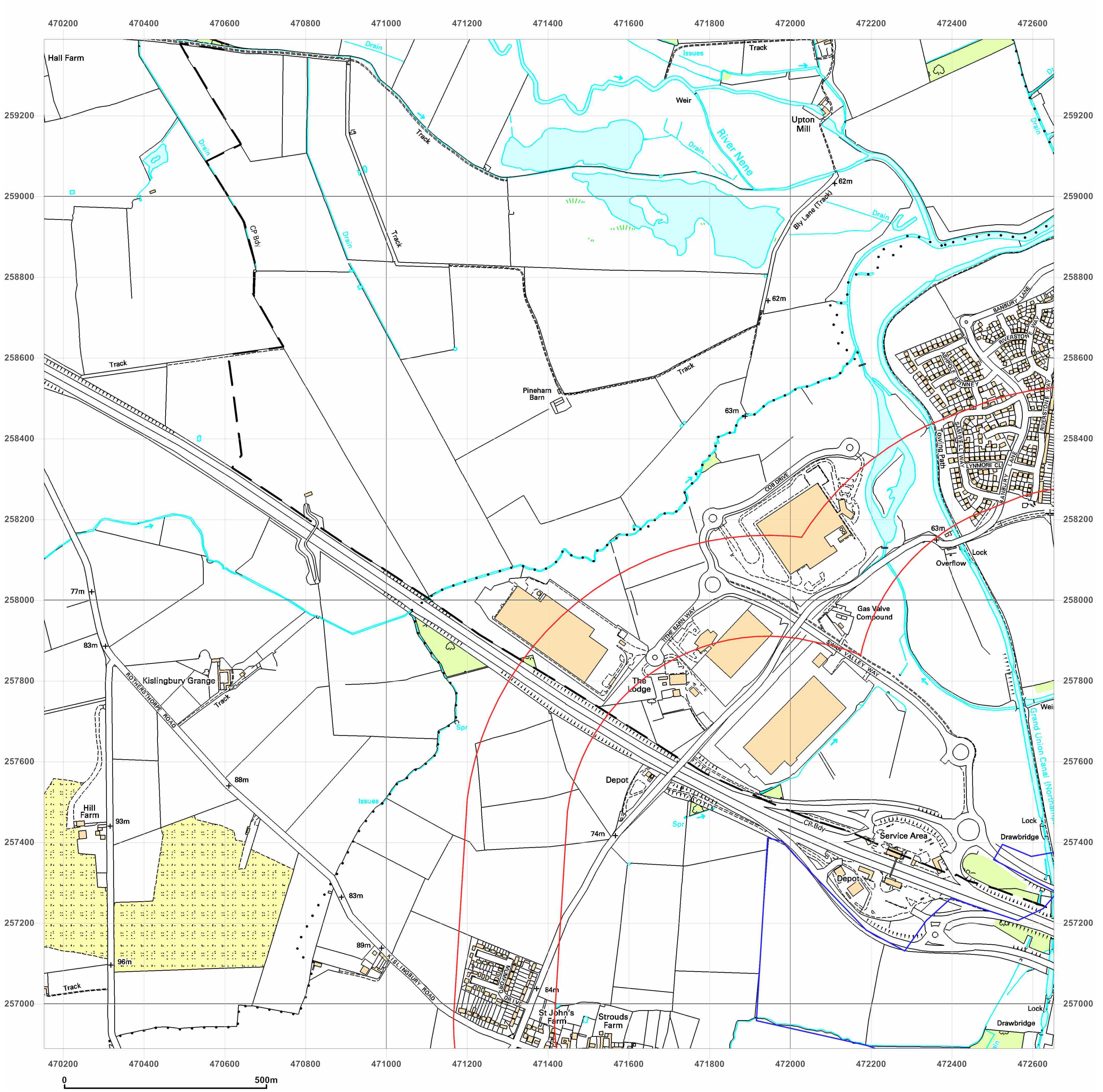
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure
INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_2
Grid Ref: 471402, 258139

Map Name: 1:10,000 Raster

Map date: 2002

Scale: 1:10,000

Printed at: 1:10,000

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2002

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Production date: 19 June 2017

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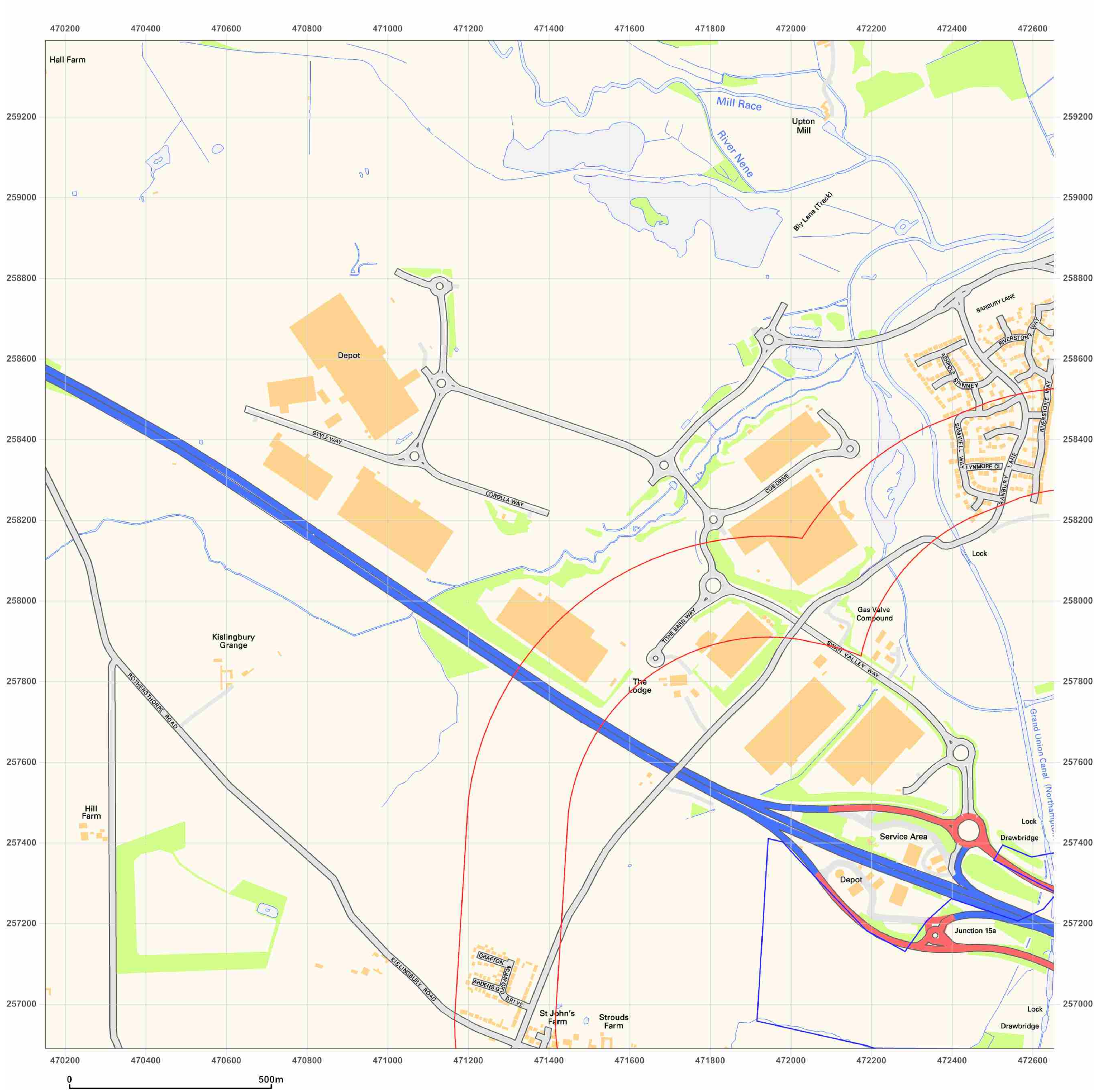

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_2
Grid Ref: 471402, 258139

Map Name: National Grid

Map date: **2010**

Scale: 1:10,000

Printed at: 1:10,000

N
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2010

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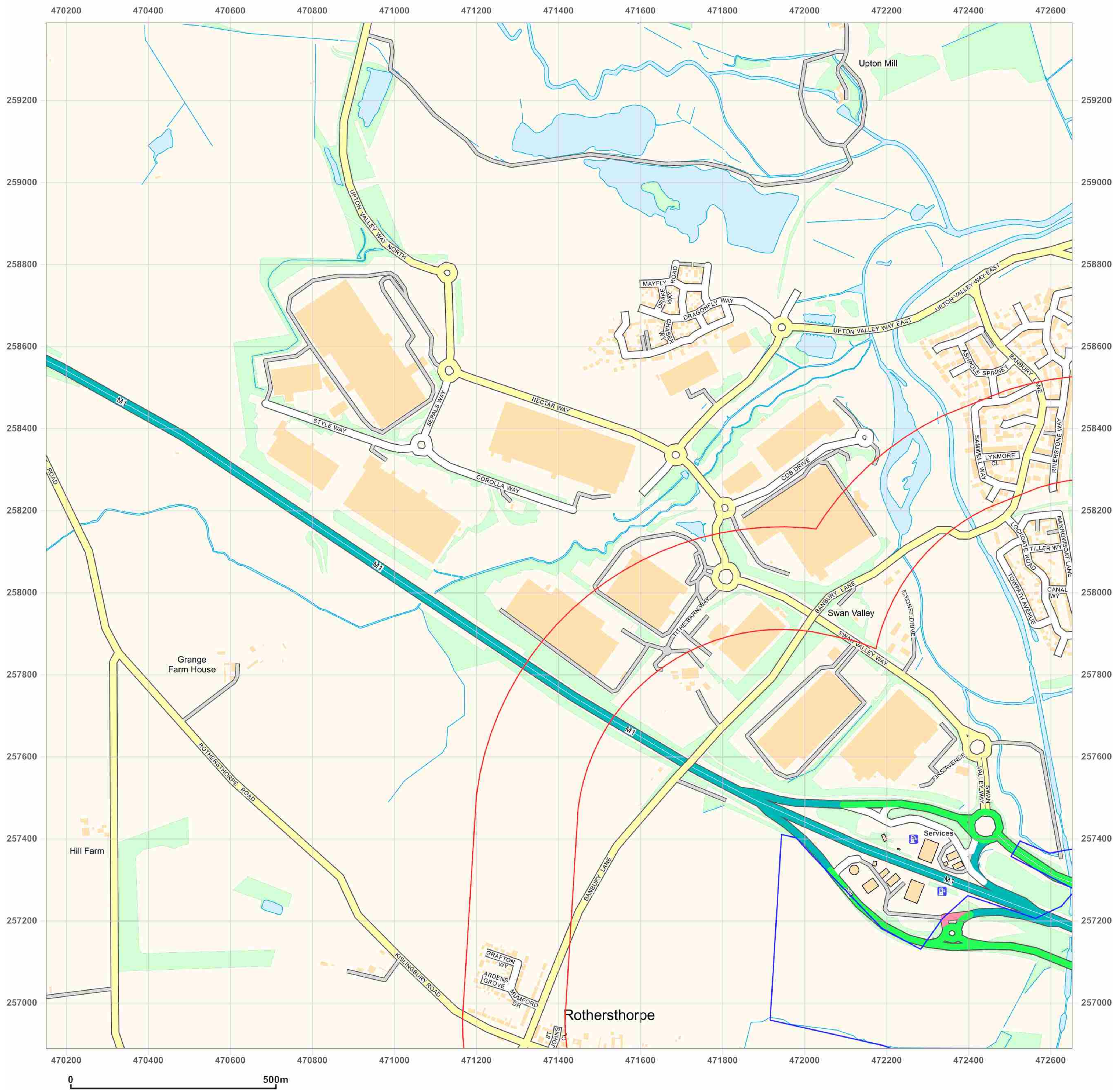
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_1_2
Grid Ref: 471402, 258139

Map Name: National Grid

Map date: **2014**

Scale: 1:10,000

Printed at: 1:10,000

N
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2014

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W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_1
Grid Ref: 473812, 255729

Map Name: County Series

Map date: **1883-1884**

Scale: 1:10,560

Printed at: 1:10,560

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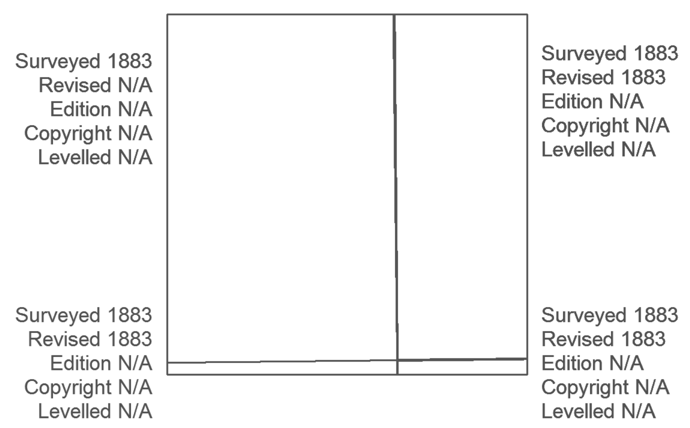

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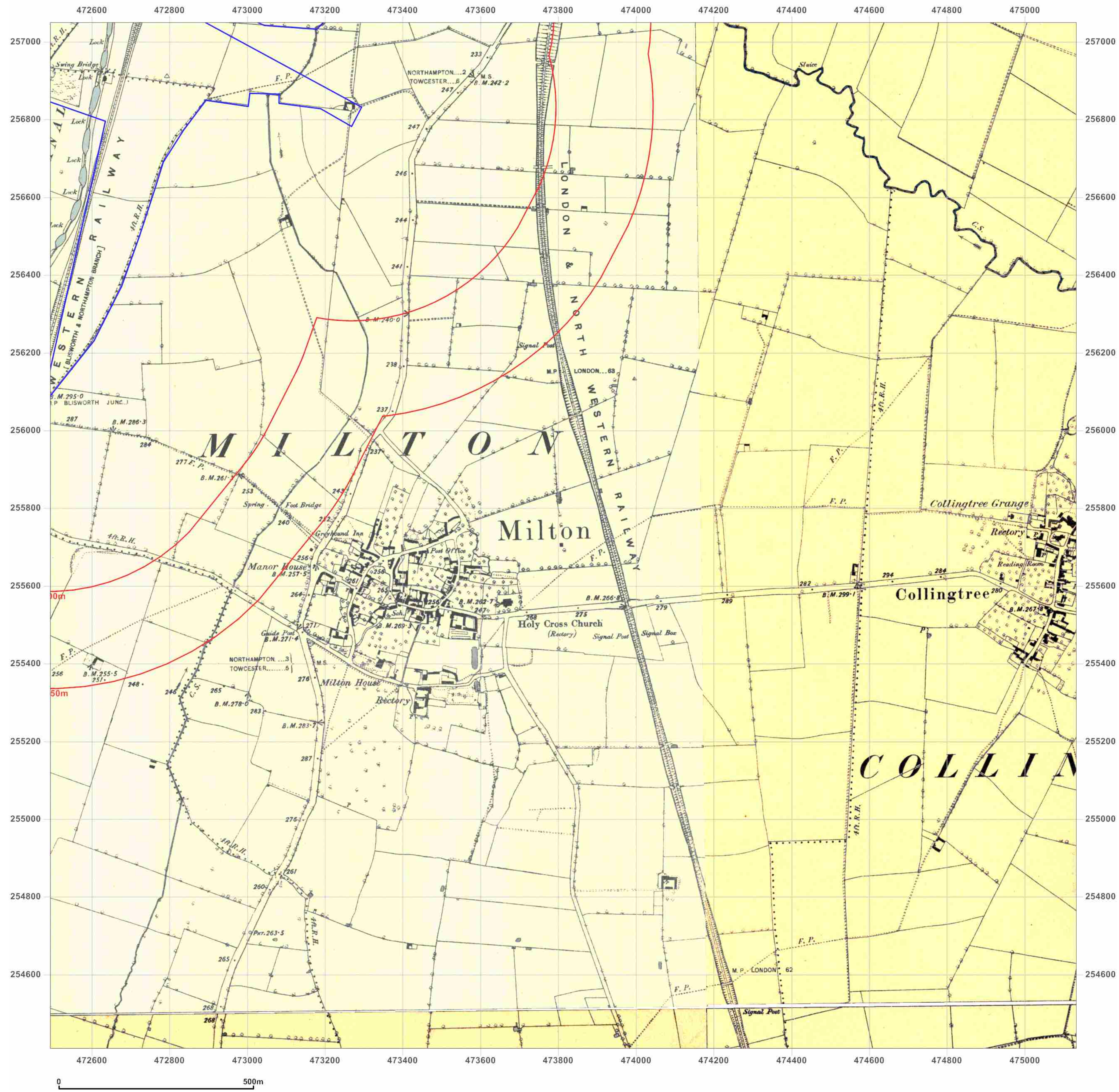
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_1
Grid Ref: 473812, 255729

Map Name: County Series

Map date: **1883-1884**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1883
Revised 1883
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1883
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1883
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1883
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Powered by

Produced by
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T: 08444 159000
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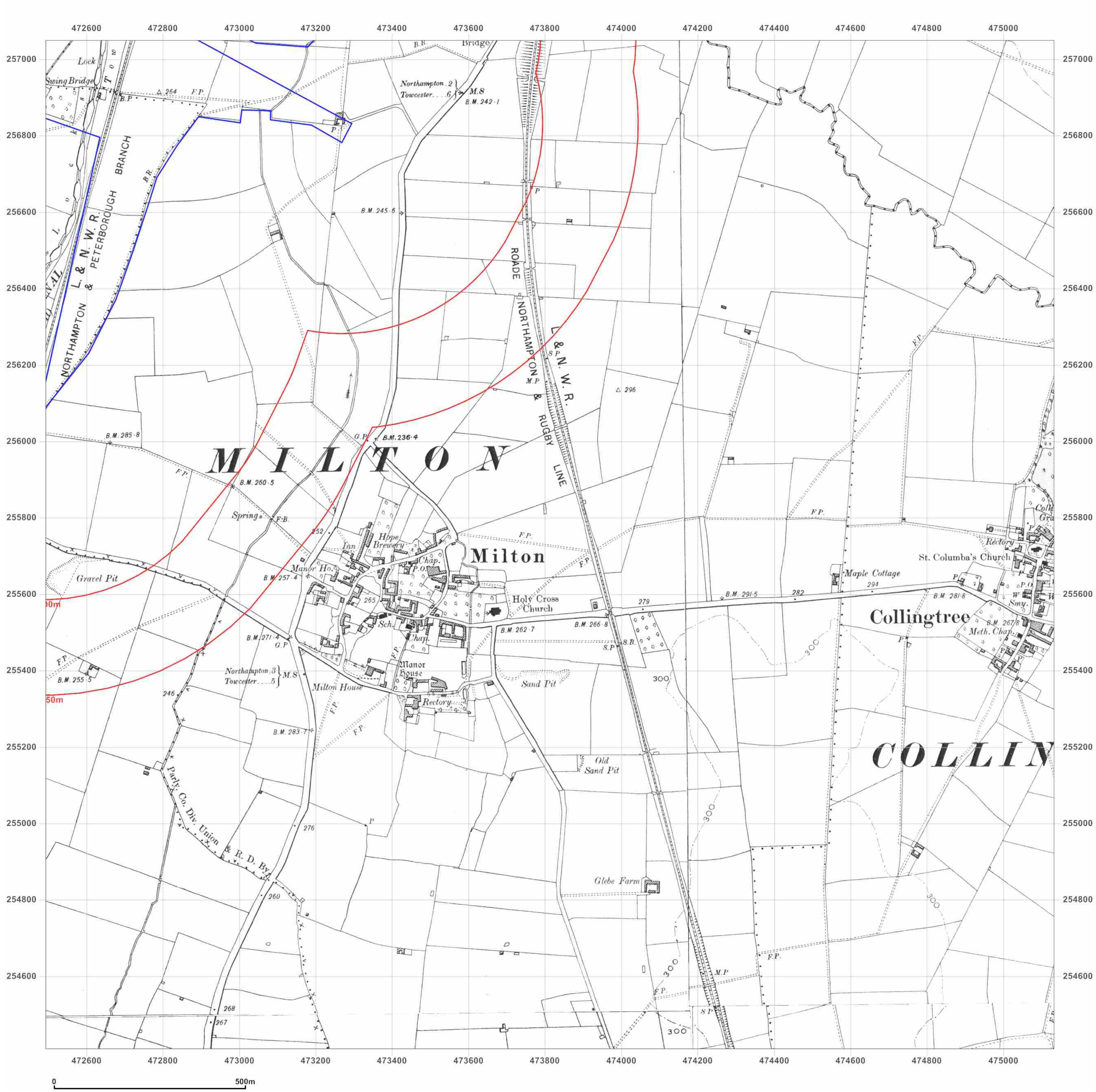
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_1
Grid Ref: 473812, 255729

Map Name: County Series

Map date: **1899-1900**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1883 Revised 1900 Edition 1900 Copyright N/A Levelled N/A	Surveyed 1883 Revised 1899 Edition N/A Copyright N/A Levelled N/A
Surveyed 1883 Revised 1899 Edition N/A Copyright N/A Levelled N/A	Surveyed 1883 Revised 1899 Edition N/A Copyright N/A Levelled N/A

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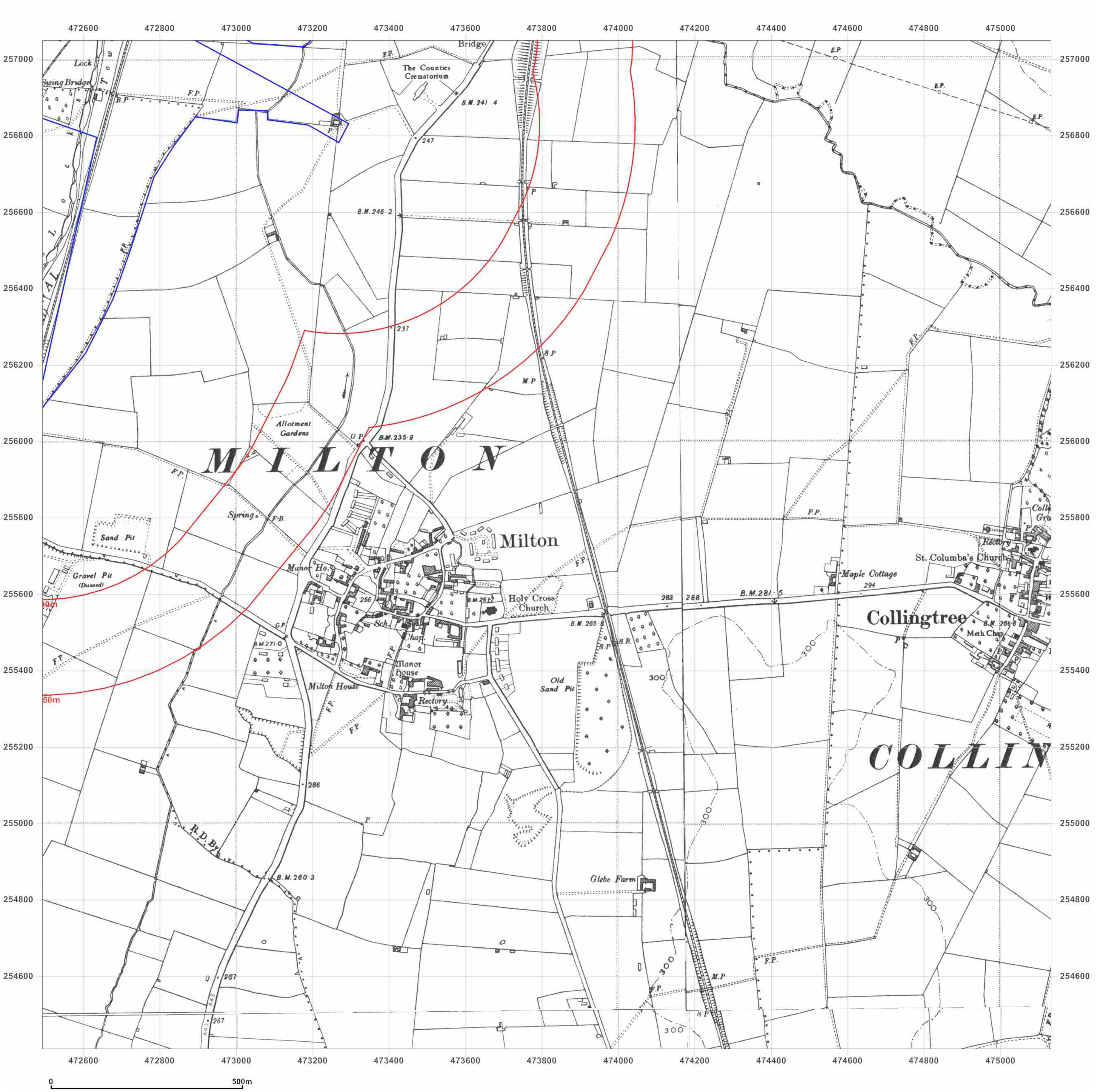
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_1
Grid Ref: 473812, 255729

Map Name: County Series

Map date: 1950

Scale: 1:10,560

Printed at: 1:10,560

Surveyed 1883 Revised 1950 Edition N/A Copyright N/A Levelled N/A	Surveyed 1883 Revised 1950 Edition N/A Copyright N/A Levelled N/A
Surveyed 1883 Revised 1950 Edition N/A Copyright N/A Levelled N/A	Surveyed 1883 Revised 1950 Edition N/A Copyright N/A Levelled N/A

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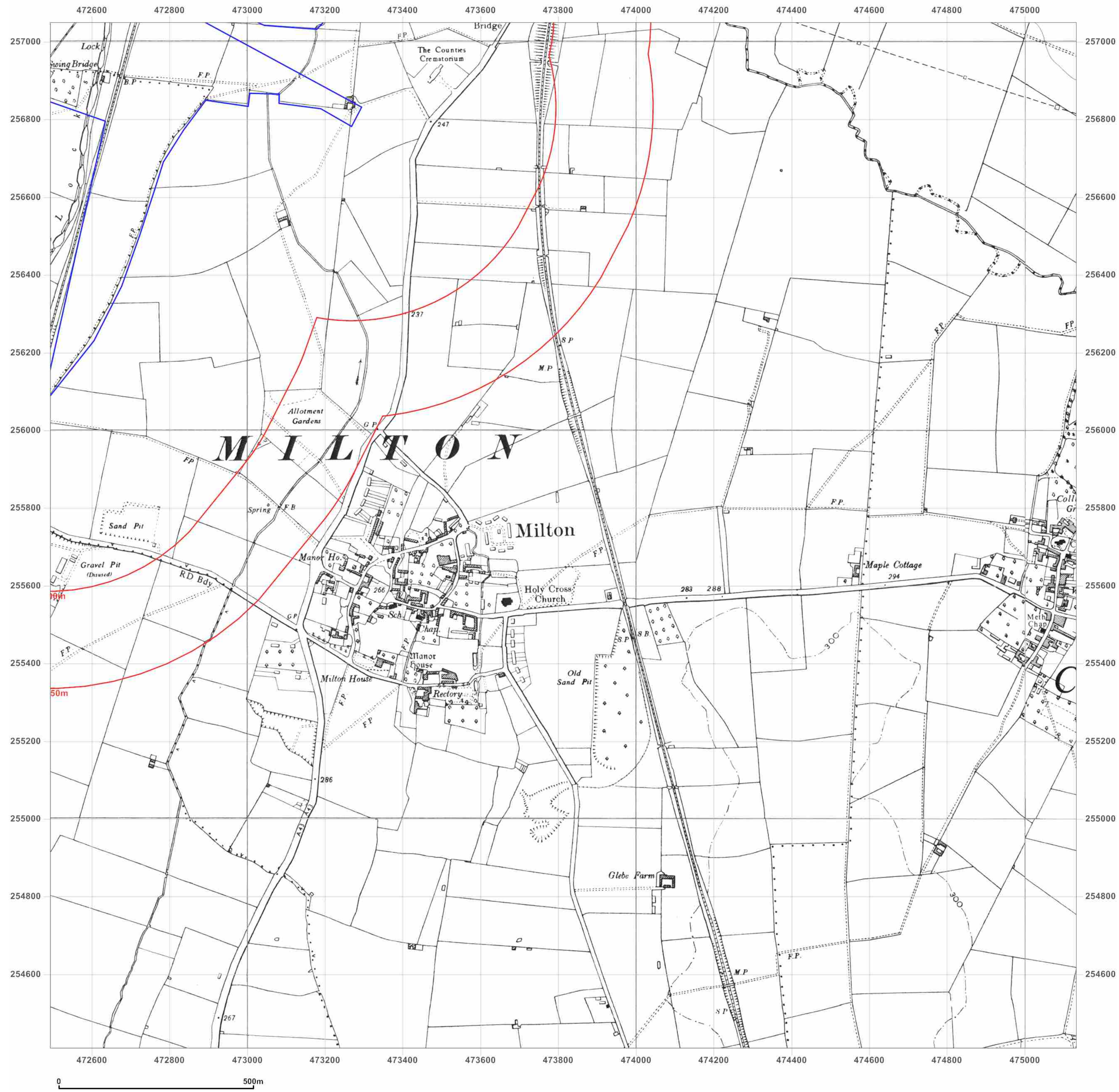
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_1
Grid Ref: 473812, 255729

Map Name: Provisional

Map date: **1957-1958**

Scale: 1:10,560

Printed at: 1:10,560

N W E S

Surveyed N/A Revised 1957 Edition N/A Copyright 1958 Levelled N/A	Surveyed N/A Revised 1957 Edition 1958 Copyright N/A Levelled N/A
Surveyed N/A Revised 1957 Edition N/A Copyright 1958 Levelled N/A	Surveyed 1950 Revised 1950 Edition N/A Copyright N/A Levelled N/A

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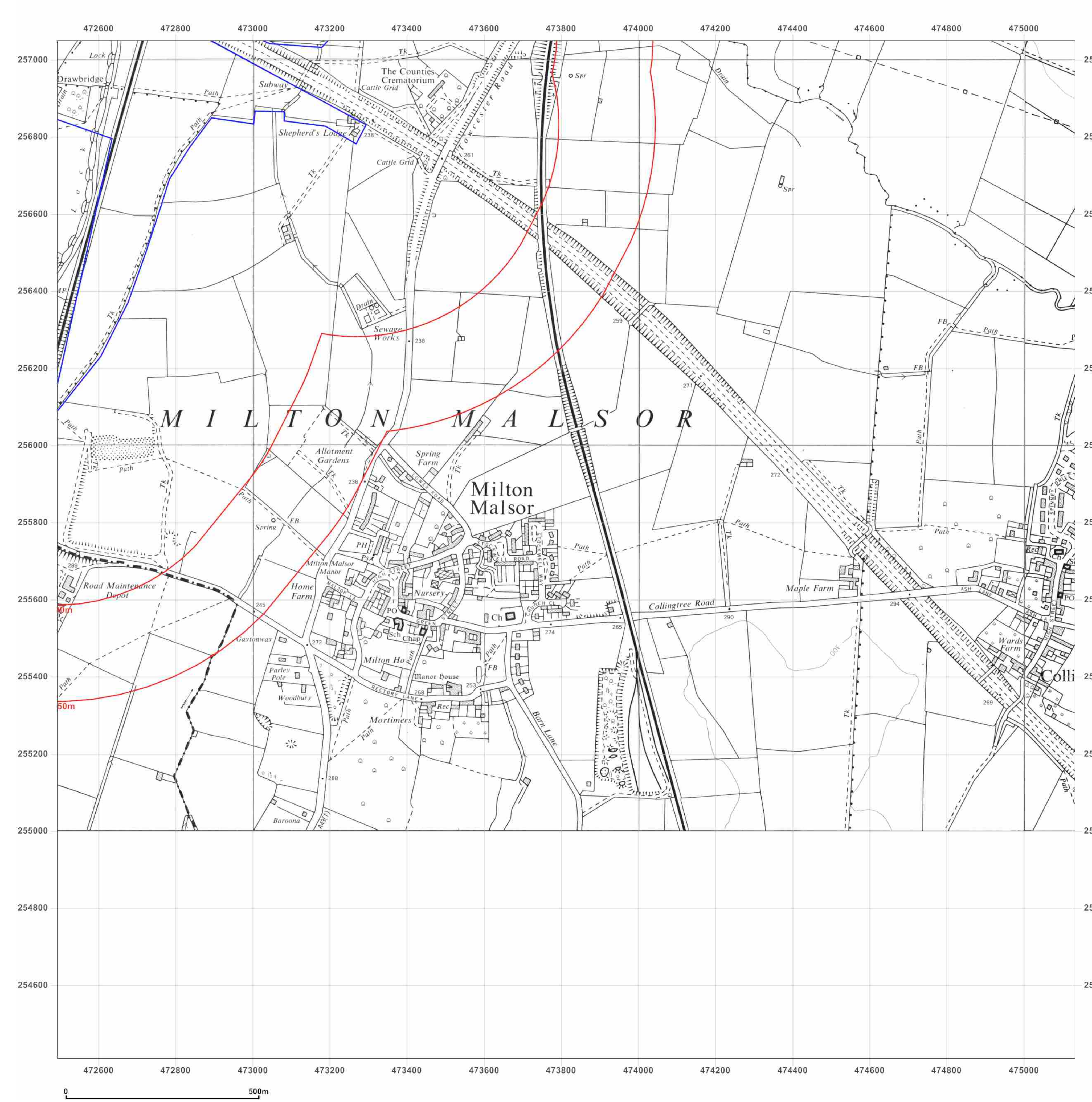
Production date: 19 June 2017

To view map legend click here *Legend*



![Groundsure Insights]

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_1
Grid Ref: 473812, 255729

Map Name: Provisional

Map date: **1968**

Scale: 1:10,560

Printed at: 1:10,560

N W E S

Surveyed 1968
Revised 1968
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1968
Revised 1968
Edition N/A
Copyright N/A
Levelled N/A

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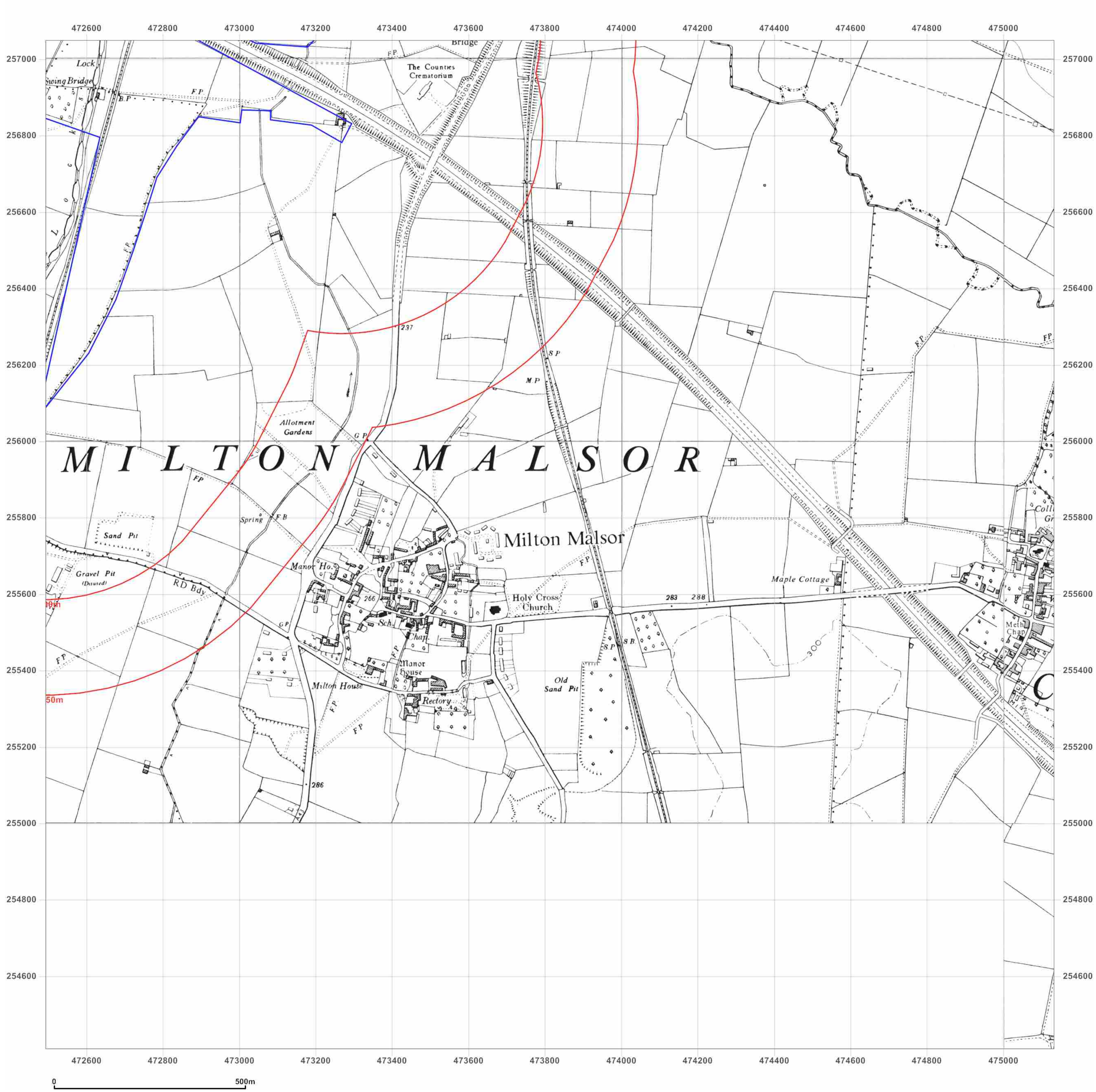
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_1
Grid Ref: 473812, 255729

Map Name: Provisional

Map date: **1965-1968**

Scale: 1:10,560

Printed at: 1:10,560

N
W E
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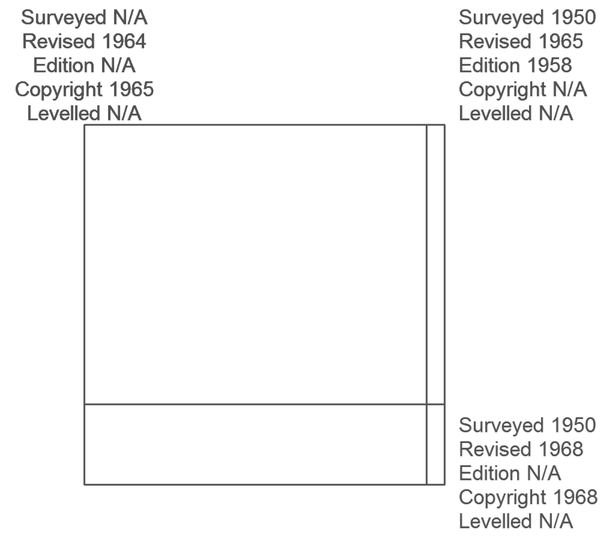

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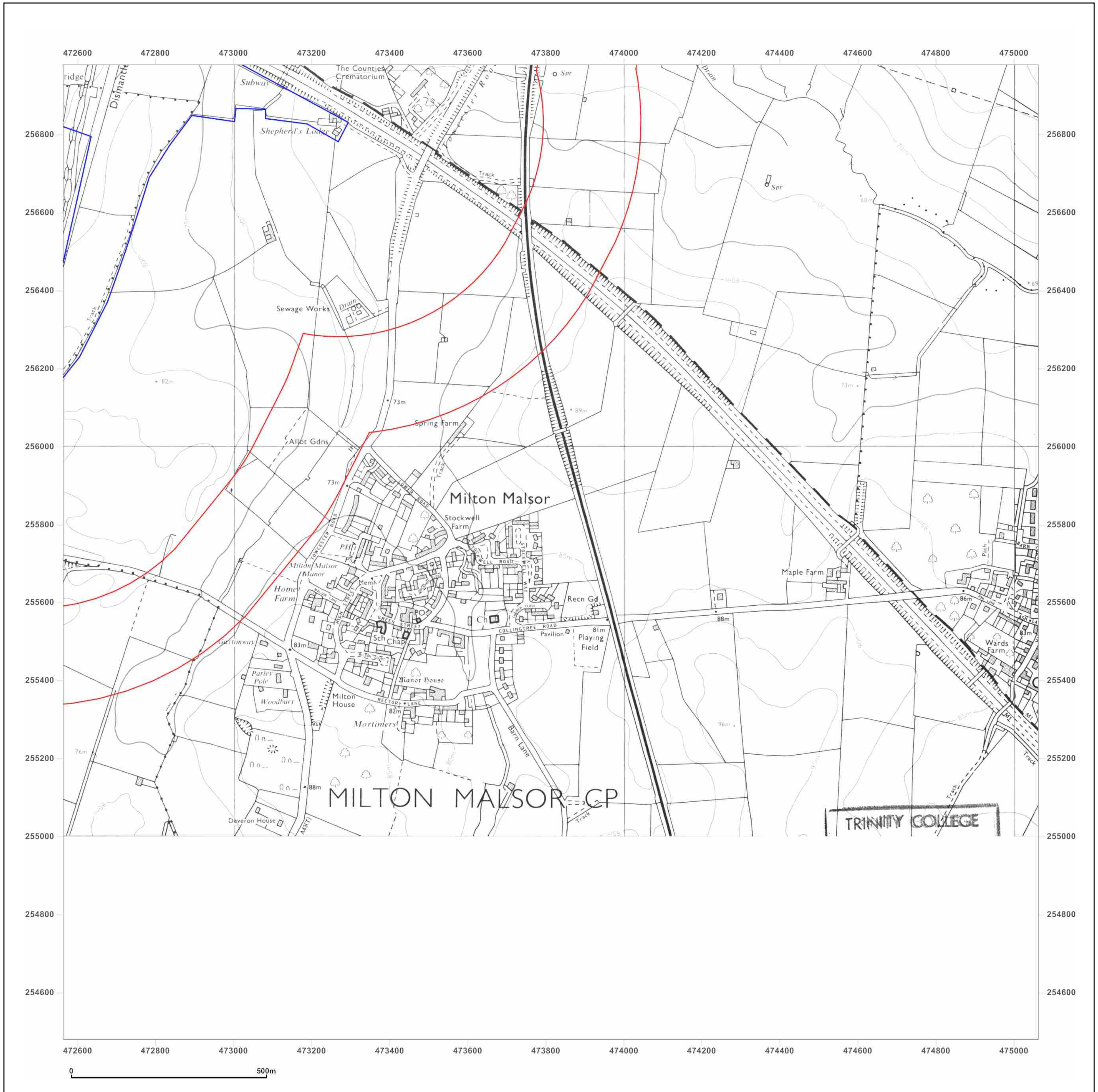
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_1
Grid Ref: 473812, 255729

Map Name: National Grid

Map date: 1981

Scale: 1:10,000

Printed at: 1:10,000

N
W E
S

Surveyed 1977
Revised 1981
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1978
Revised 1981
Edition N/A
Copyright N/A
Levelled N/A

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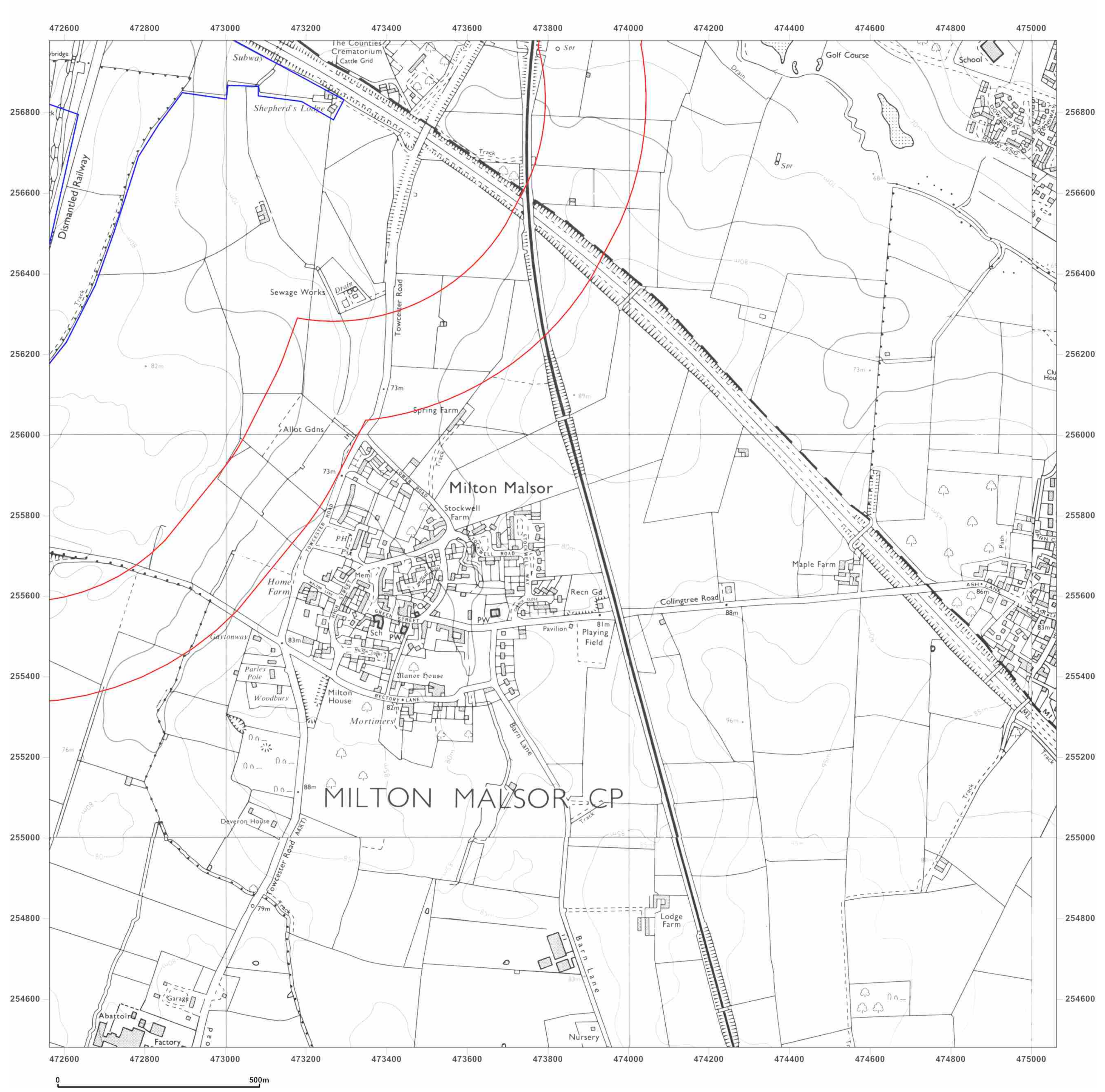
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_1
Grid Ref: 473812, 255729

Map Name: National Grid

Map date: **1989-1992**

Scale: 1:10,000

Printed at: 1:10,000

N
W E
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Surveyed 1988
Revised 1989
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1989
Revised 1991
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1977
Revised 1992
Edition N/A
Copyright N/A
Levelled N/A

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Production date: 19 June 2017

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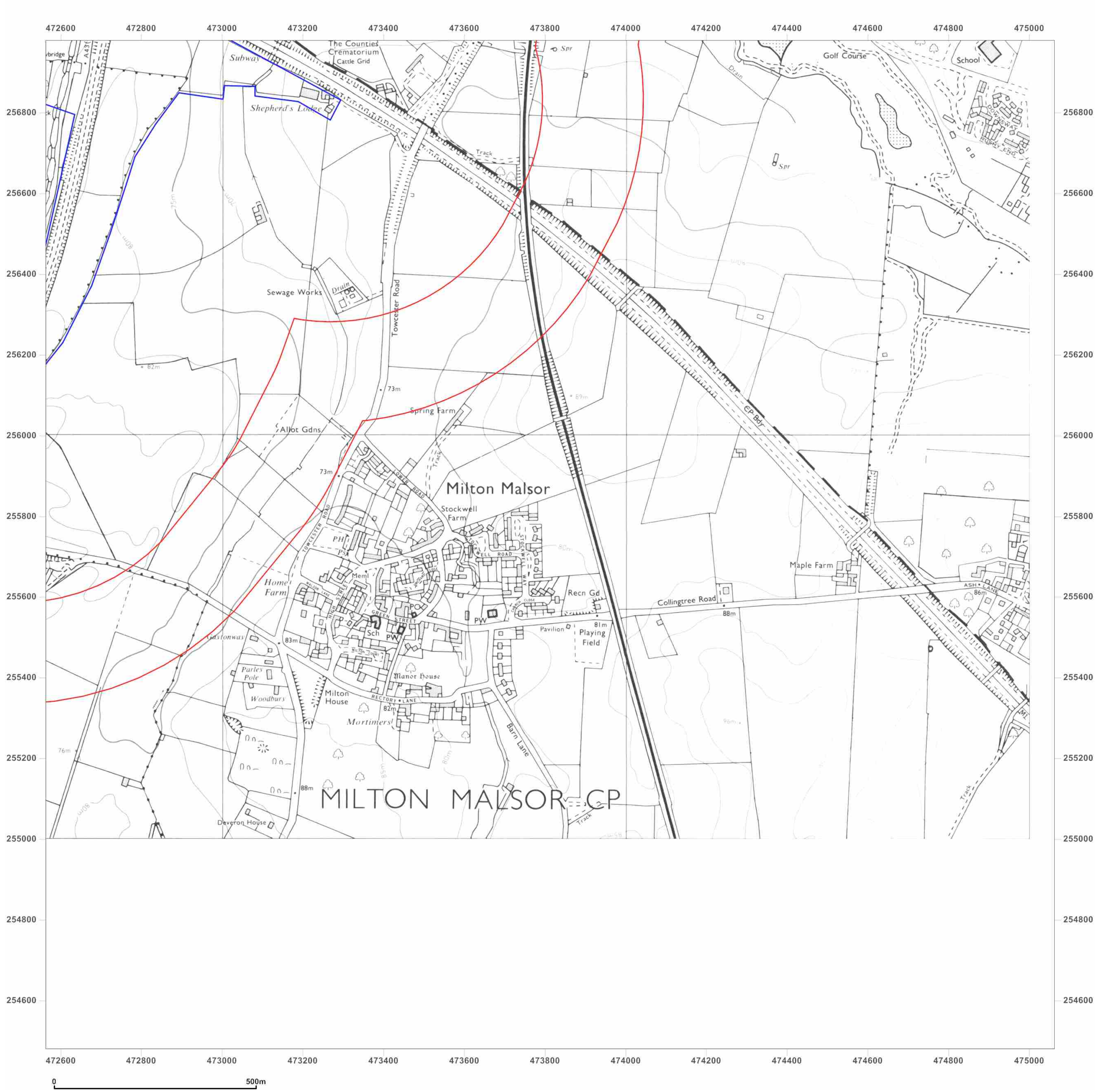

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_1
Grid Ref: 473812, 255729

Map Name: National Grid

Map date: **1992**

Scale: 1:10,000

Printed at: 1:10,000

N
W E
S

Surveyed 1988
Revised 1992
Edition N/A
Copyright N/A
Levelled N/A

Powered by

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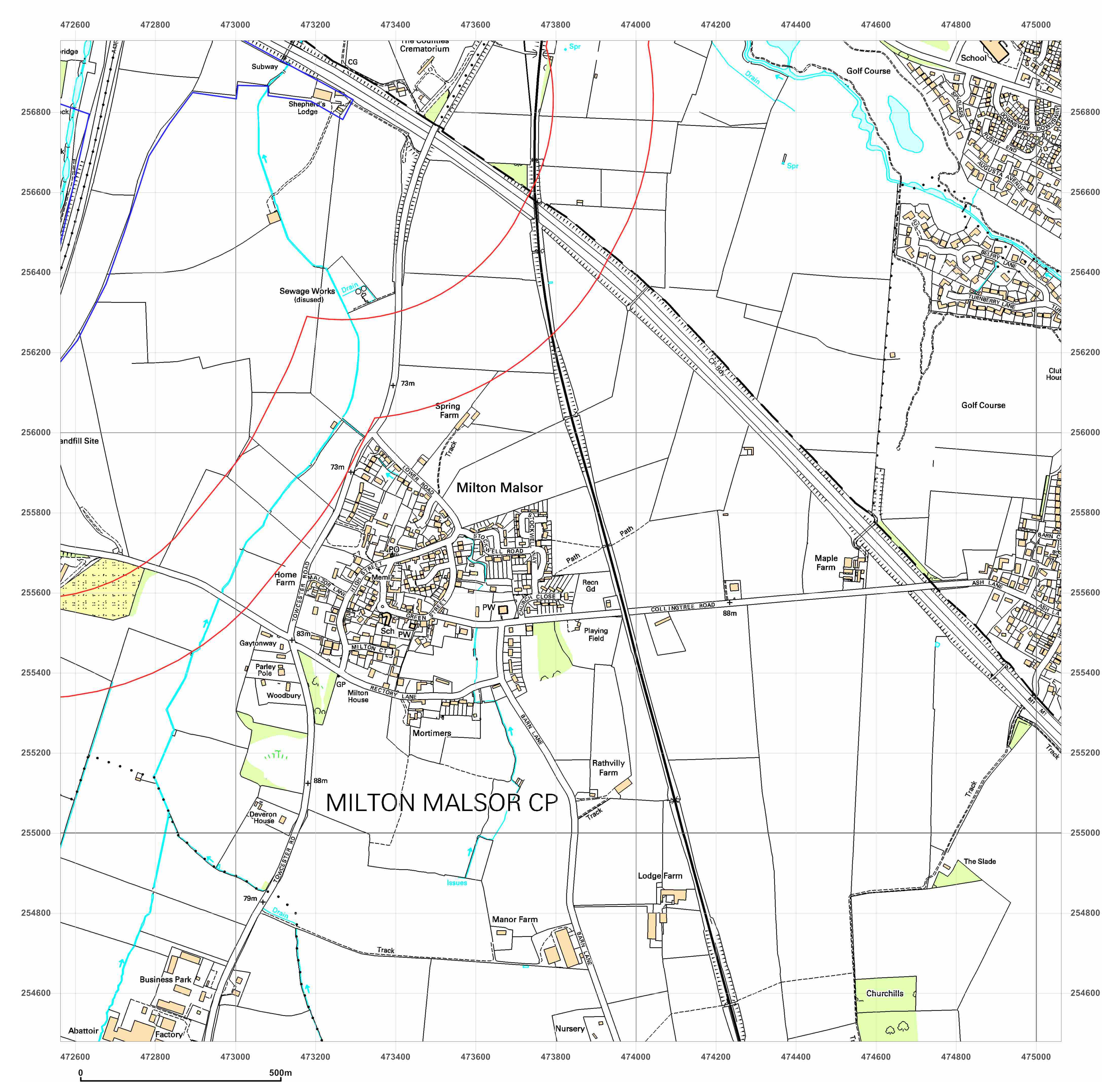
Production date: 19 June 2017

To view map legend click here *Legend*



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_1
Grid Ref: 473812, 255729

Map Name: 1:10,000 Raster

Map date: 2002

Scale: 1:10,000

Printed at: 1:10,000

N W E S

2002

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Production date: 19 June 2017

To view map legend click here *Legend*

![Groundsure Insights]

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_1
Grid Ref: 473812, 255729

Map Name: National Grid

Map date: **2010**

Scale: 1:10,000

Printed at: 1:10,000

N
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2010

Powered by

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W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_1
Grid Ref: 473812, 255729

Map Name: National Grid

Map date: **2014**

Scale: 1:10,000

Printed at: 1:10,000

N
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2014

Powered by OS

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W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*

Groundsure INSIGHTS

Site Details:

472716, 257183

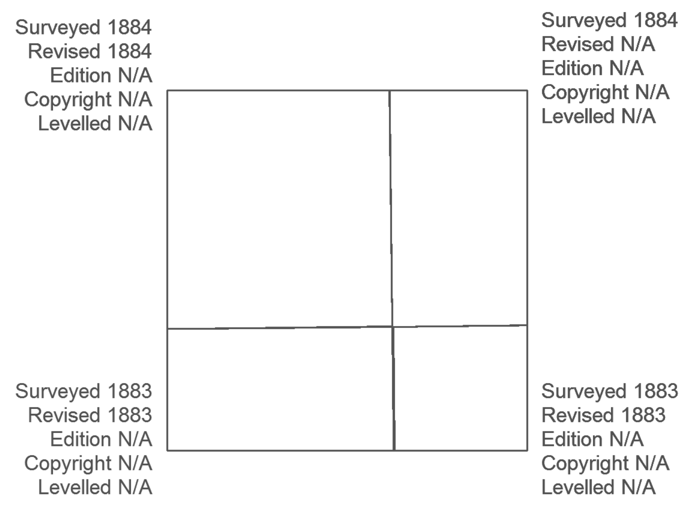
Client Ref: POP009664
Report Ref: GS-4001370_SS_2_2
Grid Ref: 473812, 258139

Map Name: County Series

Map date: **1883-1885**

Scale: 1:10,560

Printed at: 1:10,560



Powered by

Produced by
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W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_2
Grid Ref: 473812, 258139

Map Name: County Series

Map date: 1884-1885

Scale: 1:10,560

Printed at: 1:10,560

N
W E
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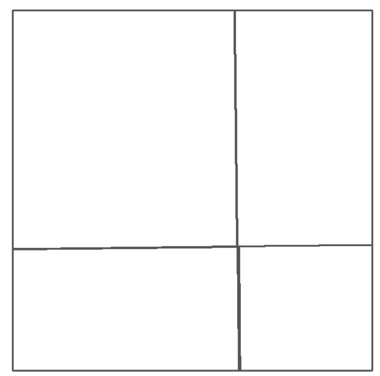
Surveyed 1884
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1884
Revised N/A
Edition 1885
Copyright N/A
Levelled N/A



Surveyed 1883
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1883
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

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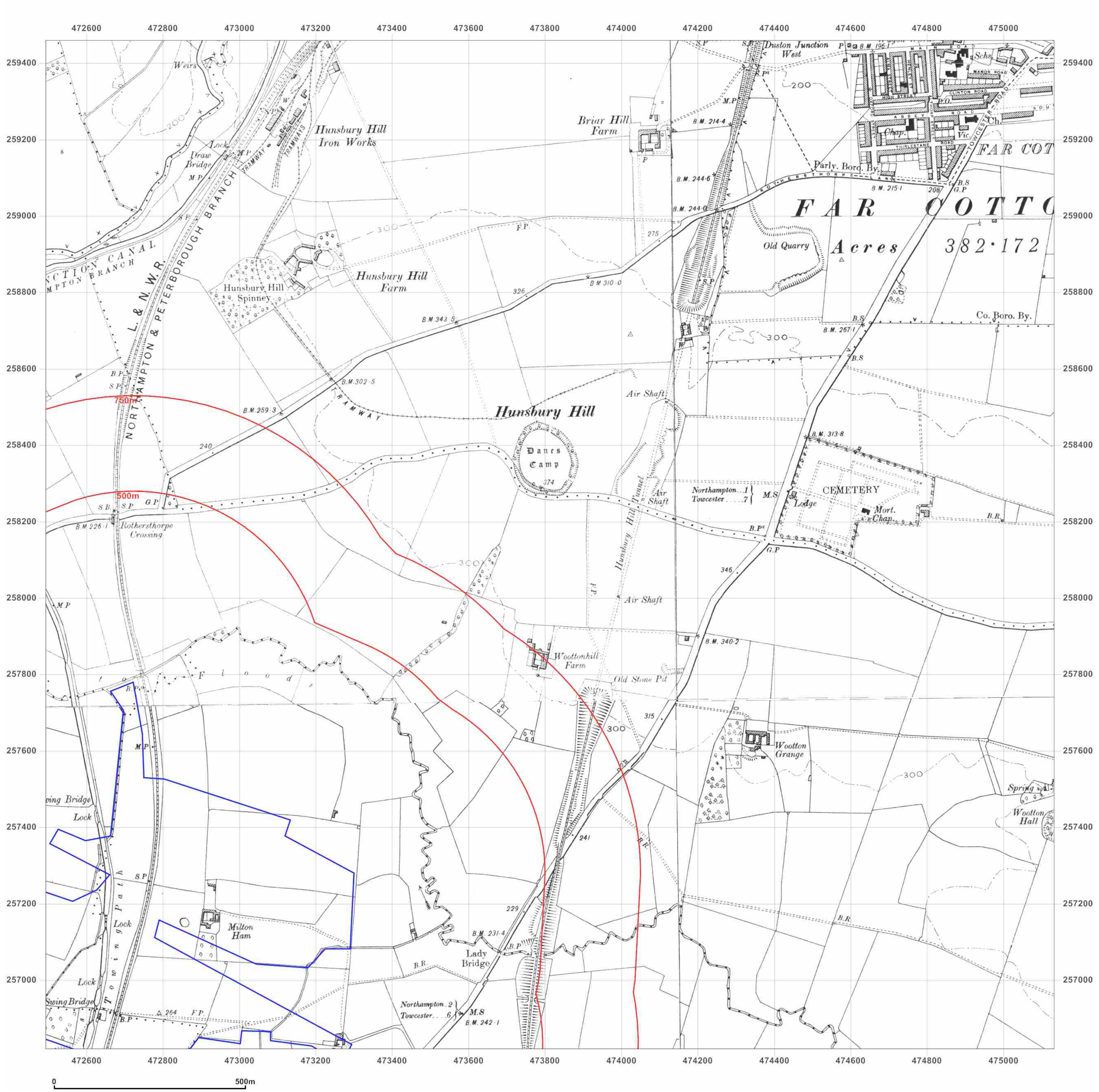
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_2
Grid Ref: 473812, 258139

Map Name: County Series

Map date: 1899-1900

Scale: 1:10,560

Printed at: 1:10,560

N W E S

Surveyed 1883 Revised 1899 Edition N/A Copyright N/A Levelled N/A	Surveyed 1884 Revised 1899 Edition N/A Copyright N/A Levelled N/A
Surveyed 1883 Revised 1900 Edition 1900 Copyright N/A Levelled N/A	Surveyed 1883 Revised 1899 Edition N/A Copyright N/A Levelled N/A

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T: 08444 159000
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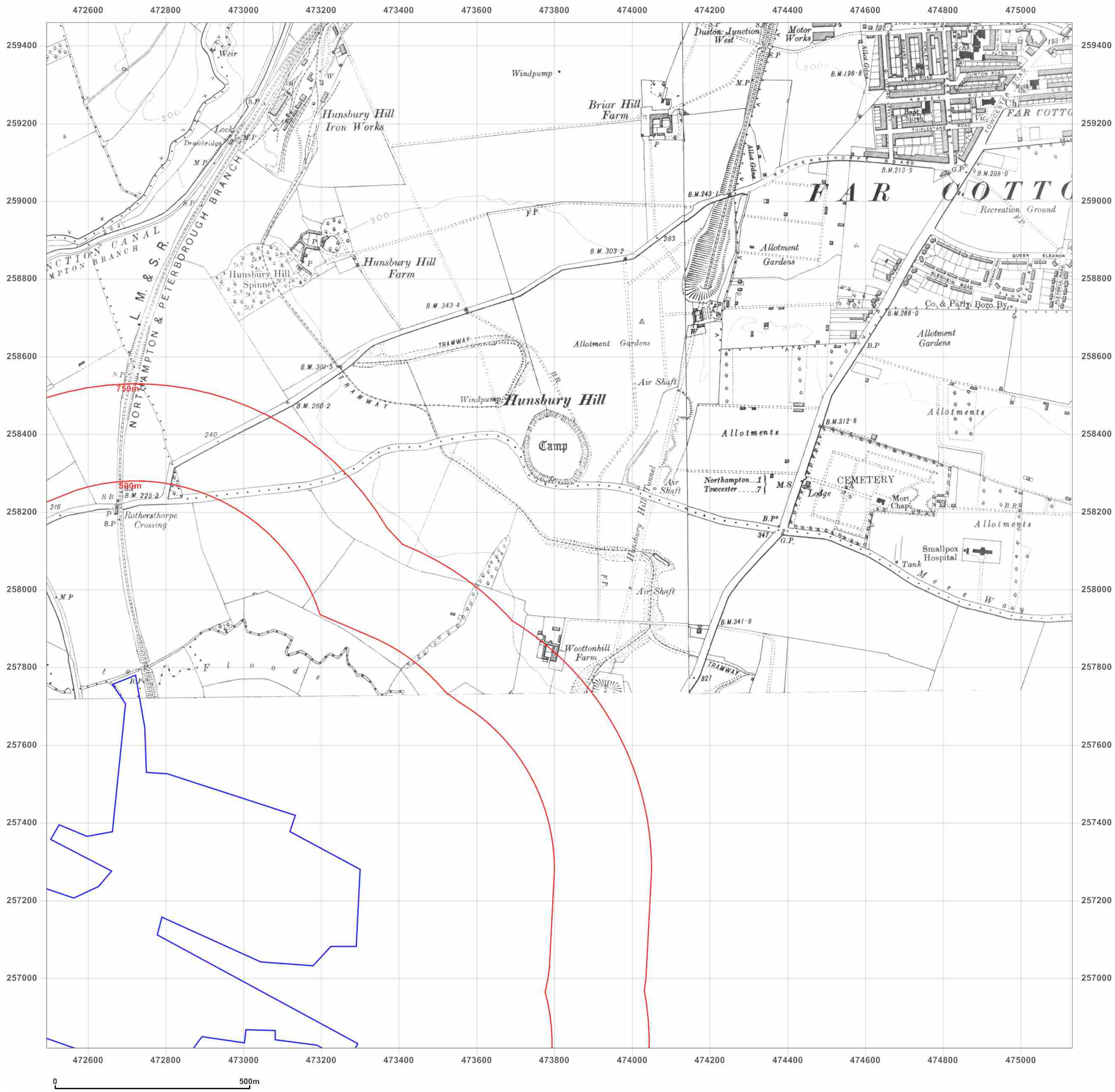
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_2
Grid Ref: 473812, 258139

Map Name: County Series

Map date: **1923-1924**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1883
Revised 1923
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1884
Revised 1924
Edition N/A
Copyright N/A
Levelled N/A

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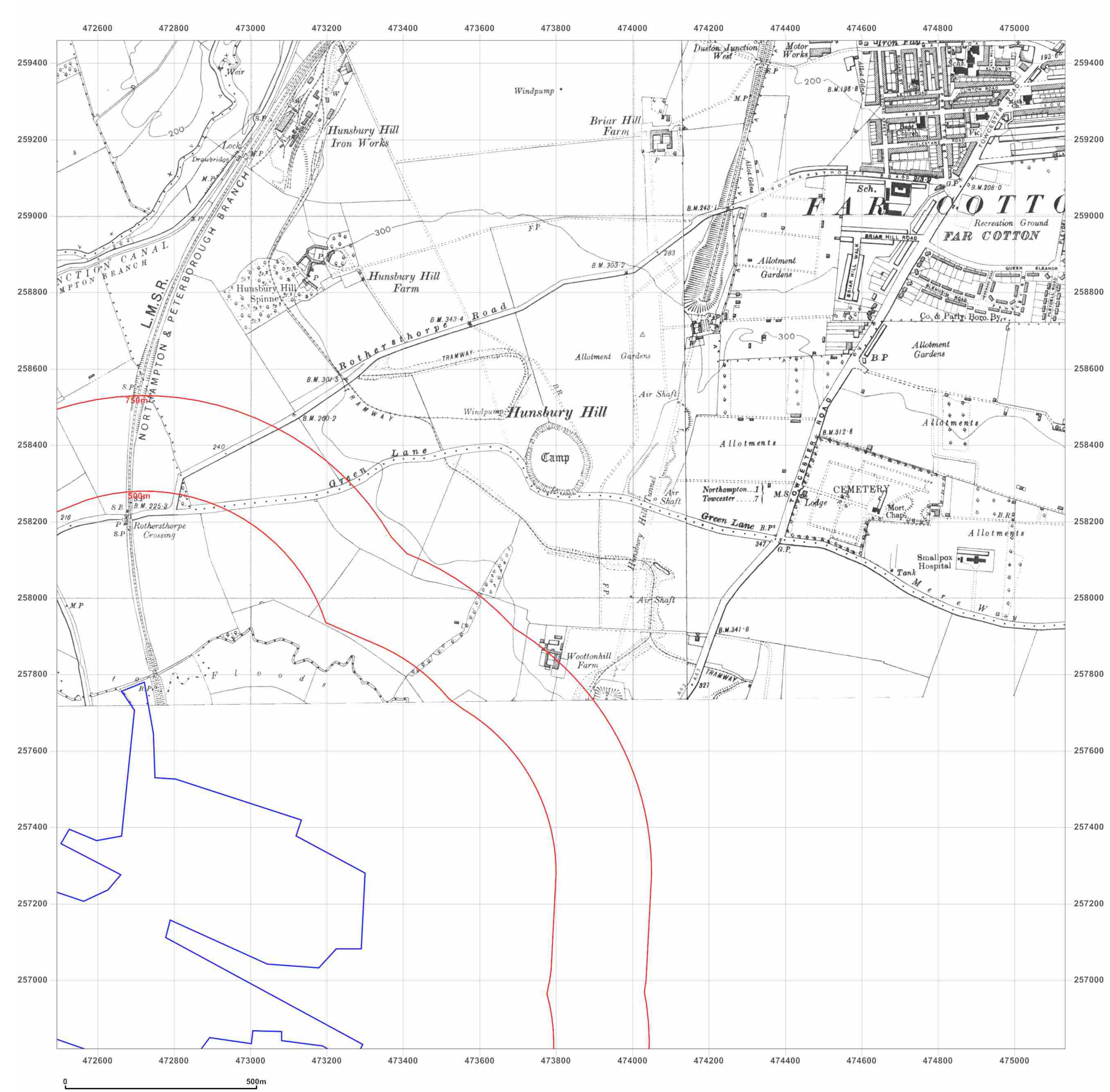
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_2
Grid Ref: 473812, 258139

Map Name: County Series

Map date: **1938**

Scale: 1:10,560

Printed at: 1:10,560

N
W E
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Surveyed 1883
Revised 1938
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1884
Revised 1938
Edition N/A
Copyright N/A
Levelled N/A

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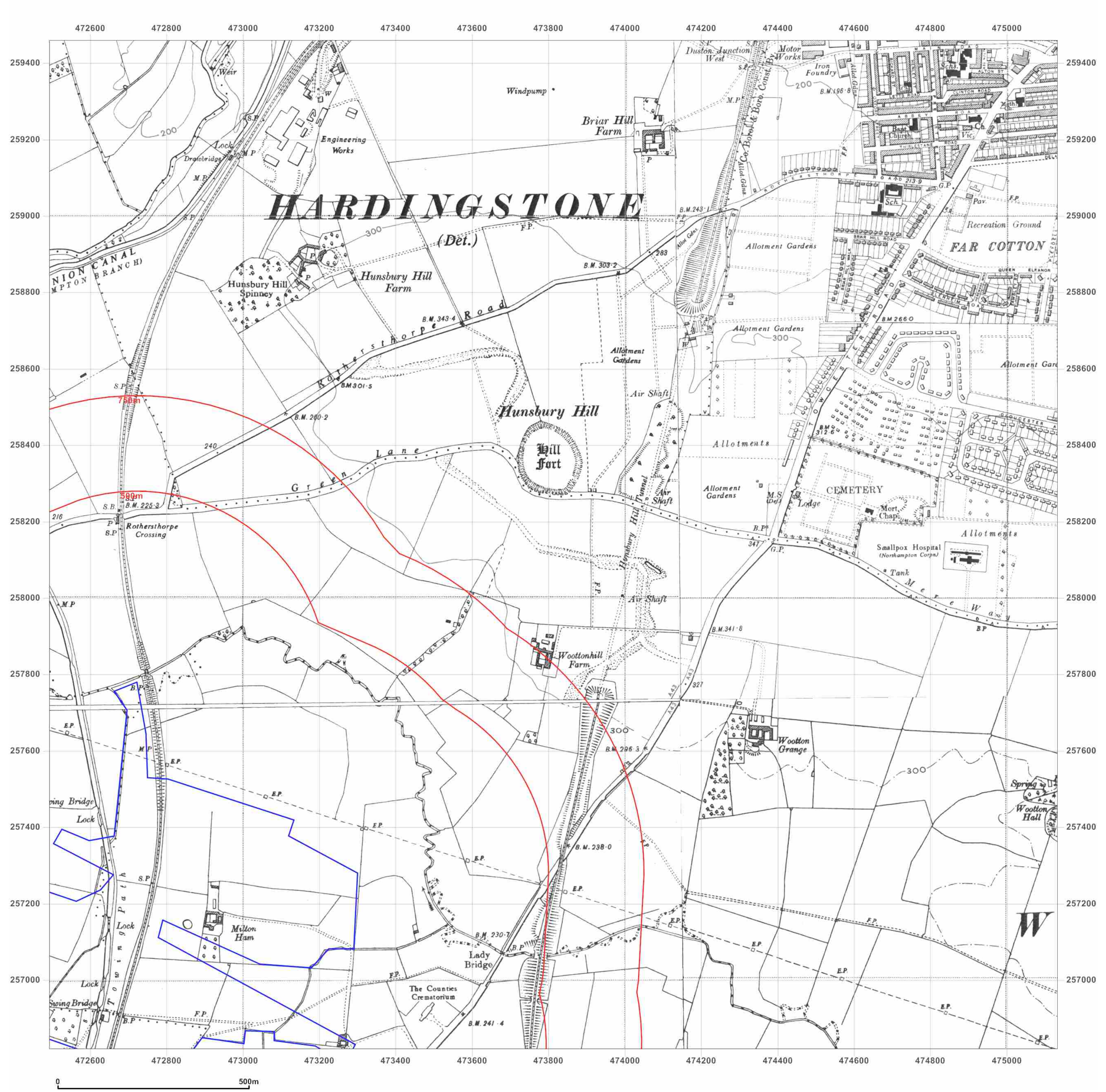
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_2
Grid Ref: 473812, 258139

Map Name: County Series

Map date: 1950

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1883
Revised 1950
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1884
Revised 1950
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1883
Revised 1950
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1883
Revised 1950
Edition N/A
Copyright N/A
Levelled N/A

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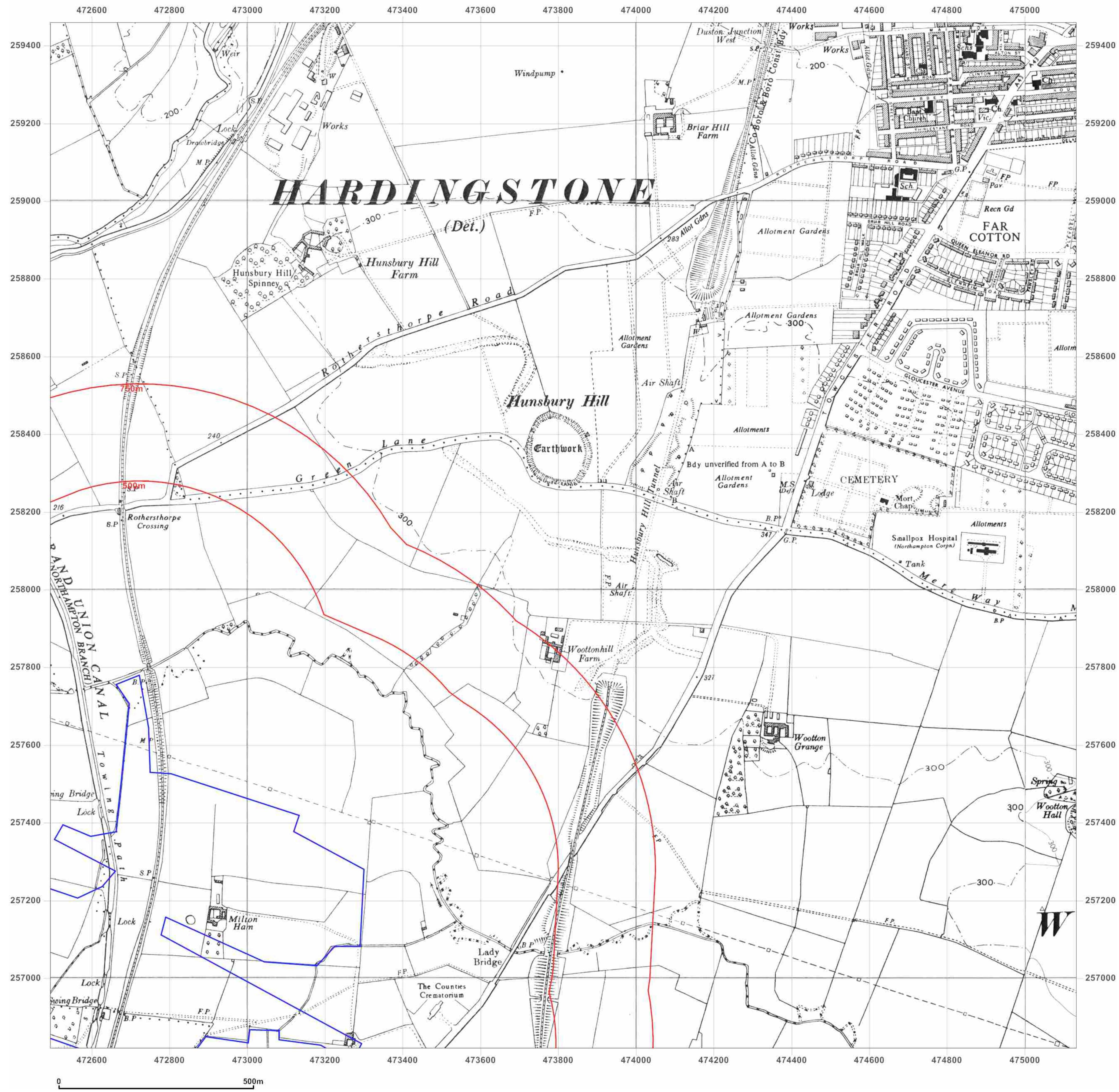
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_2
Grid Ref: 473812, 258139

Map Name: Provisional

Map date: 1958

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed N/A
Revised 1957
Edition N/A
Copyright 1958
Levelled N/A

Surveyed N/A
Revised 1957
Edition 1958
Copyright N/A
Levelled N/A

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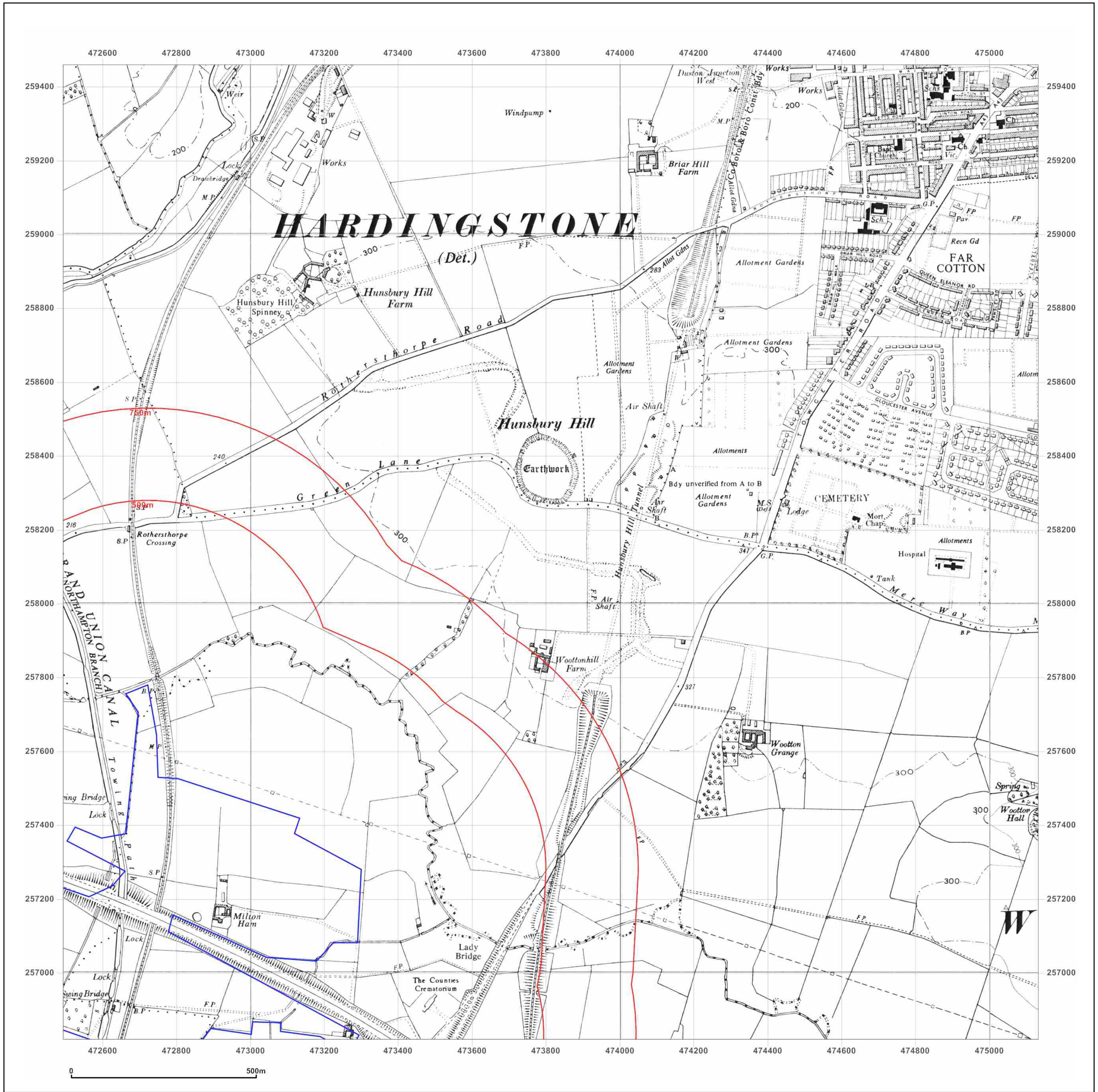
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_2
Grid Ref: 473812, 258139

Map Name: Provisional

Map date: 1965

Scale: 1:10,560

Printed at: 1:10,560

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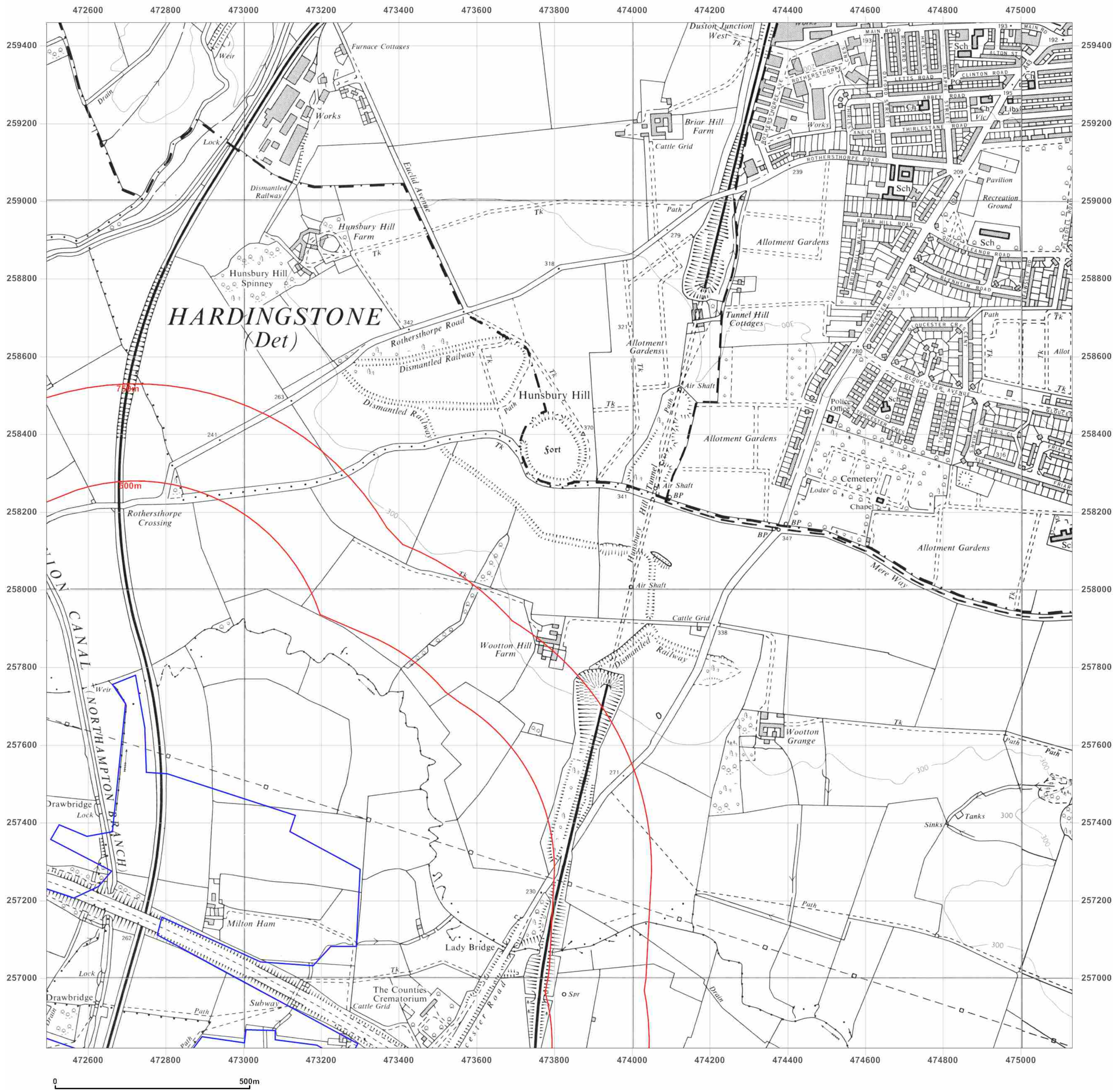
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_2
Grid Ref: 473812, 258139

Map Name: Provisional

Map date: 1968

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1968
Revised 1968
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1968
Revised 1968
Edition N/A
Copyright N/A
Levelled N/A

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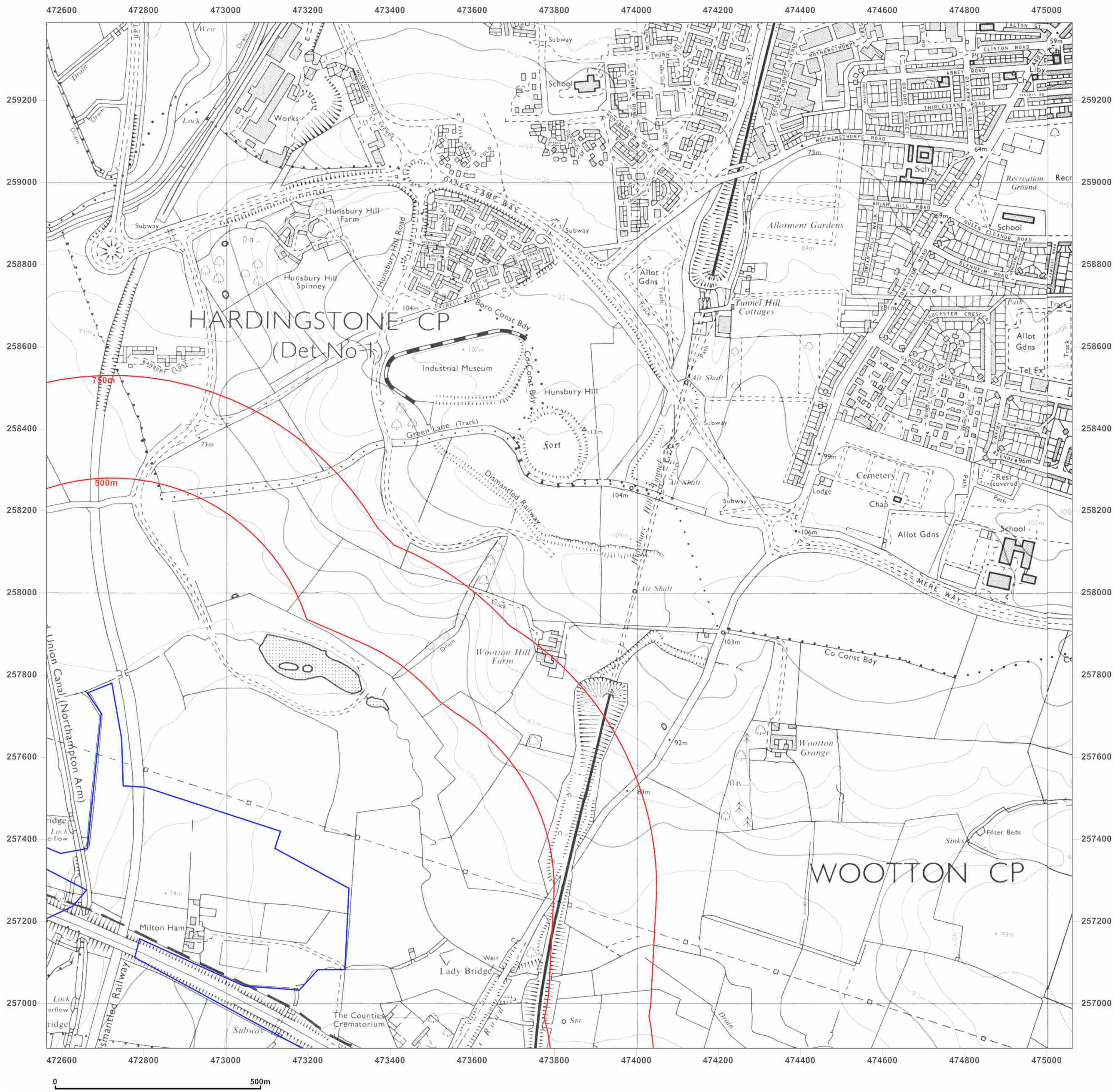
Production date: 19 June 2017

To view map legend click here *Legend*



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_2
Grid Ref: 473812, 258139

Map Name: National Grid

Map date: **1981**

Scale: 1:10,000

Printed at: 1:10,000

N
W E
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Surveyed 1977
Revised 1981
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1978
Revised 1981
Edition N/A
Copyright N/A
Levelled N/A

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Production date: 19 June 2017

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Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_2
Grid Ref: 473812, 258139

Map Name: National Grid

Map date: **1989-1991**

Scale: 1:10,000

Printed at: 1:10,000

N
W E
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Surveyed 1988
Revised 1989
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1989
Revised 1991
Edition N/A
Copyright N/A
Levelled N/A

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W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_2
Grid Ref: 473812, 258139

Map Name: National Grid

Map date: **1992**

Scale: 1:10,000

Printed at: 1:10,000

N
W E
S

Surveyed 1988
Revised 1992
Edition N/A
Copyright N/A
Levelled N/A

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Production date: 19 June 2017

To view map legend click here *Legend*

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_2
Grid Ref: 473812, 258139

Map Name: 1:10,000 Raster

Map date: **2002**

Scale: 1:10,000

Printed at: 1:10,000

N
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2002

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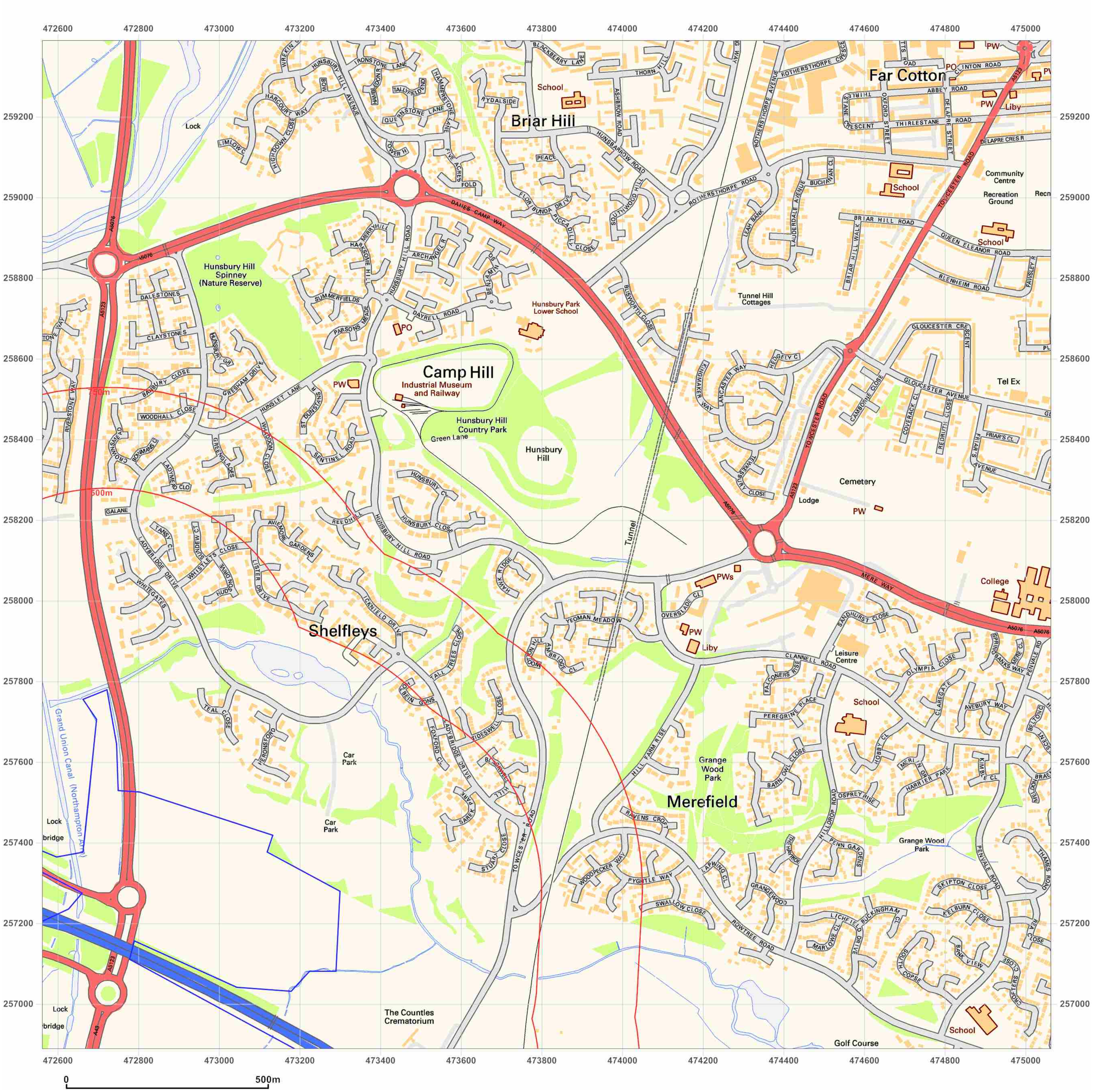
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_2
Grid Ref: 473812, 258139

Map Name: National Grid

Map date: **2010**

Scale: 1:10,000

Printed at: 1:10,000

N
W E
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2010

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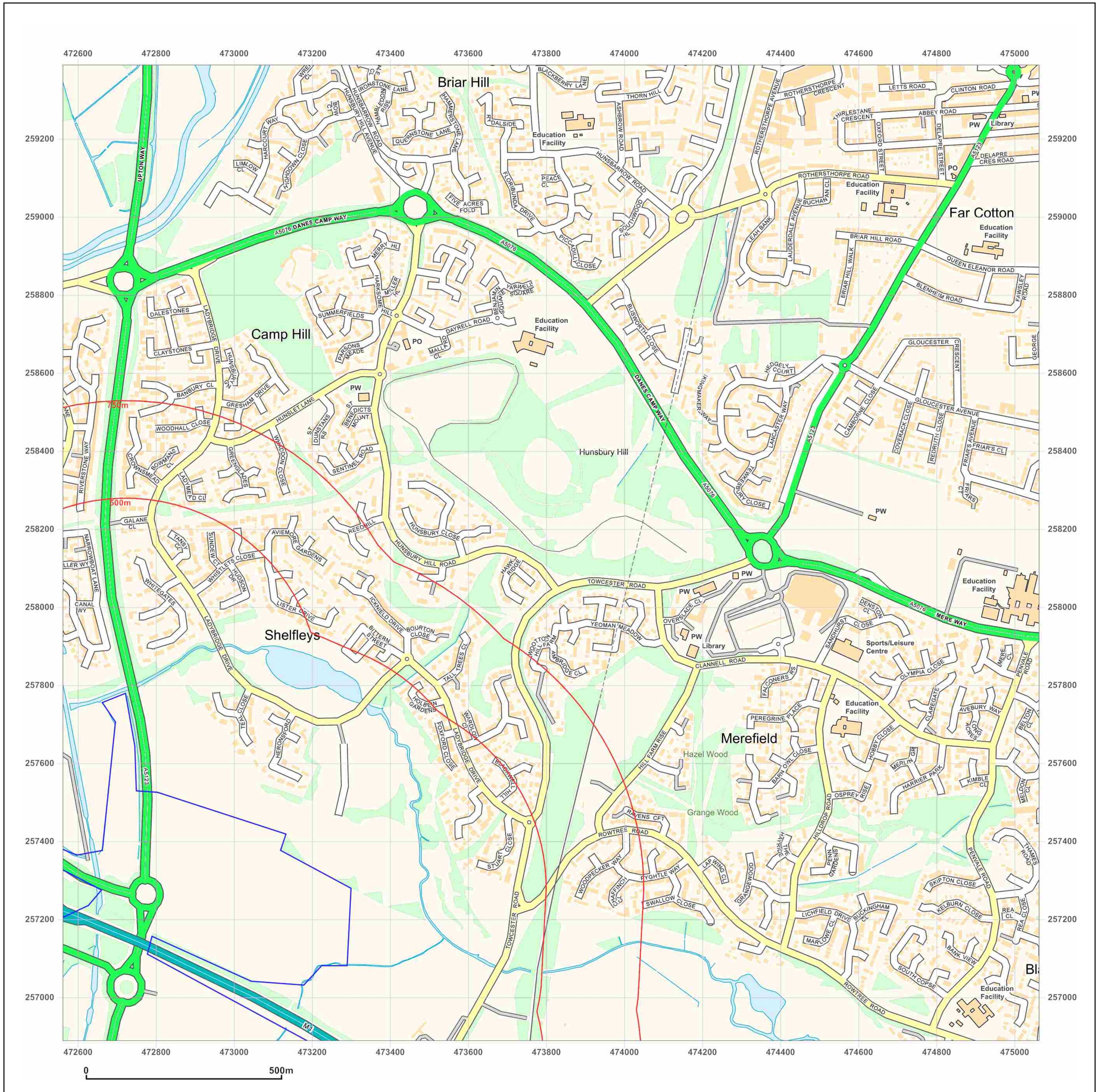
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_SS_2_2
Grid Ref: 473812, 258139

Map Name: National Grid

Map date: 2014

Scale: 1:10,000

Printed at: 1:10,000

N
W E
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2014

Powered by

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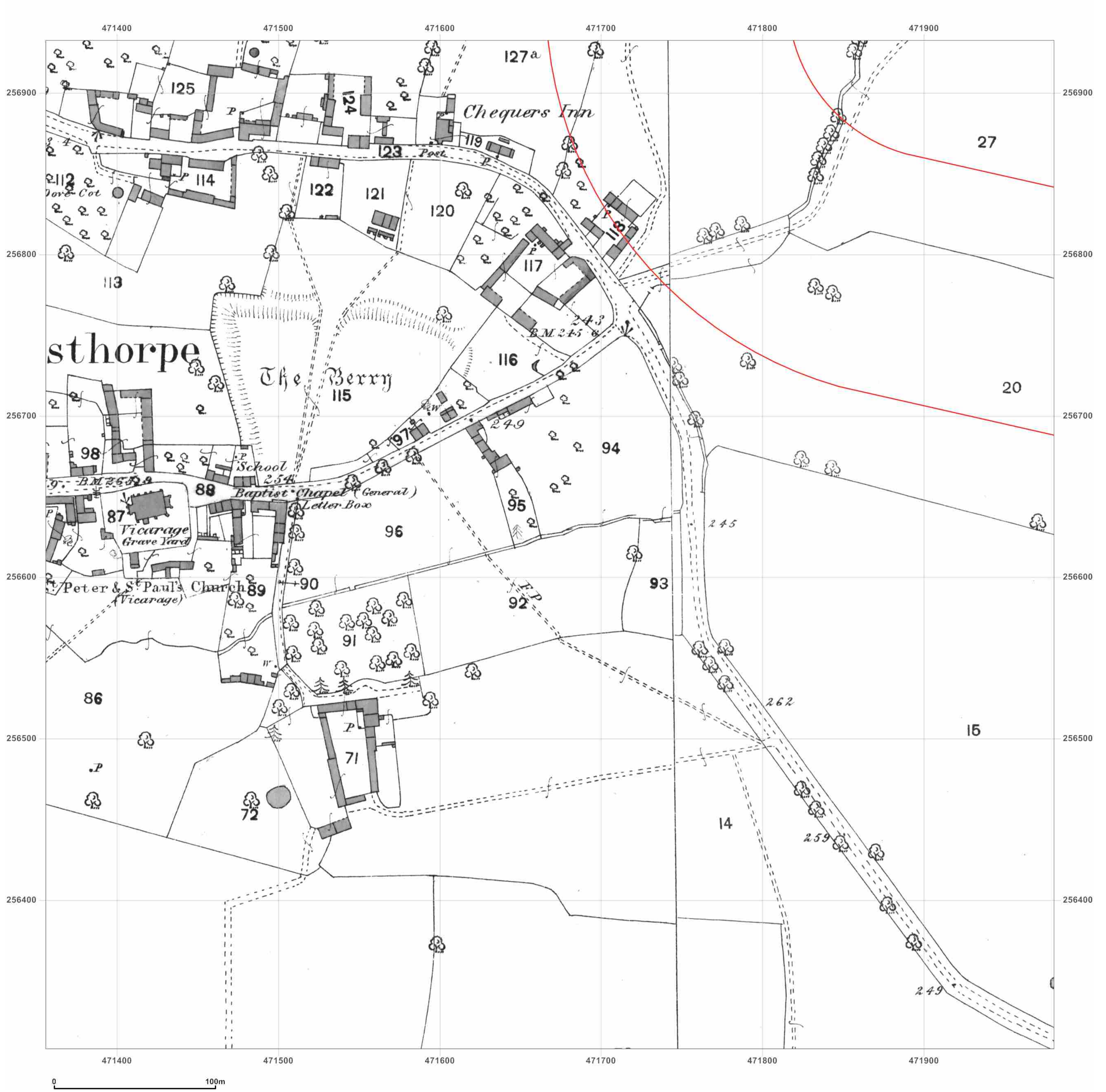
T: 08444 159000
E: info@groundsure.com
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_1_2
Grid Ref: 471668, 256620

Map Name: County Series

Map date: 1885

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed 1885 Revised 1885 Edition N/A Copyright N/A Levelled N/A	Surveyed 1885 Revised 1885 Edition N/A Copyright N/A Levelled N/A

Powered by

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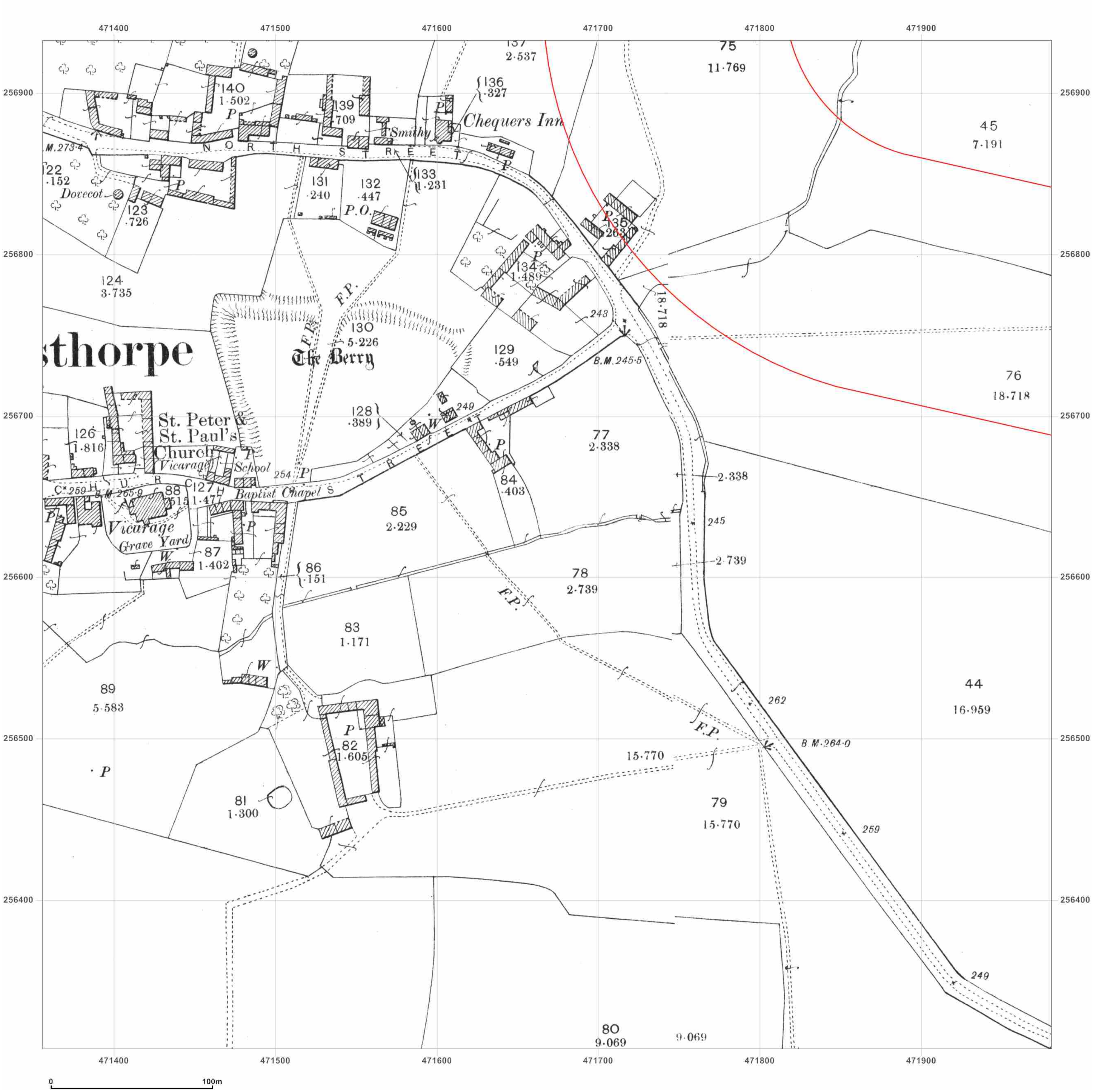
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure
INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_1_2
Grid Ref: 471668, 256620

Map Name: County Series

Map date: 1900

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

Powered by OS

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T: 08444 159000
E: info@groundsure.com
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*

![Groundsure Insights]

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_1_2
Grid Ref: 471668, 256620

Map Name: National Grid

Map date: **1964**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1961

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W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_1_2
Grid Ref: 471668, 256620

Map Name: National Grid

Map date: 1965

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

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

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Produced by
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E: info@groundsure.com
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_1_2
Grid Ref: 471668, 256620

Map Name: National Grid

Map date: **1976**

Scale: 1:2,500

Printed at: 1:2,500

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W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_1_2
Grid Ref: 471668, 256620

Map Name: National Grid

Map date: **1993**

Scale: 1:2,500

Printed at: 1:2,500

N W E S

Surveyed N/A
Revised N/A
Edition N/A
Copyright 1993
Levelled N/A

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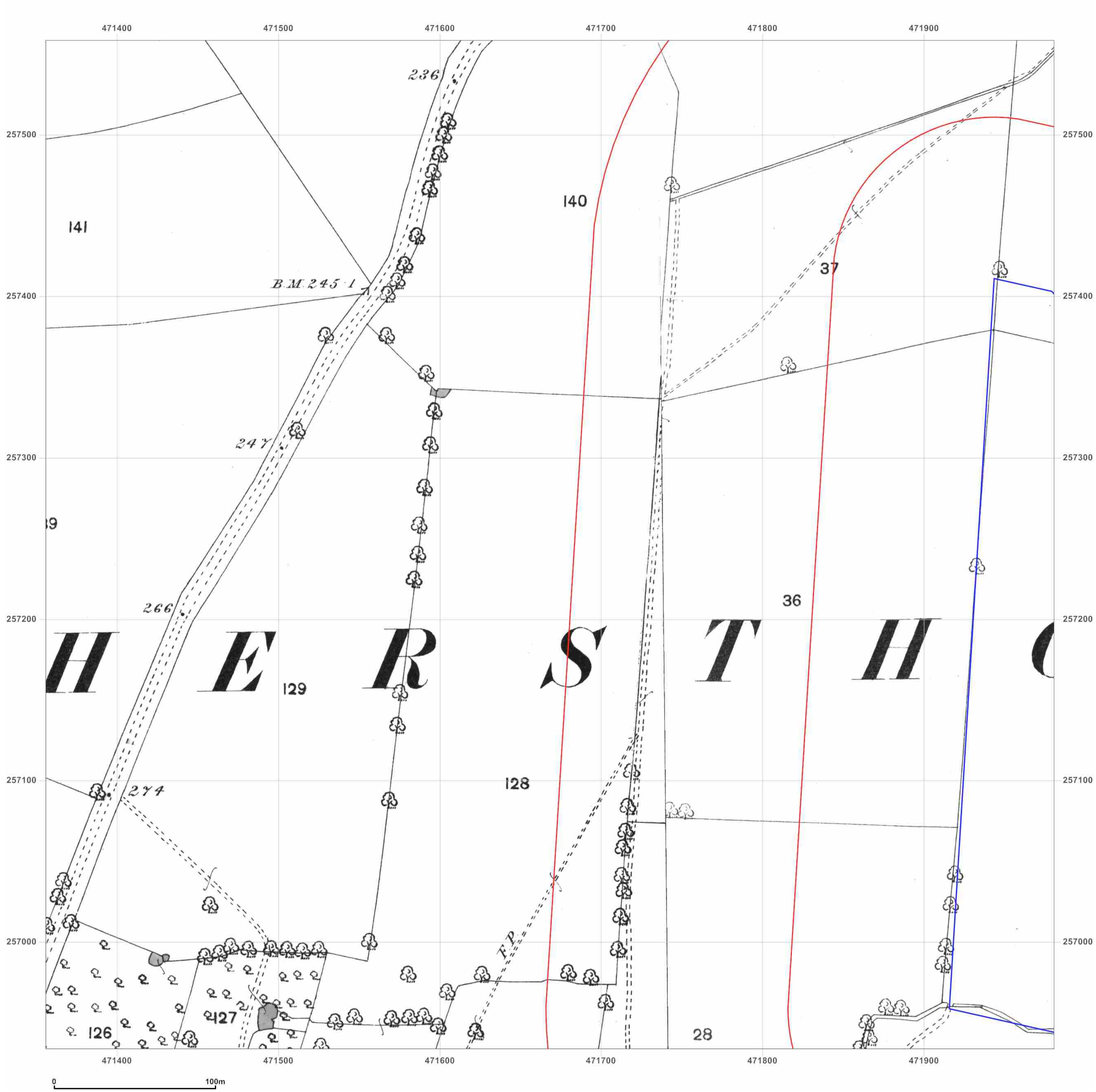
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

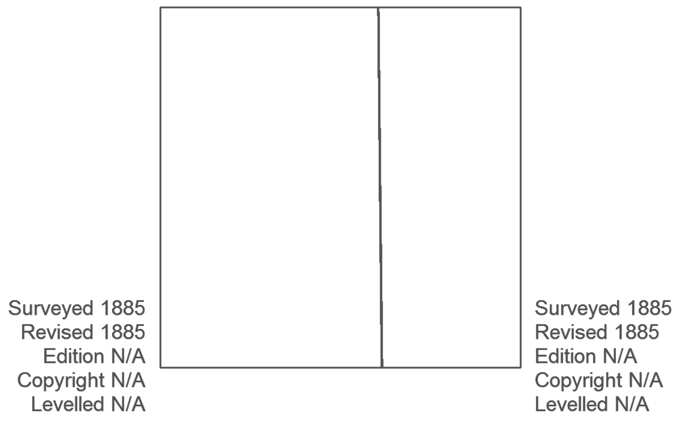
Client Ref: POP009664
Report Ref: GS-4001370_LS_1_3
Grid Ref: 471668, 257246

Map Name: County Series

Map date: **1885**

Scale: 1:2,500

Printed at: 1:2,500



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W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_1_3
Grid Ref: 471668, 257246

Map Name: County Series

Map date: **1900**

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

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Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_1_3
Grid Ref: 471668, 257246

Map Name: National Grid

Map date: **1964**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1961

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Production date: 19 June 2017

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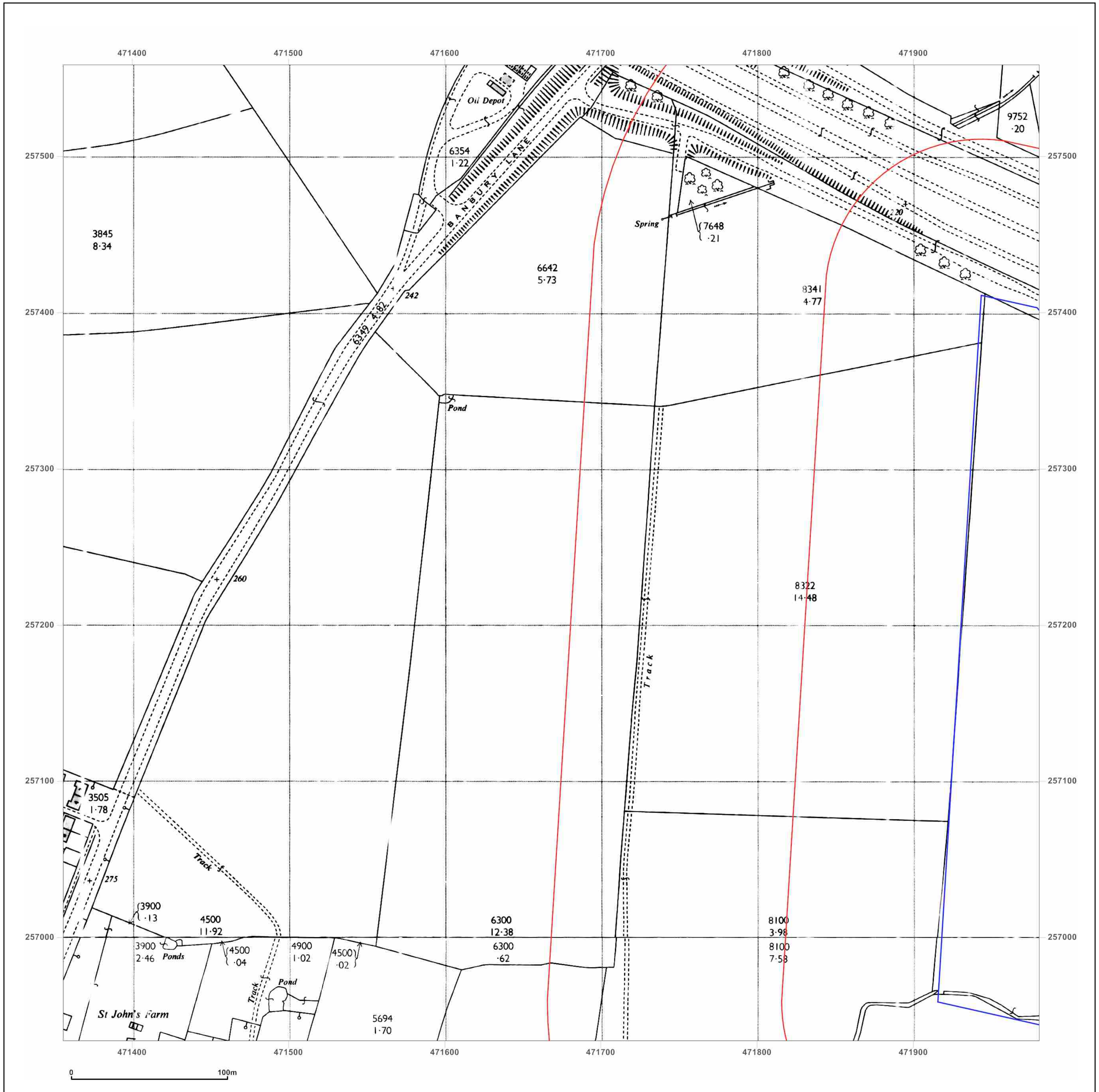

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_1_3
Grid Ref: 471668, 257246

Map Name: National Grid

Map date: 1965

Scale: 1:2,500

Printed at: 1:2,500

N W E S

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

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

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Production date: 19 June 2017

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Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_1_3
Grid Ref: 471668, 257246

Map Name: National Grid

Map date: 1976

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1976
Revised 1976
Edition N/A
Copyright 1977
Levelled 1960

Surveyed 1976
Revised 1976
Edition N/A
Copyright 1977
Levelled 1960

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Production date: 19 June 2017

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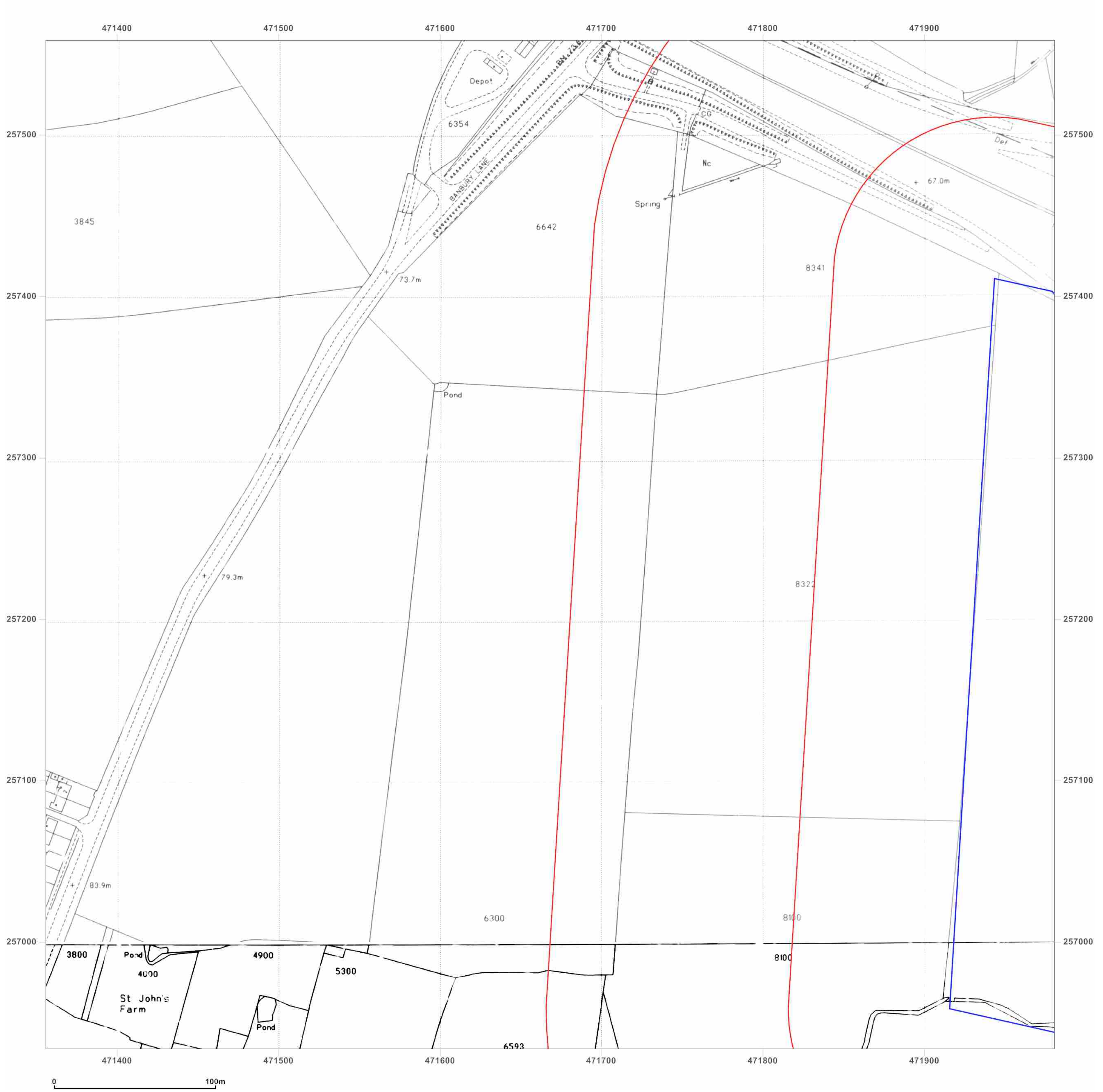

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_1_3
Grid Ref: 471668, 257246

Map Name: National Grid

Map date: **1993**

Scale: 1:2,500

Printed at: 1:2,500

N W E S

Surveyed 1993
Revised 1993
Edition N/A
Copyright N/A
Levelled N/A

Surveyed N/A
Revised N/A
Edition N/A
Copyright 1993
Levelled N/A

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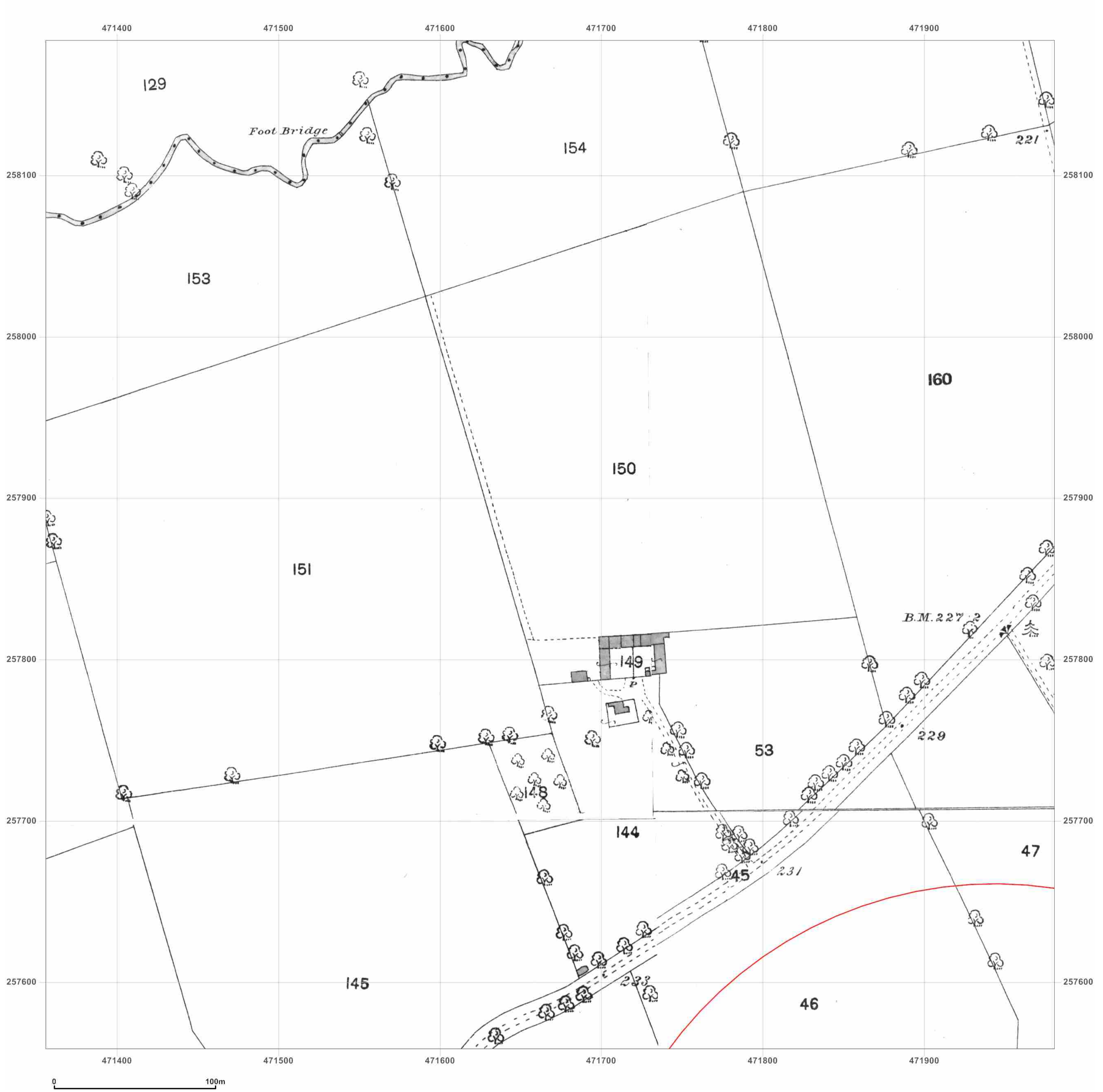


Groundsure INSIGHTS

Site Details:

472716, 257183

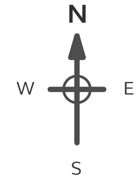
Client Ref: POP009664
Report Ref: GS-4001370_LS_1_4
Grid Ref: 471668, 257871

Map Name: County Series

Map date: **1885-1886**

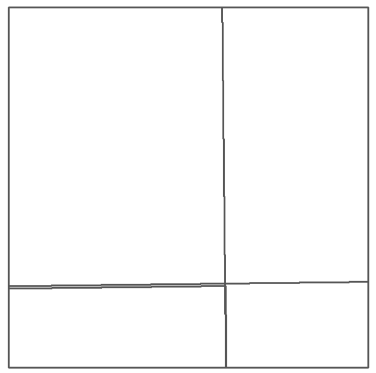
Scale: 1:2,500

Printed at: 1:2,500



Surveyed 1886
Revised 1886
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1886
Revised 1886
Edition N/A
Copyright N/A
Levelled N/A



Surveyed 1885
Revised 1885
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1885
Revised 1885
Edition N/A
Copyright N/A
Levelled N/A

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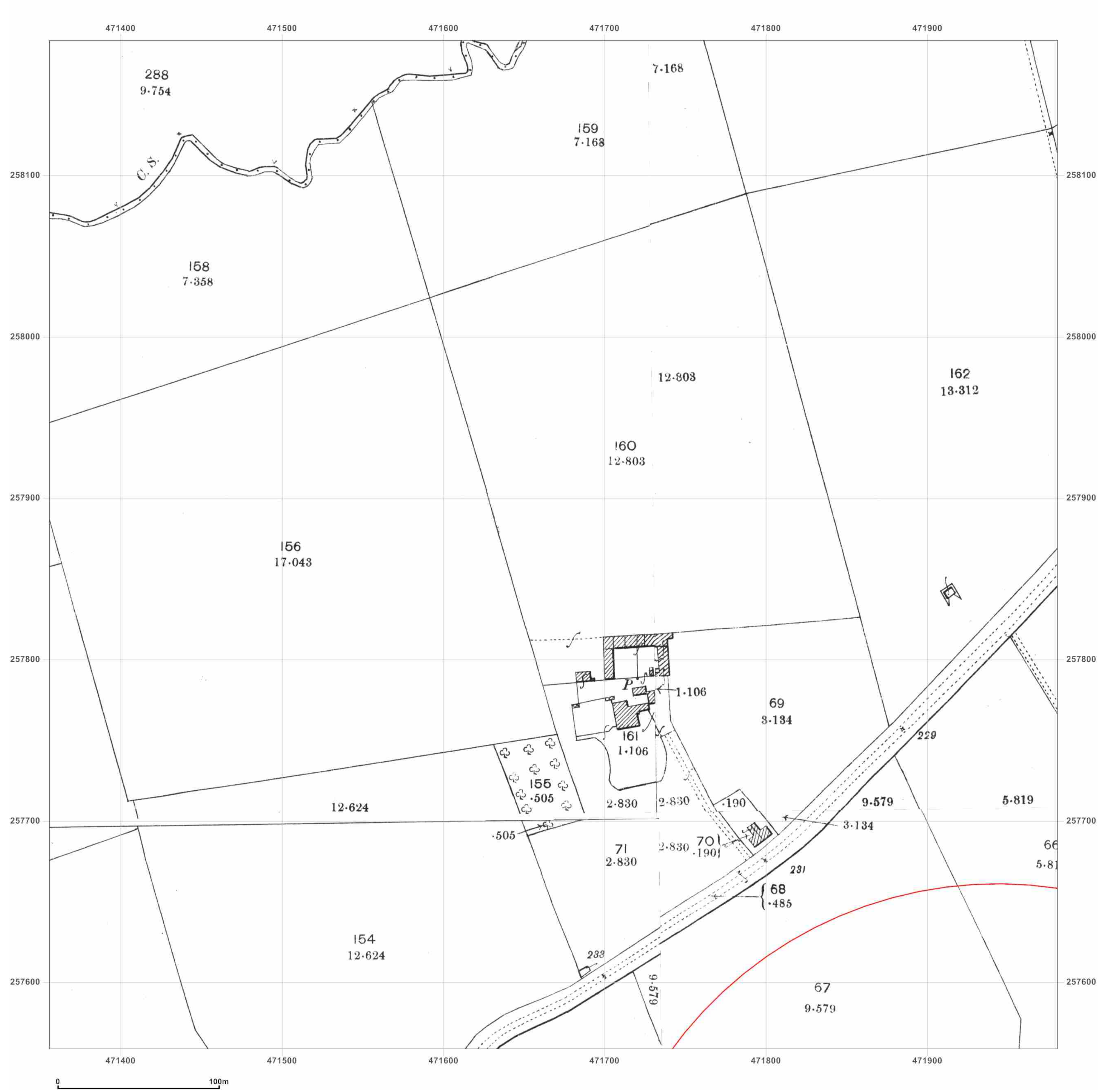

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_1_4
Grid Ref: 471668, 257871

Map Name: County Series

Map date: 1900

Scale: 1:2,500

Printed at: 1:2,500

N
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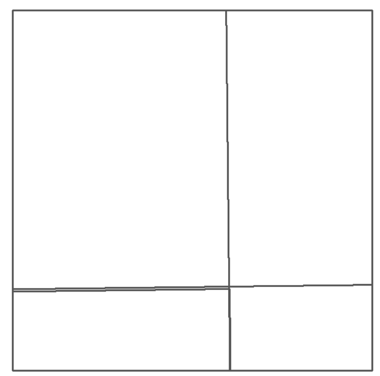
Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A



Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

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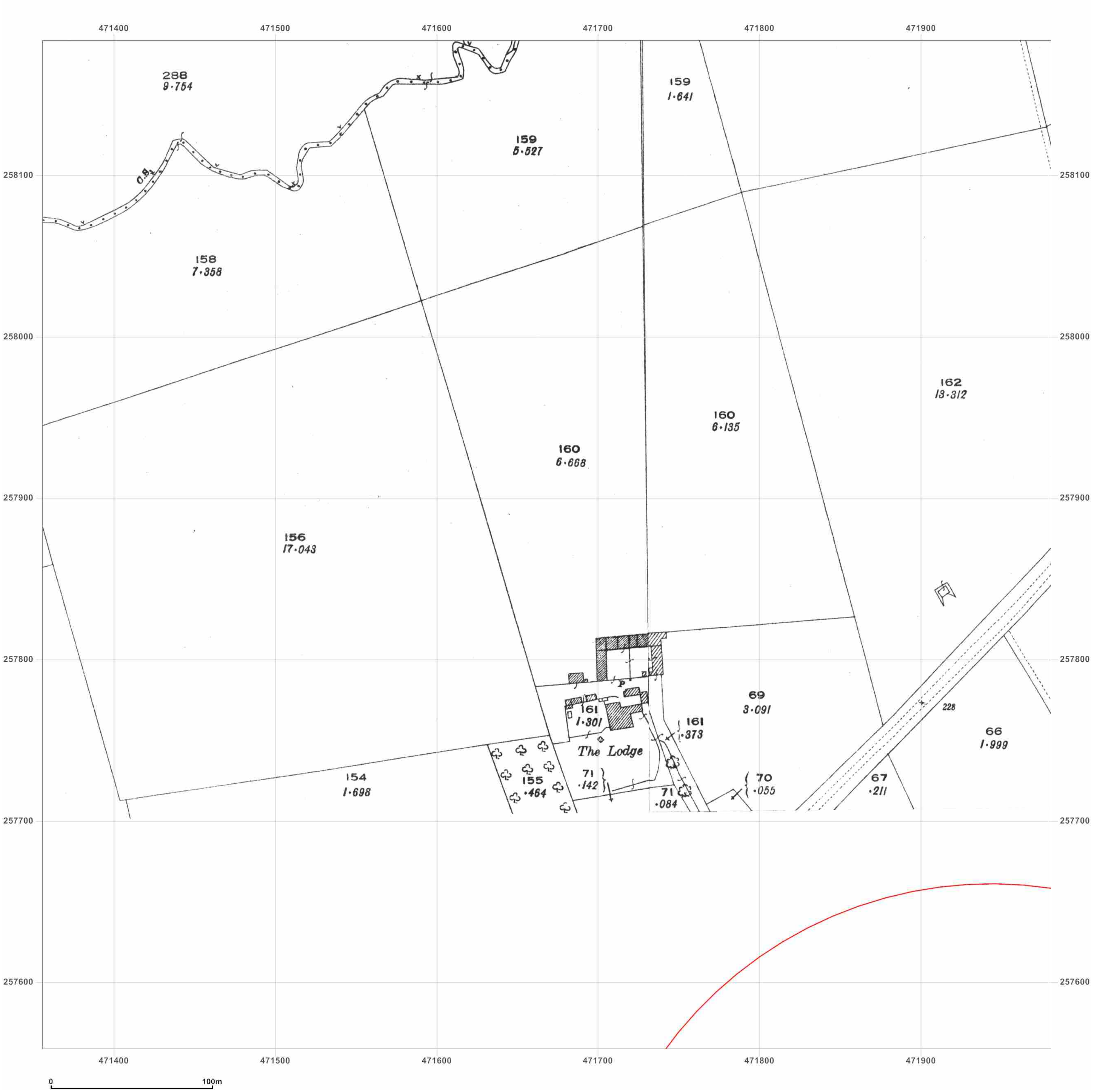

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_1_4
Grid Ref: 471668, 257871

Map Name: County Series

Map date: **1925-1926**

Scale: 1:2,500

Printed at: 1:2,500

N
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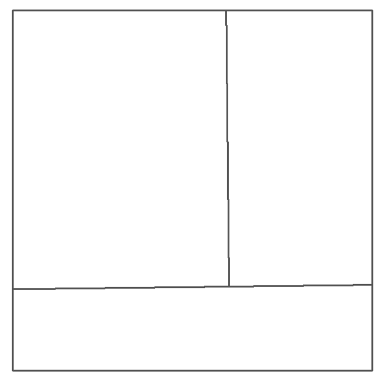
Surveyed 1926
Revised 1926
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1925
Revised 1925
Edition N/A
Copyright N/A
Levelled N/A



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Production date: 19 June 2017

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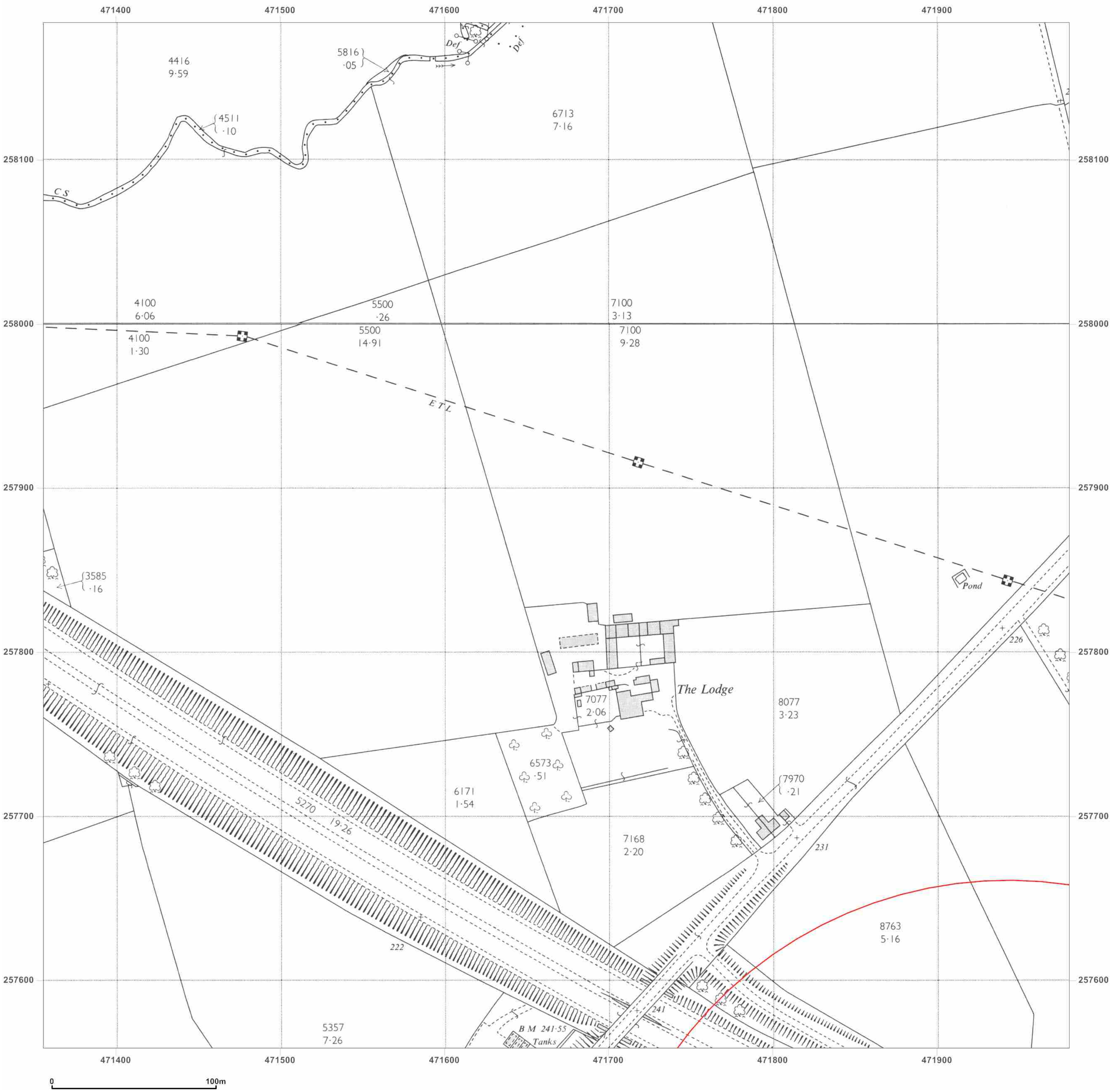

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_1_4
Grid Ref: 471668, 257871

Map Name: National Grid

Map date: **1964**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1961

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

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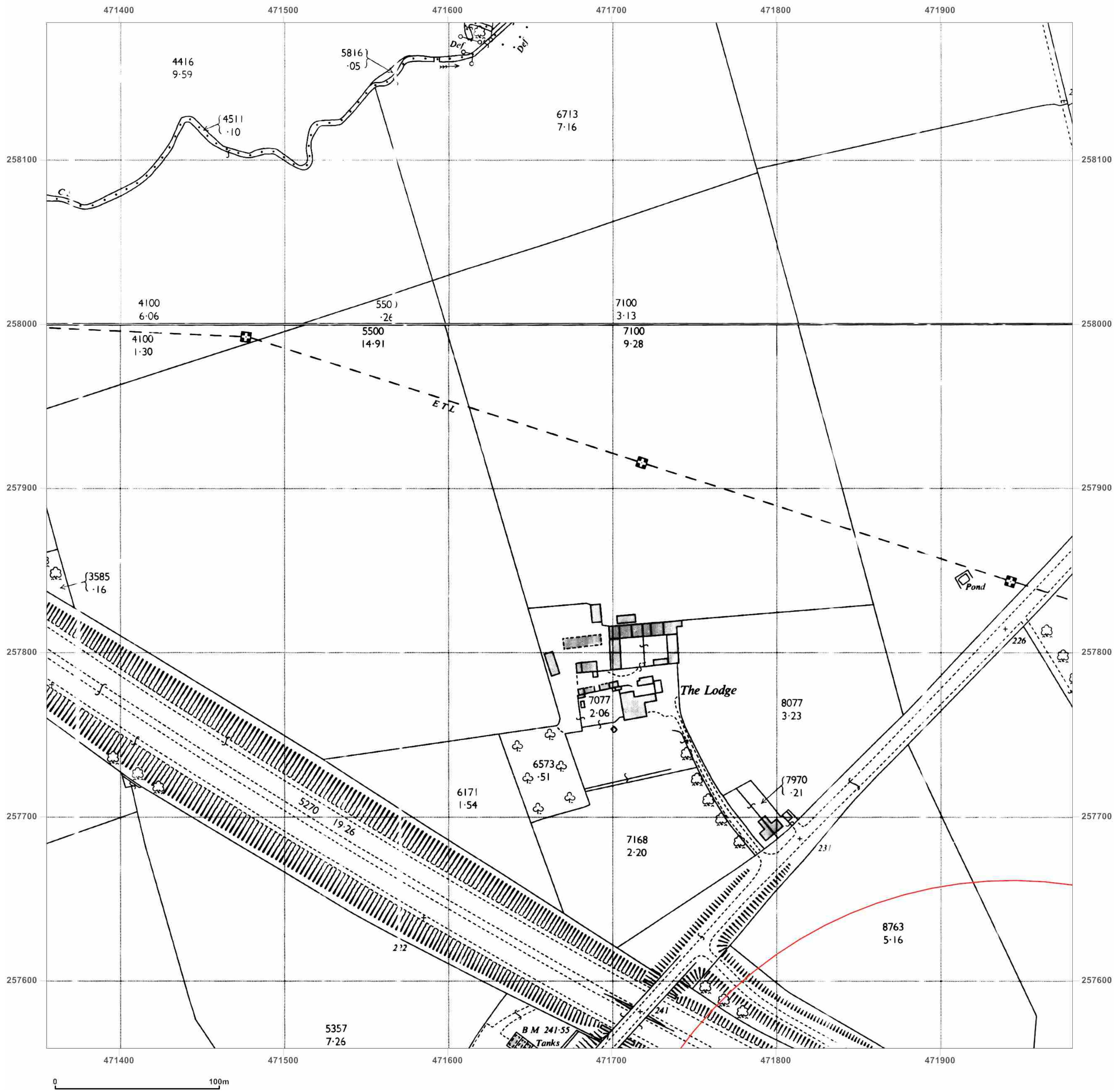

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_1_4
Grid Ref: 471668, 257871

Map Name: National Grid

Map date: 1965

Scale: 1:2,500

Printed at: 1:2,500

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

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

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Production date: 19 June 2017

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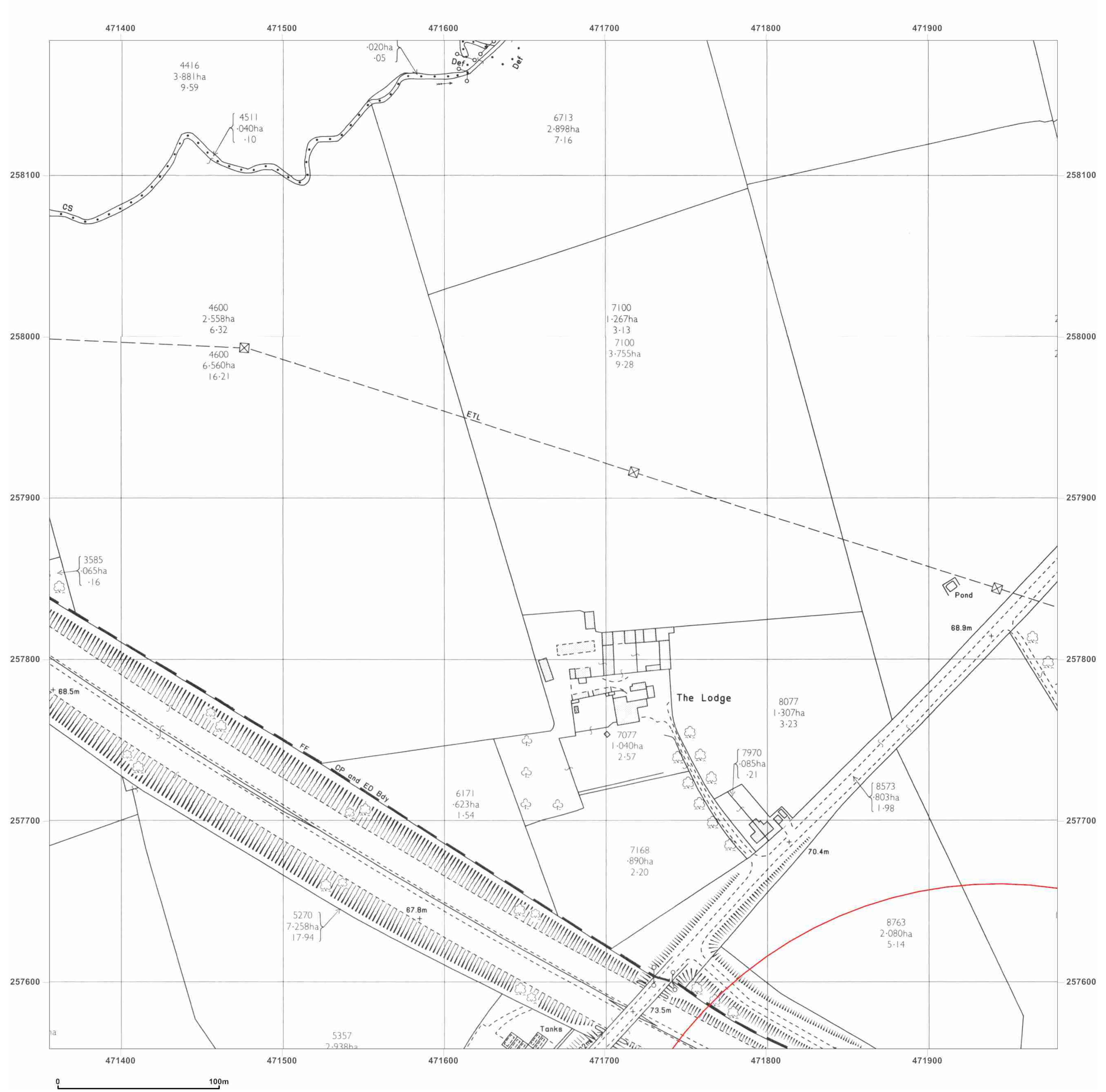

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_1_4
Grid Ref: 471668, 257871

Map Name: National Grid

Map date: **1976-1977**

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1977
Revised 1977
Edition N/A
Copyright 1978
Levelled 1961

Surveyed 1976
Revised 1976
Edition N/A
Copyright 1977
Levelled 1960

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Production date: 19 June 2017

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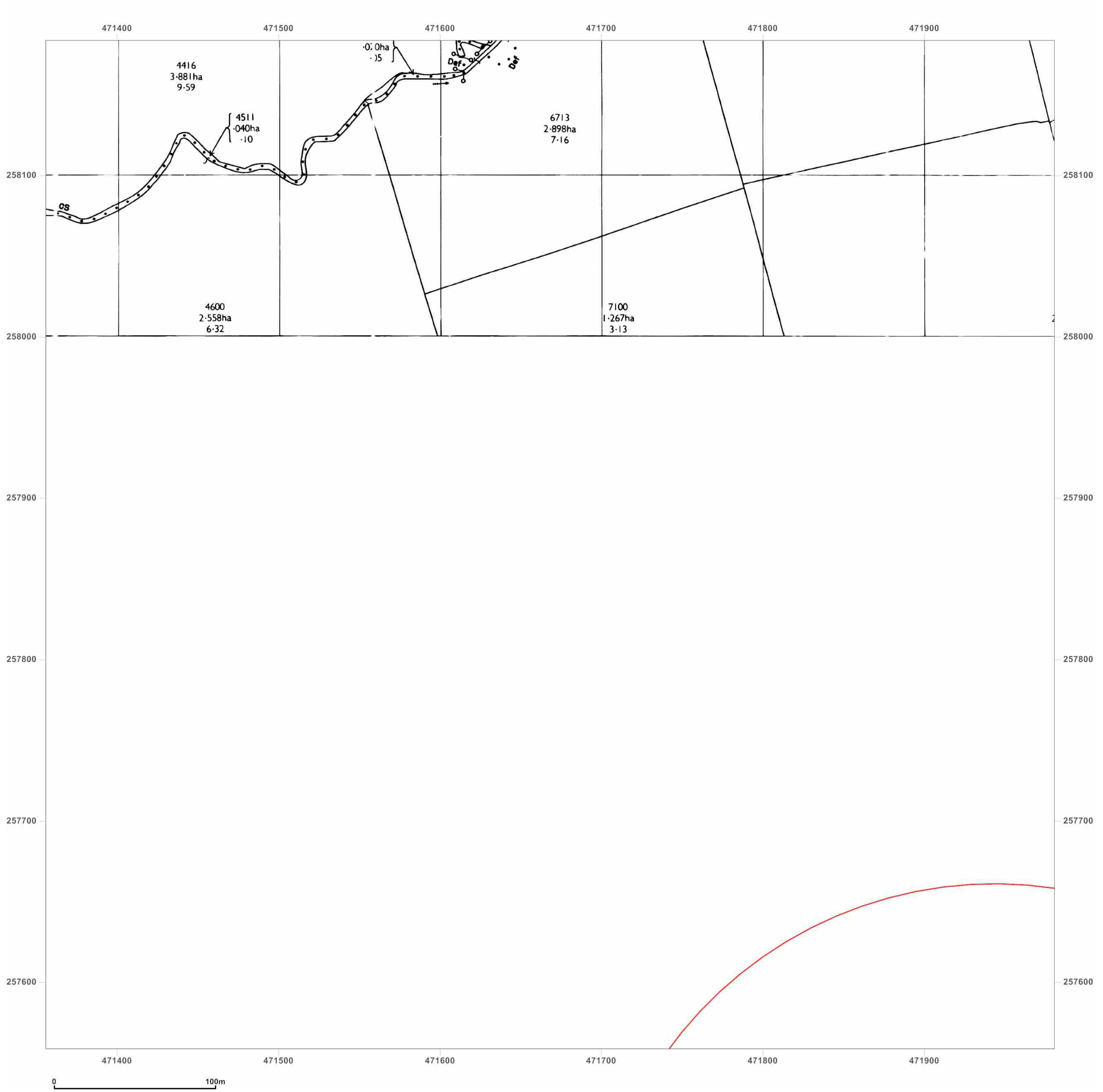

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_1_4
Grid Ref: 471668, 257871

Map Name: National Grid

Map date: **1978**

Scale: 1:2,500

Printed at: 1:2,500

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

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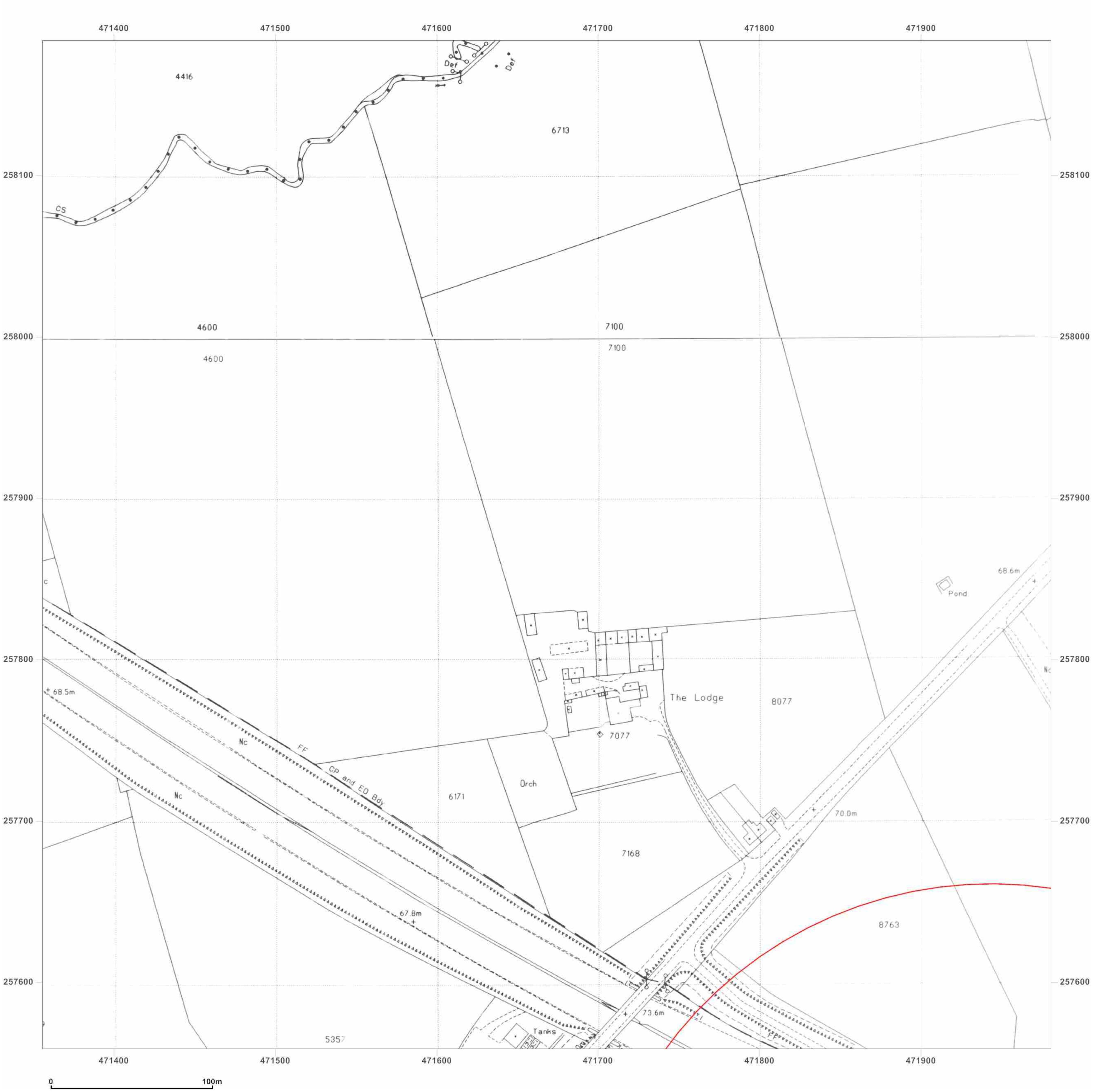

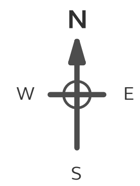

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_1_4
Grid Ref: 471668, 257871

Map Name: National Grid

Map date: **1993**

Scale: 1:2,500

Printed at: 1:2,500

Surveyed 1993
Revised 1993
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1993
Revised 1993
Edition N/A
Copyright N/A
Levelled N/A

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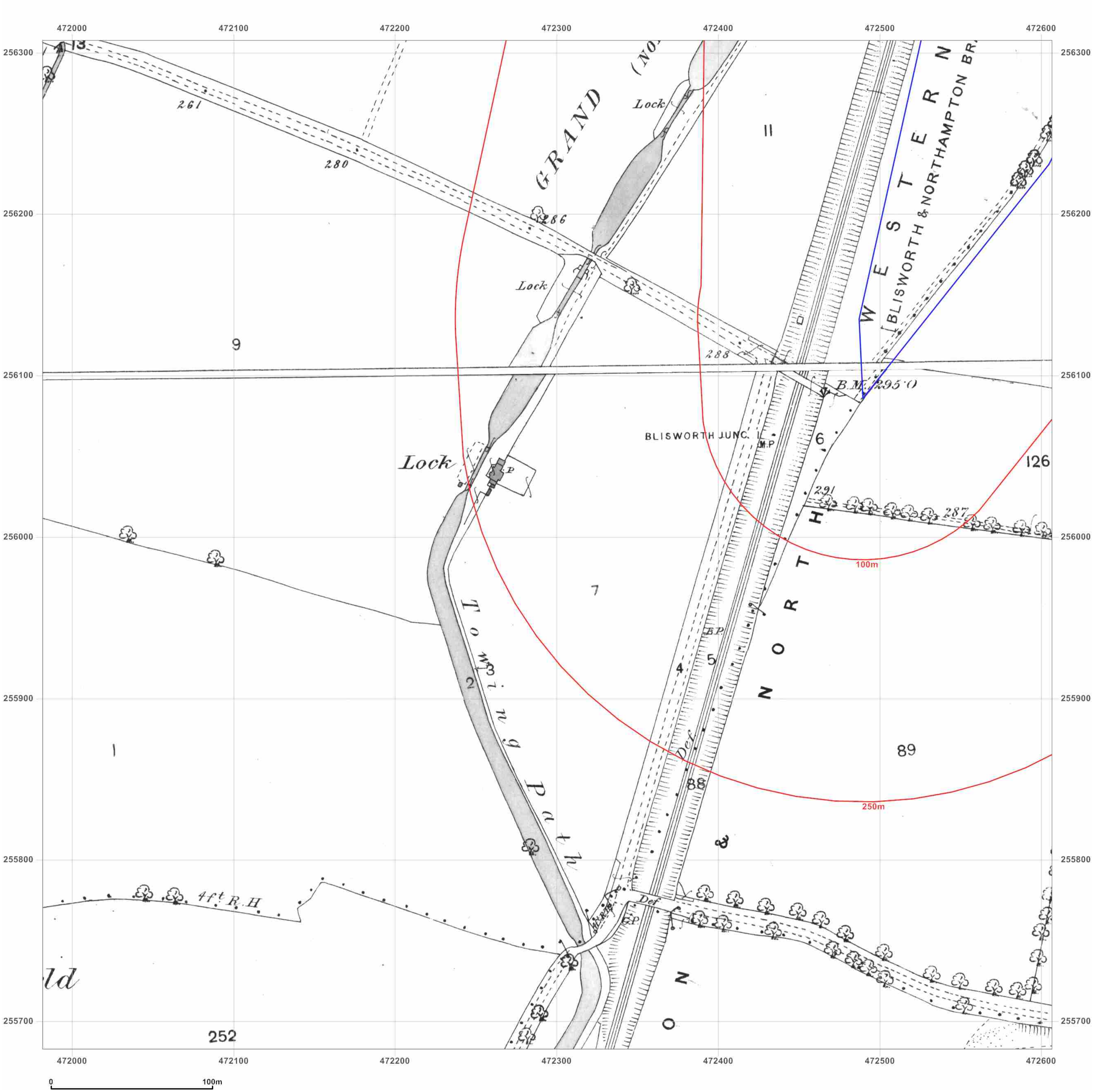

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_1
Grid Ref: 472294, 255995

Map Name: County Series

Map date: 1885

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1885
Revised 1885
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1885
Revised 1885
Edition N/A
Copyright N/A
Levelled N/A

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Production date: 19 June 2017

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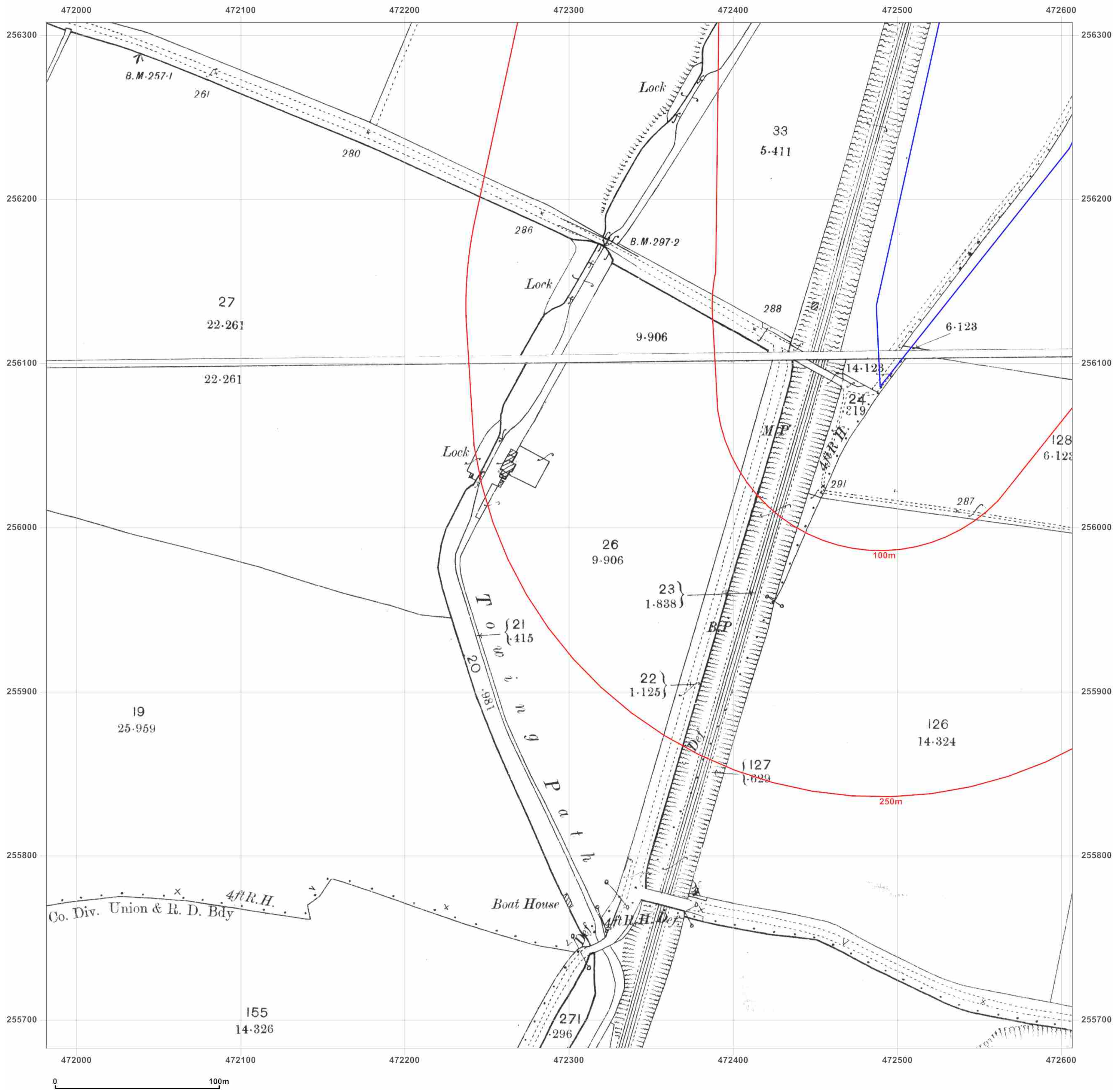

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_1
Grid Ref: 472294, 255995

Map Name: County Series

Map date: 1900

Scale: 1:2,500

Printed at: 1:2,500

N
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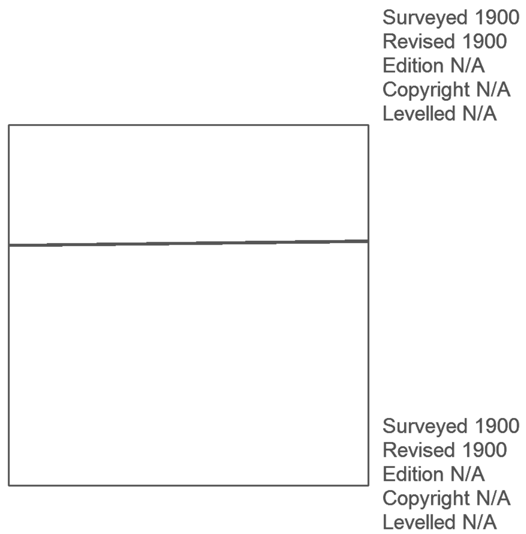

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Production date: 19 June 2017

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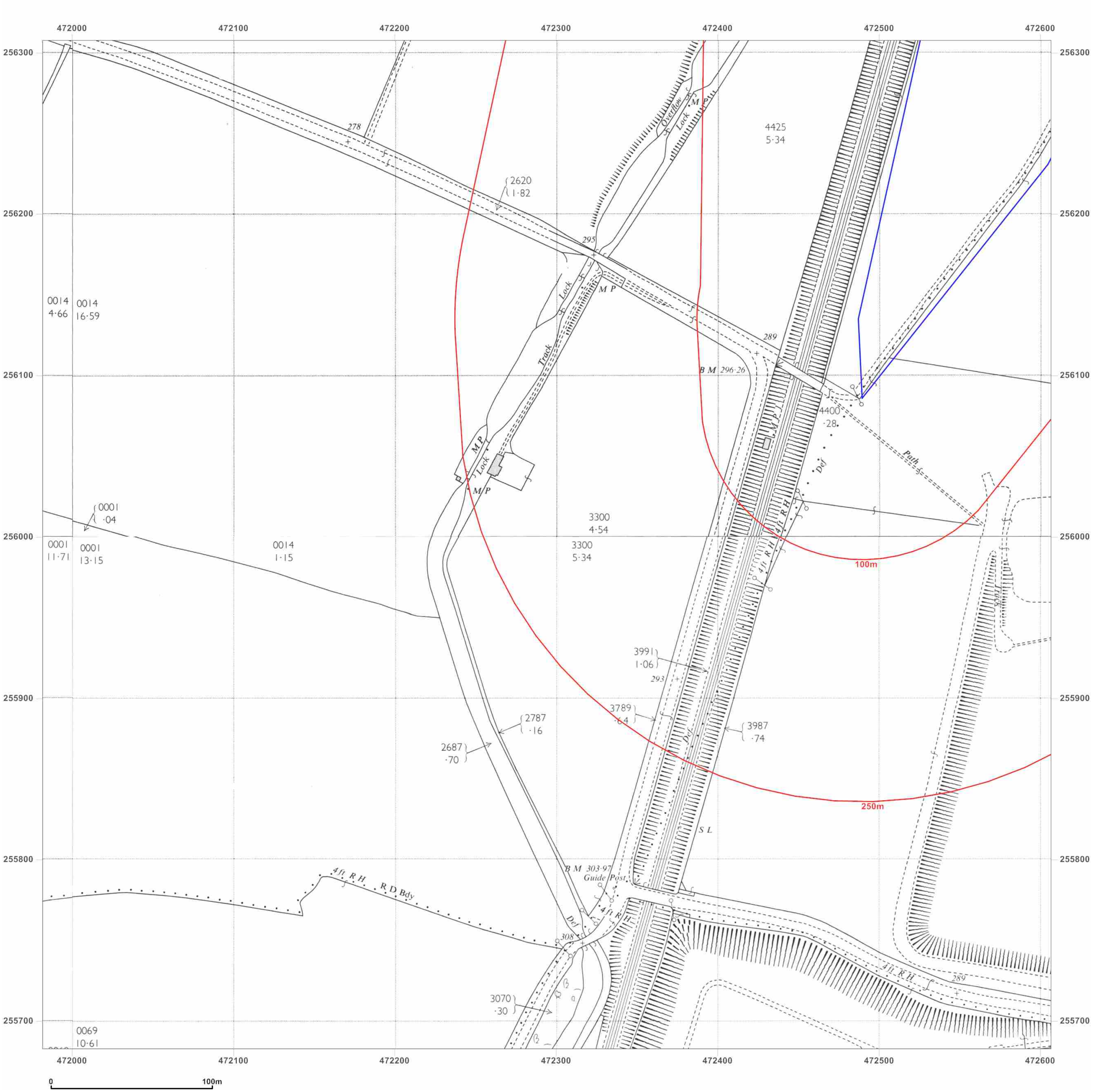

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_1
Grid Ref: 472294, 255995

Map Name: National Grid

Map date: 1964

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1961

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1961

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1961

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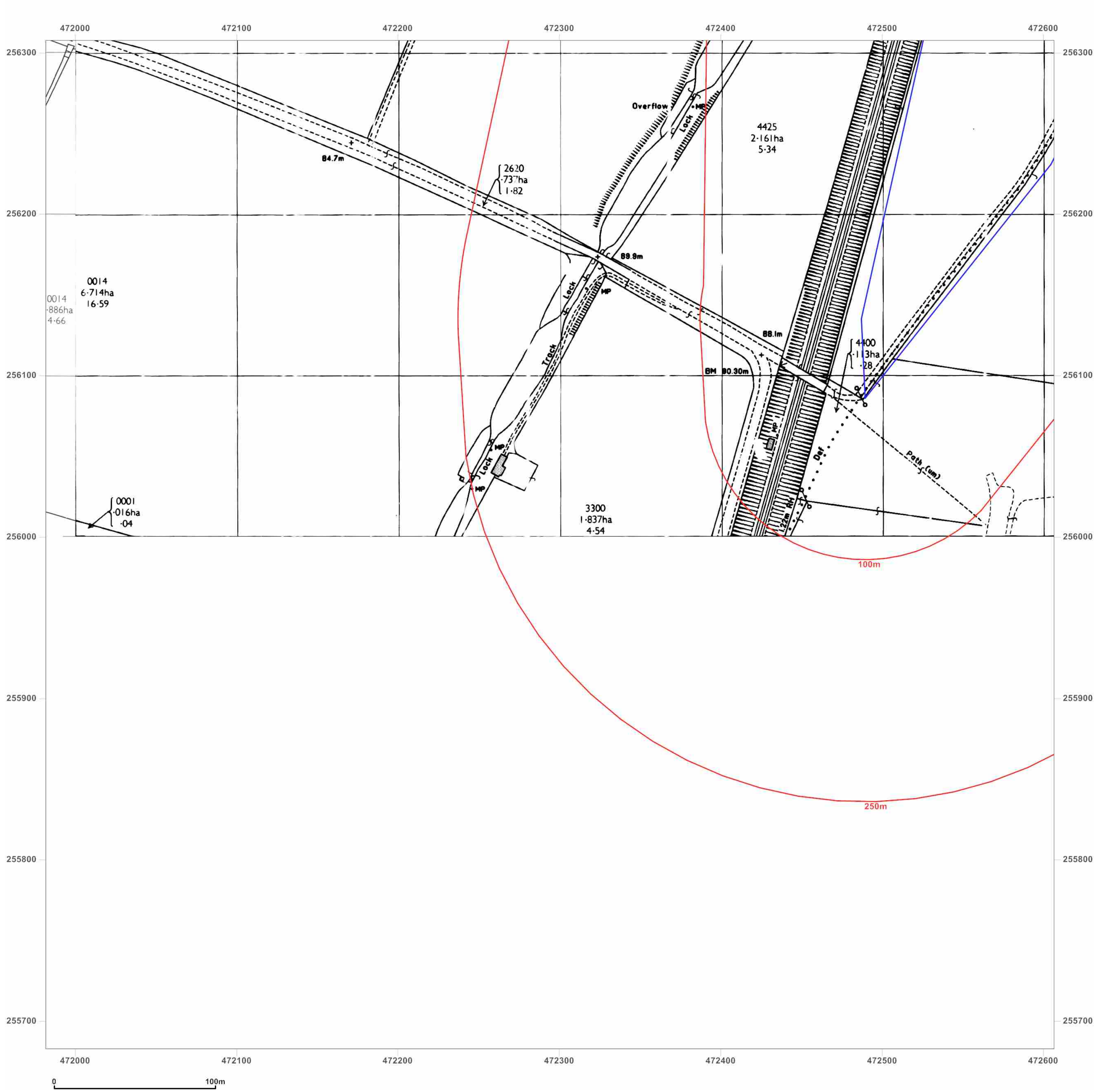
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_1
Grid Ref: 472294, 255995

Map Name: National Grid

Map date: 1976

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed 1976	Surveyed N/A
Revised 1976	Revised N/A
Edition N/A	Edition N/A
Copyright 1977	Copyright N/A
Levelled 1960	Levelled N/A

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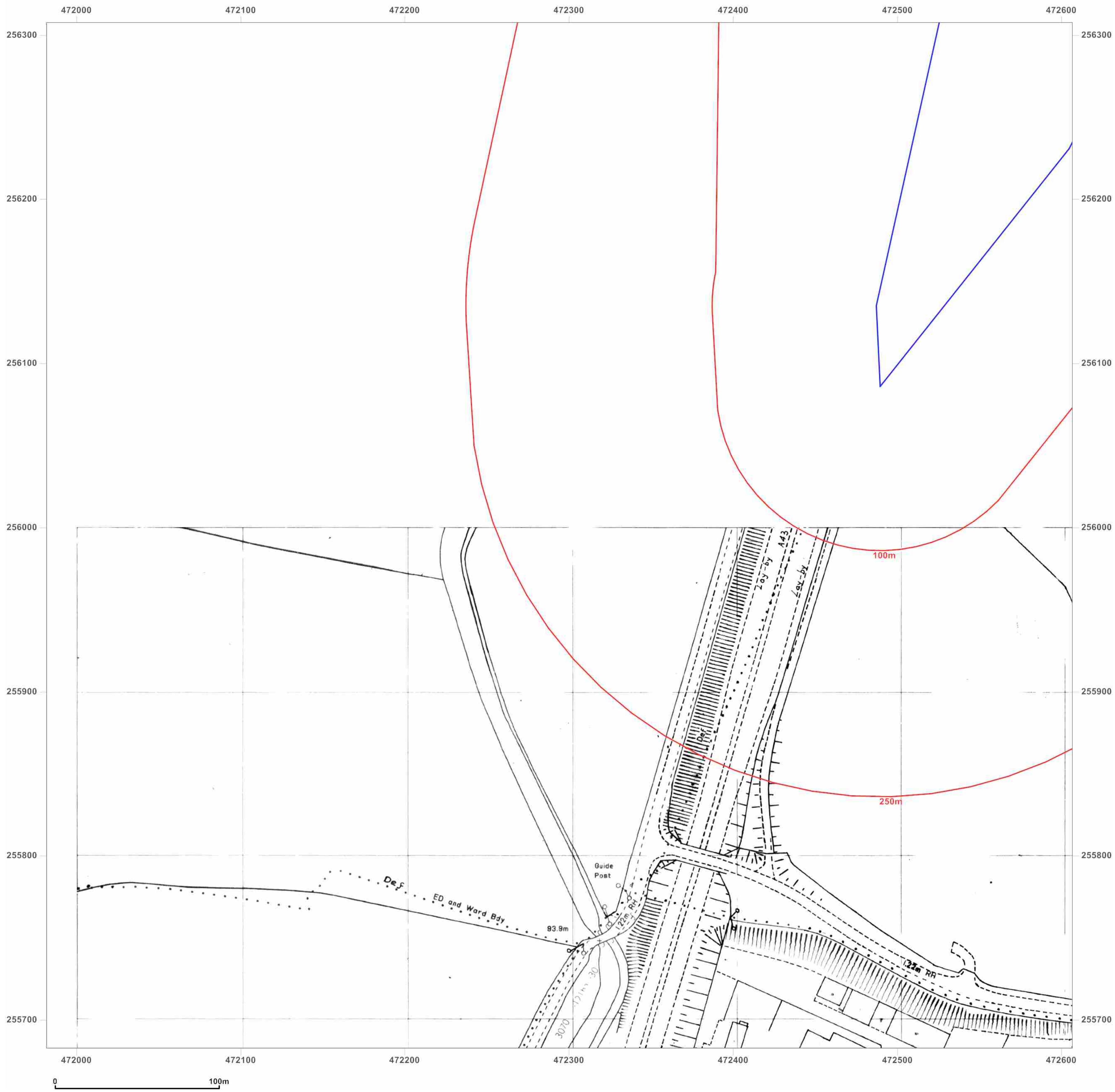
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_1
Grid Ref: 472294, 255995

Map Name: National Grid

Map date: **1992**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed 1992
Revised 1992
Edition N/A
Copyright 1992
Levelled N/A

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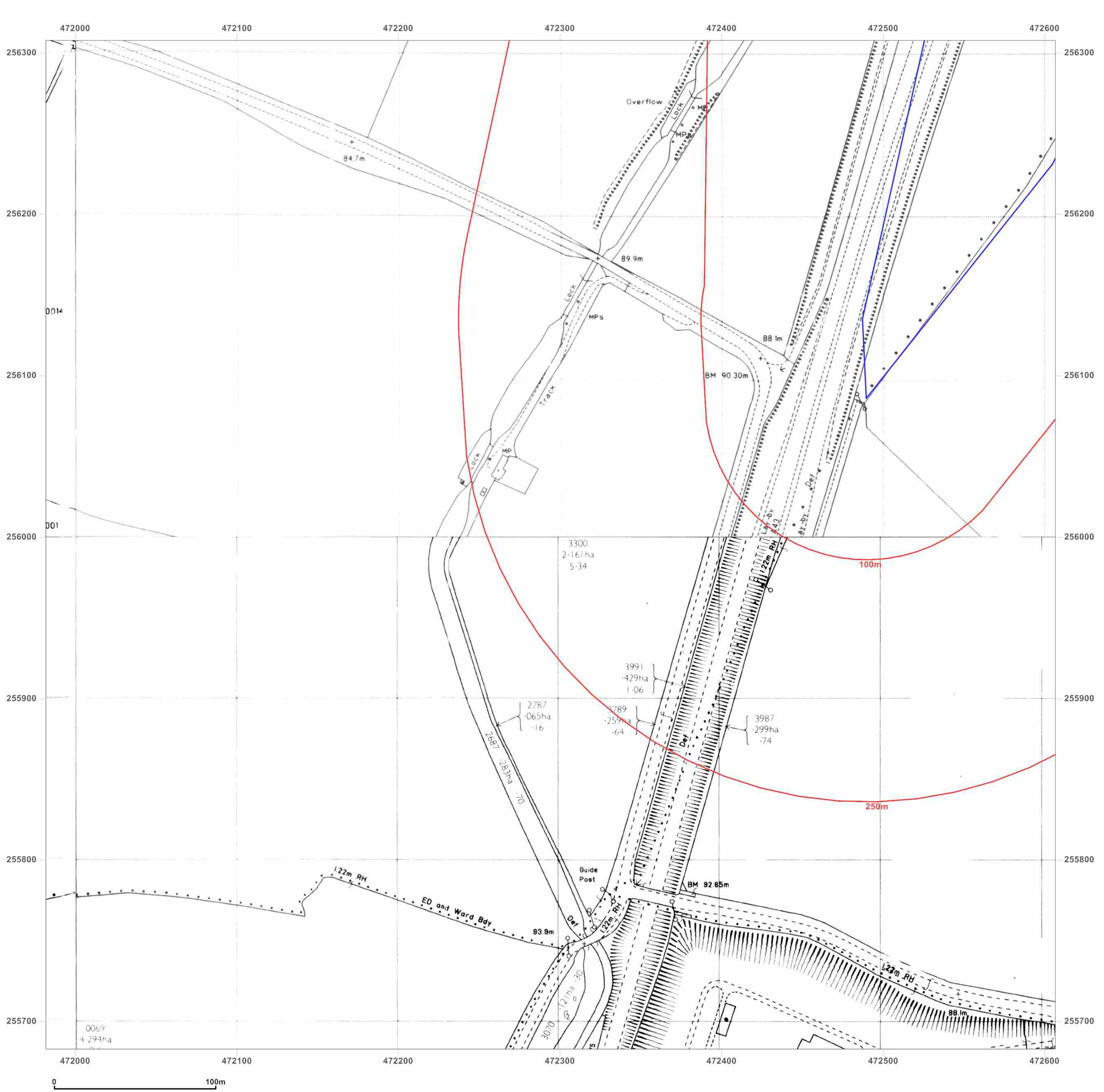
Production date: 19 June 2017

To view map legend click here *Legend*



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_1
Grid Ref: 472294, 255995

Map Name: National Grid

Map date: 1989-1993

Scale: 1:2,500

Printed at: 1:2,500

N W E S

Surveyed N/A Revised N/A Edition N/A Copyright 1993 Levelled N/A	Surveyed 1993 Revised 1993 Edition N/A Copyright N/A Levelled N/A
Surveyed N/A Revised N/A Edition N/A Copyright 1993 Levelled N/A	Surveyed 1989 Revised 1989 Edition N/A Copyright 1989 Levelled N/A

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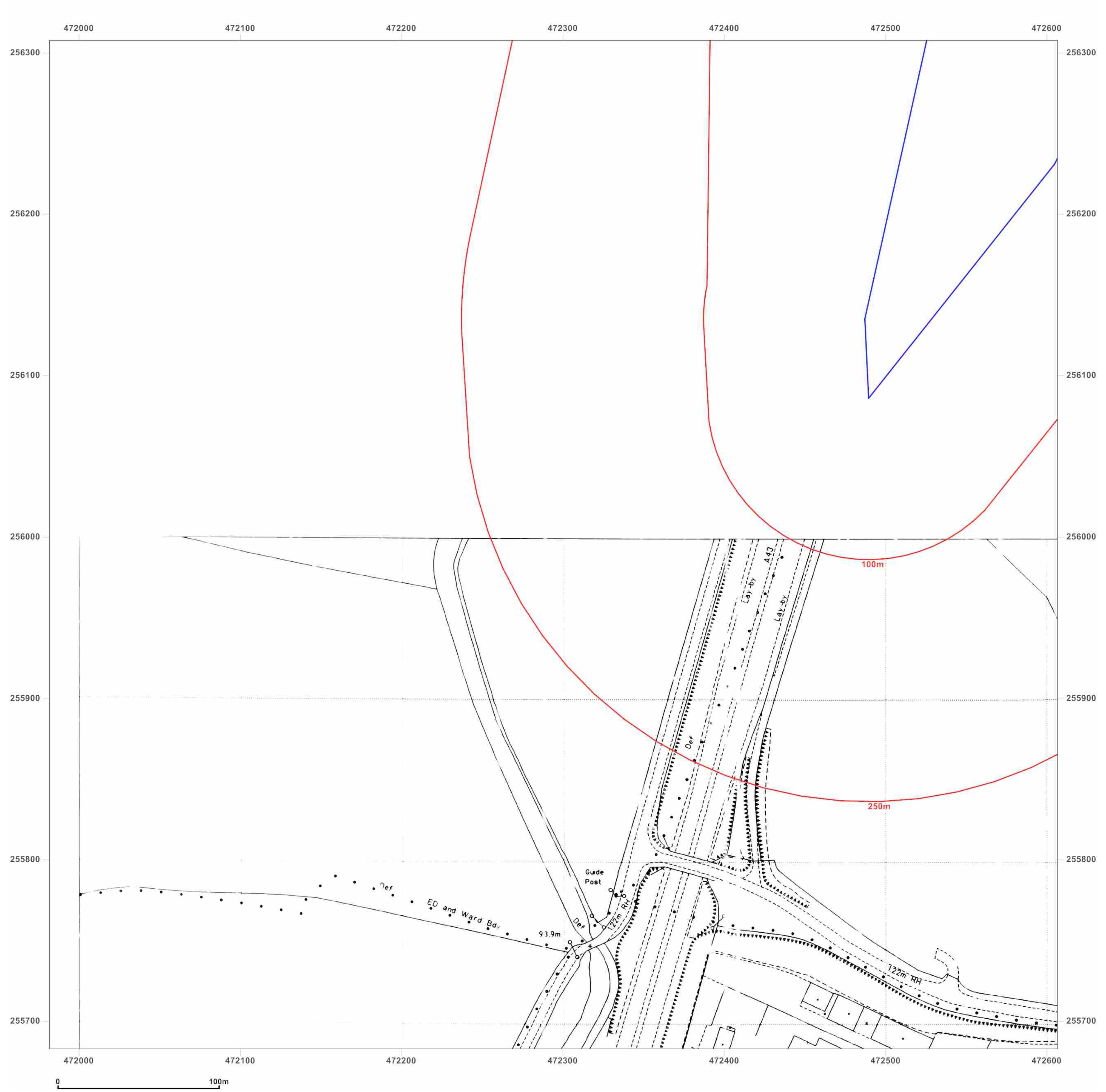
Production date: 19 June 2017

To view map legend click here Legend



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_1
Grid Ref: 472294, 255995

Map Name: National Grid

Map date: 1993

Scale: 1:2,500

Printed at: 1:2,500

N W E S

Surveyed N/A
Revised N/A
Edition N/A
Copyright 1993
Levelled N/A

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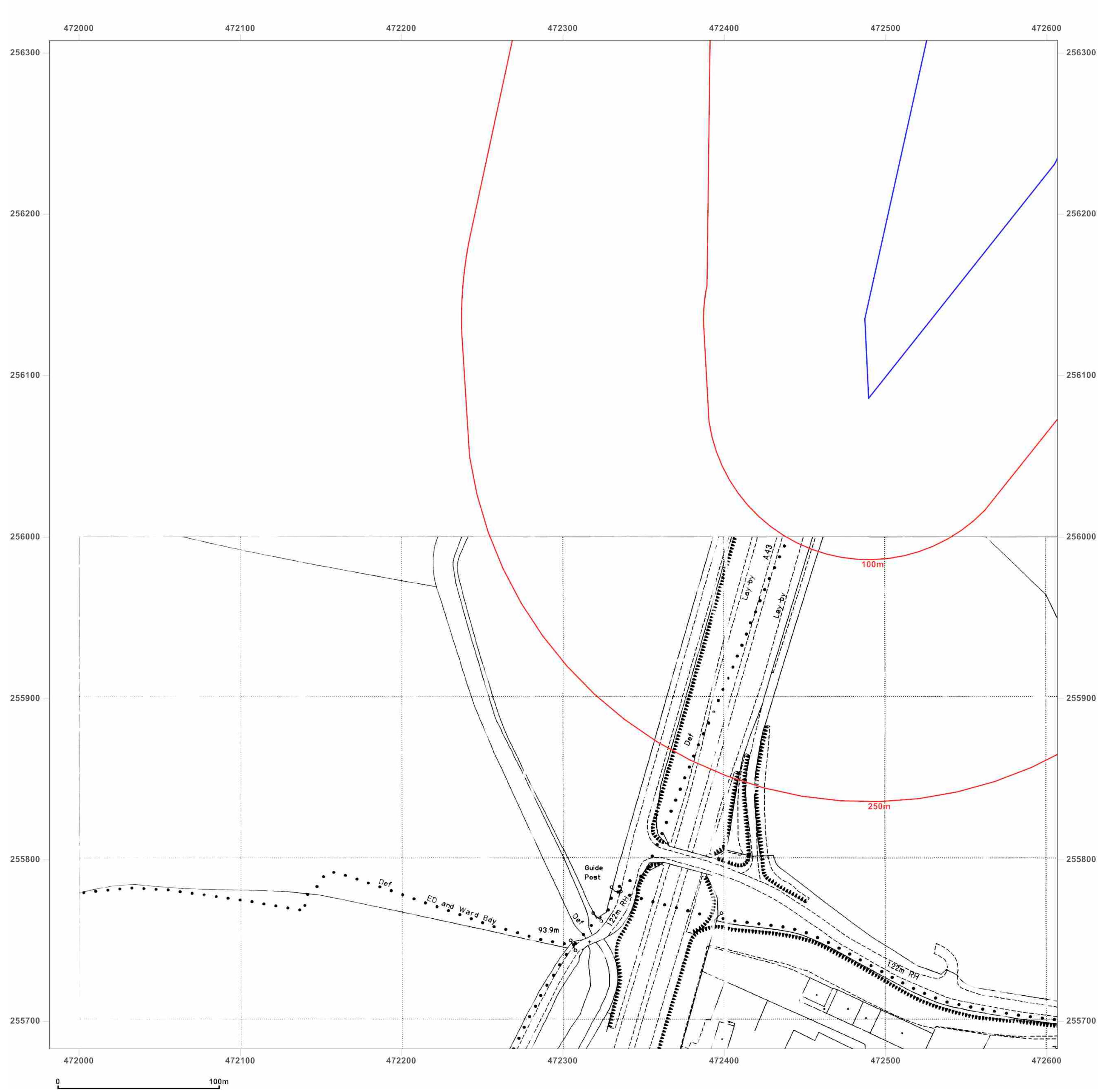
Production date: 19 June 2017

To view map legend click here *Legend*



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_1
Grid Ref: 472294, 255995

Map Name: National Grid

Map date: **1994**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed N/A
Revised N/A
Edition N/A
Copyright 1994
Levelled N/A

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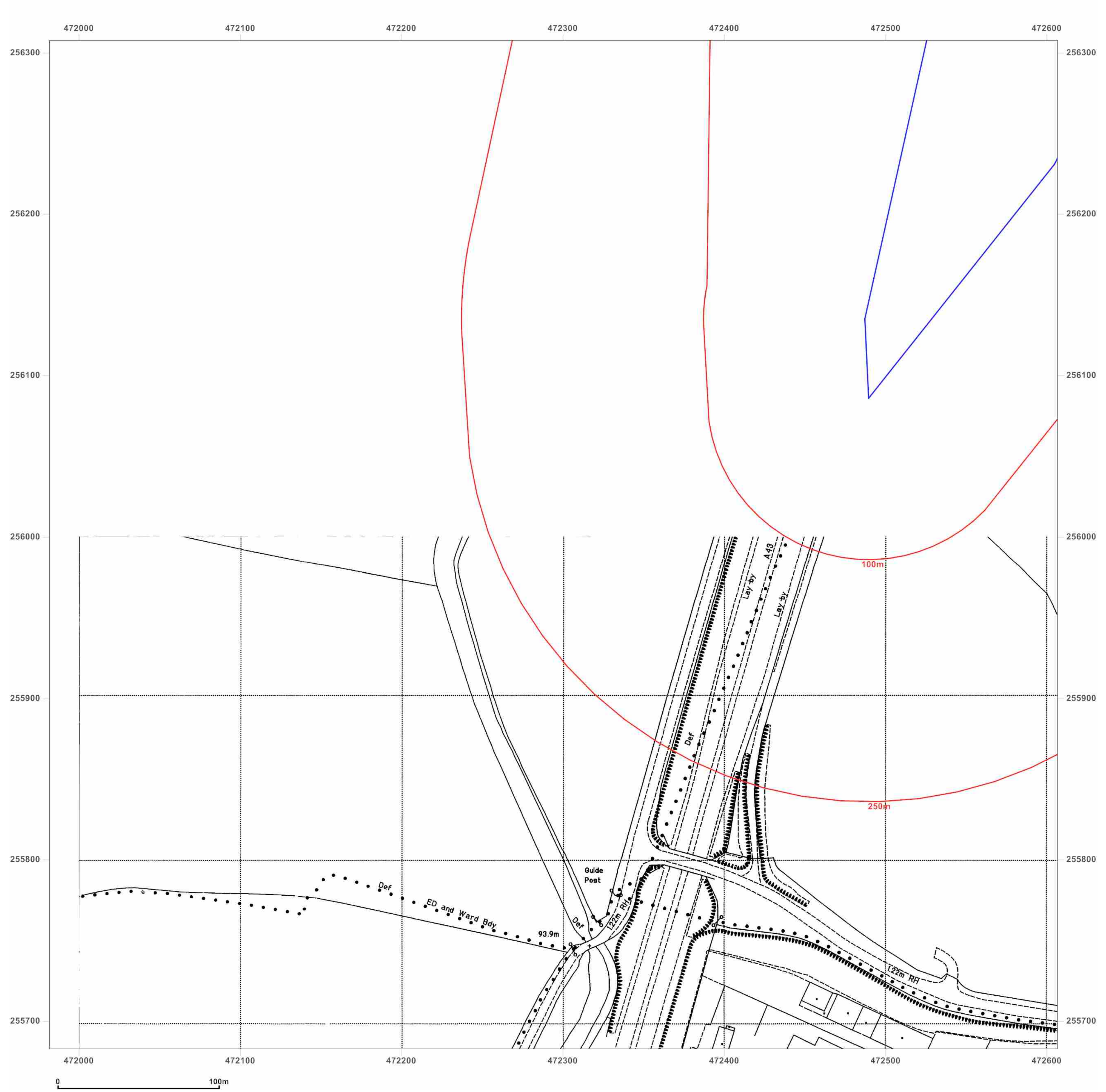
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_1
Grid Ref: 472294, 255995

Map Name: National Grid

Map date: **1994**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed 1994
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

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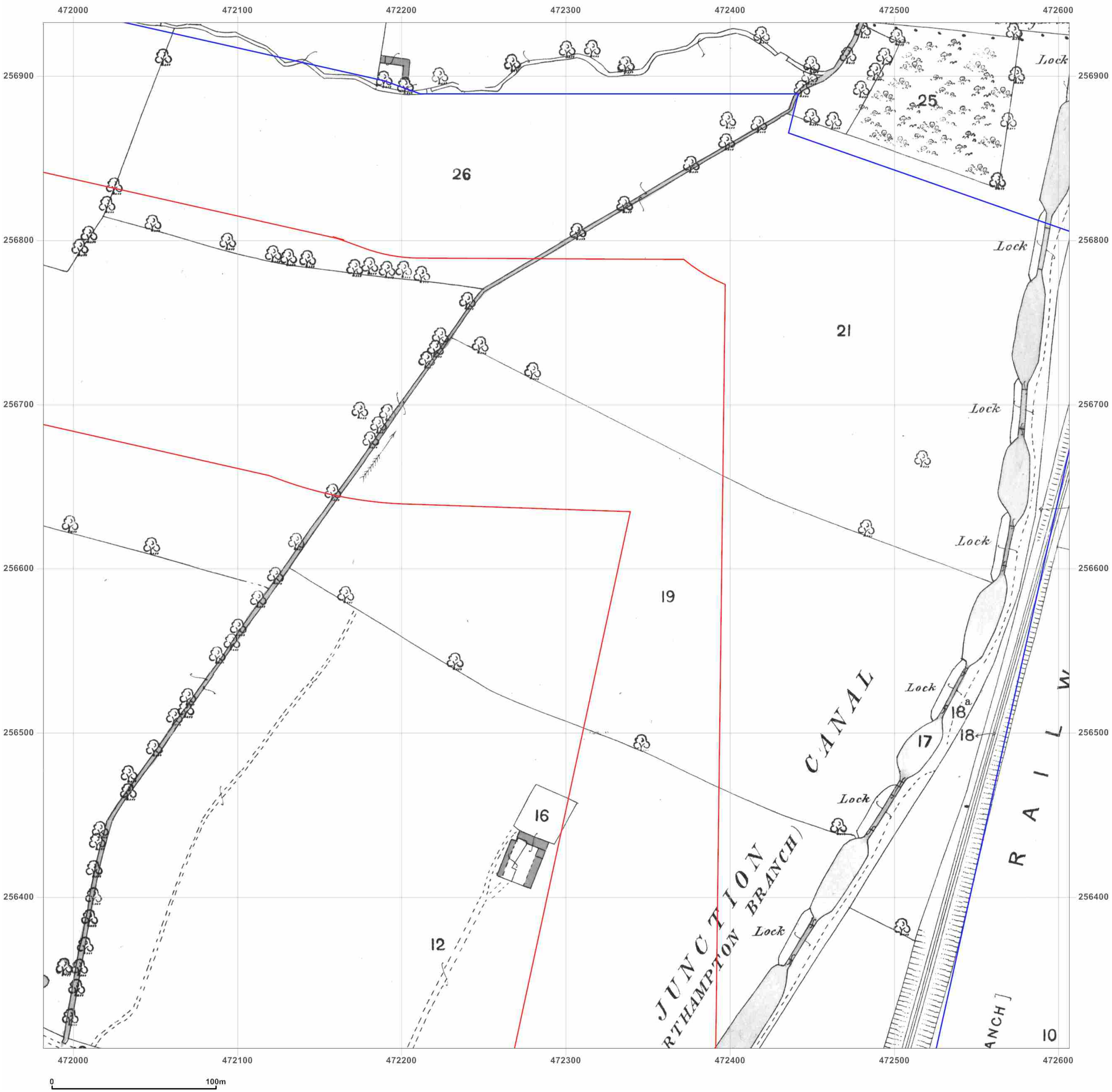
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_2
Grid Ref: 472294, 256620

Map Name: County Series

Map date: 1885

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed 1885
Revised 1885
Edition N/A
Copyright N/A
Levelled N/A

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Production date: 19 June 2017

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Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_2
Grid Ref: 472294, 256620

Map Name: County Series

Map date: 1900

Scale: 1:2,500

Printed at: 1:2,500

N W E S

Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

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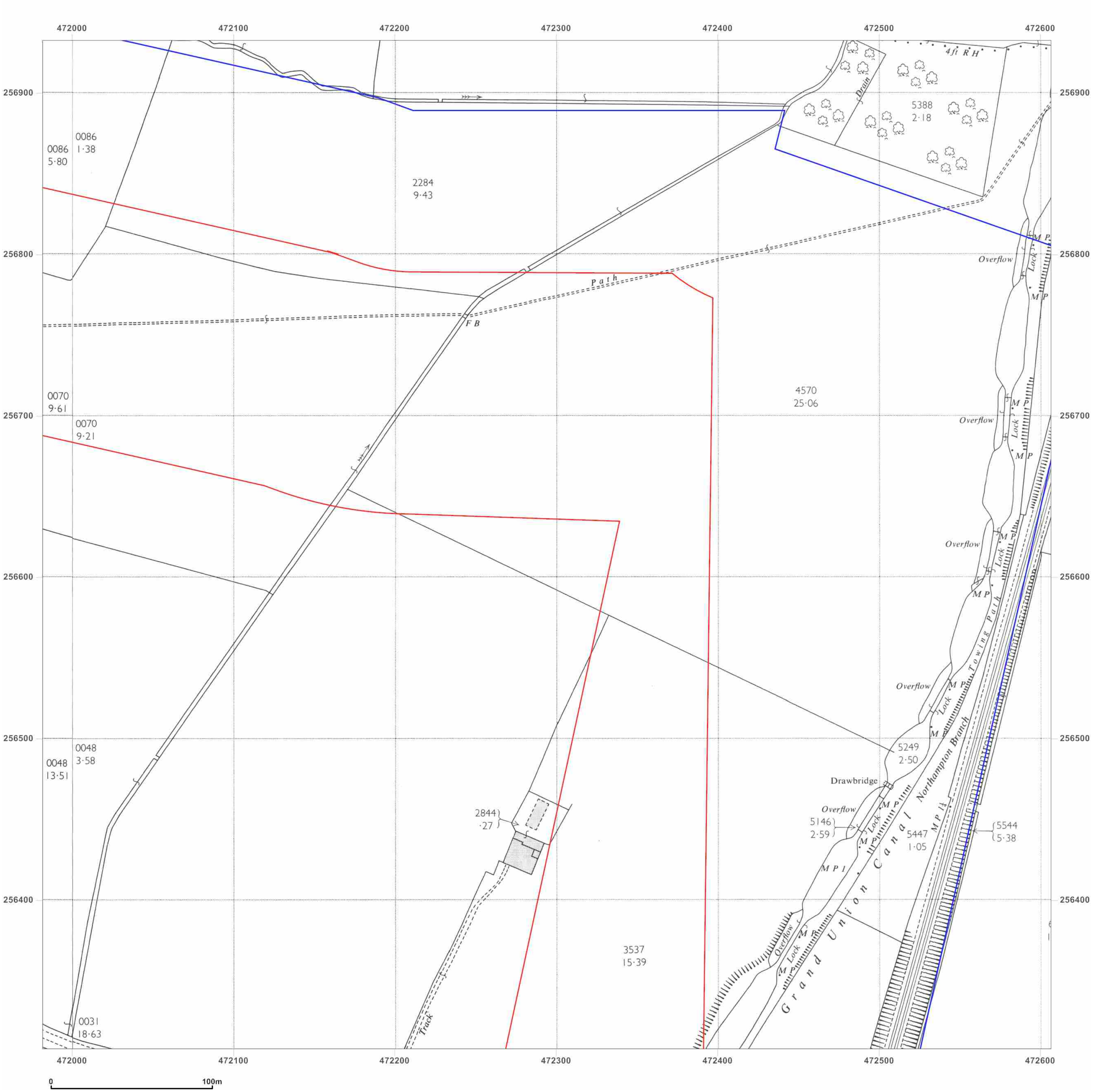

Groundsure
INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_2
Grid Ref: 472294, 256620

Map Name: National Grid

Map date: **1964**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1961

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

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Production date: 19 June 2017

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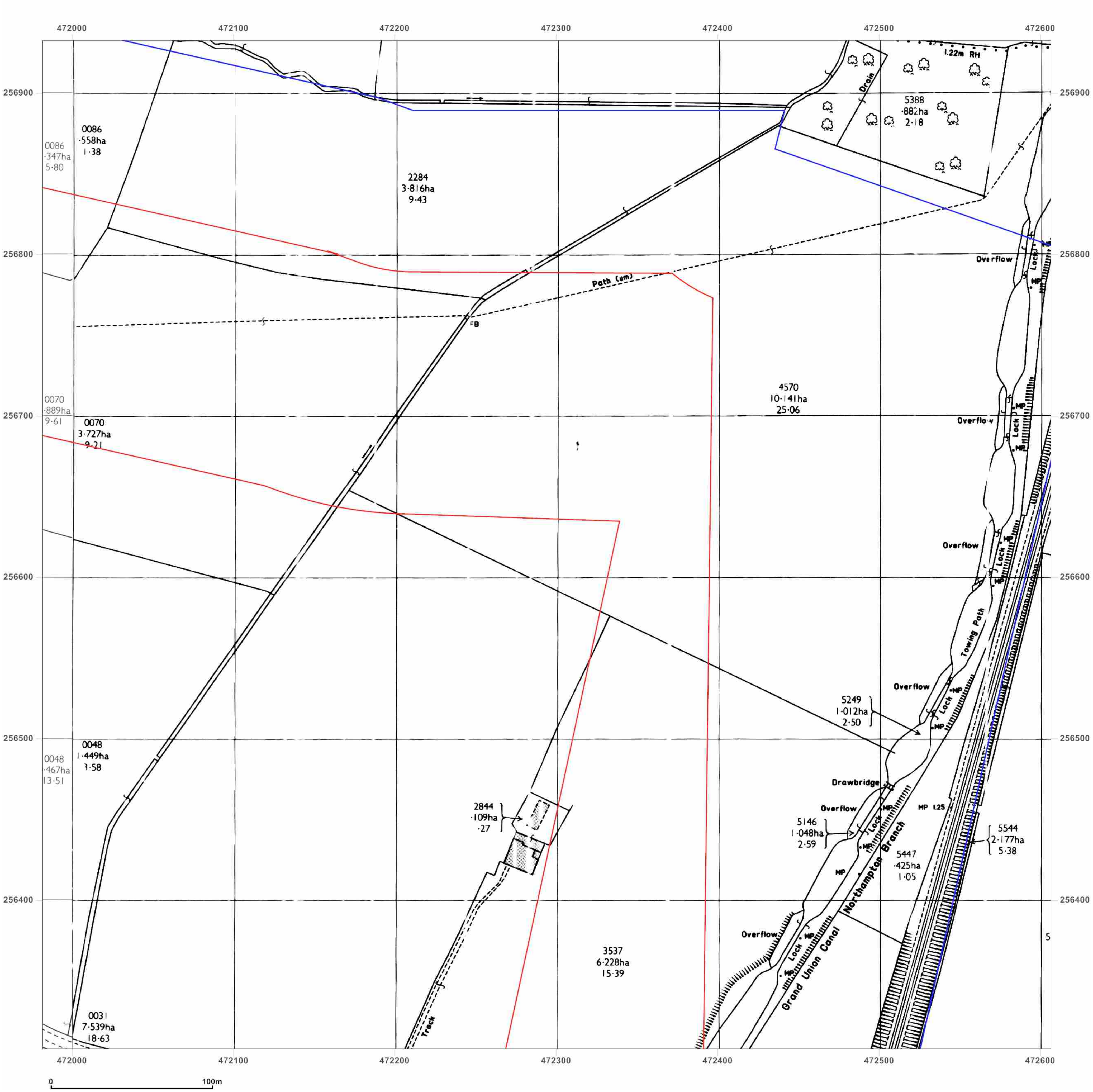

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_2
Grid Ref: 472294, 256620

Map Name: National Grid

Map date: 1976

Scale: 1:2,500

Printed at: 1:2,500

N W E S

Surveyed 1976
Revised 1976
Edition N/A
Copyright 1977
Levelled 1960

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

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Production date: 19 June 2017

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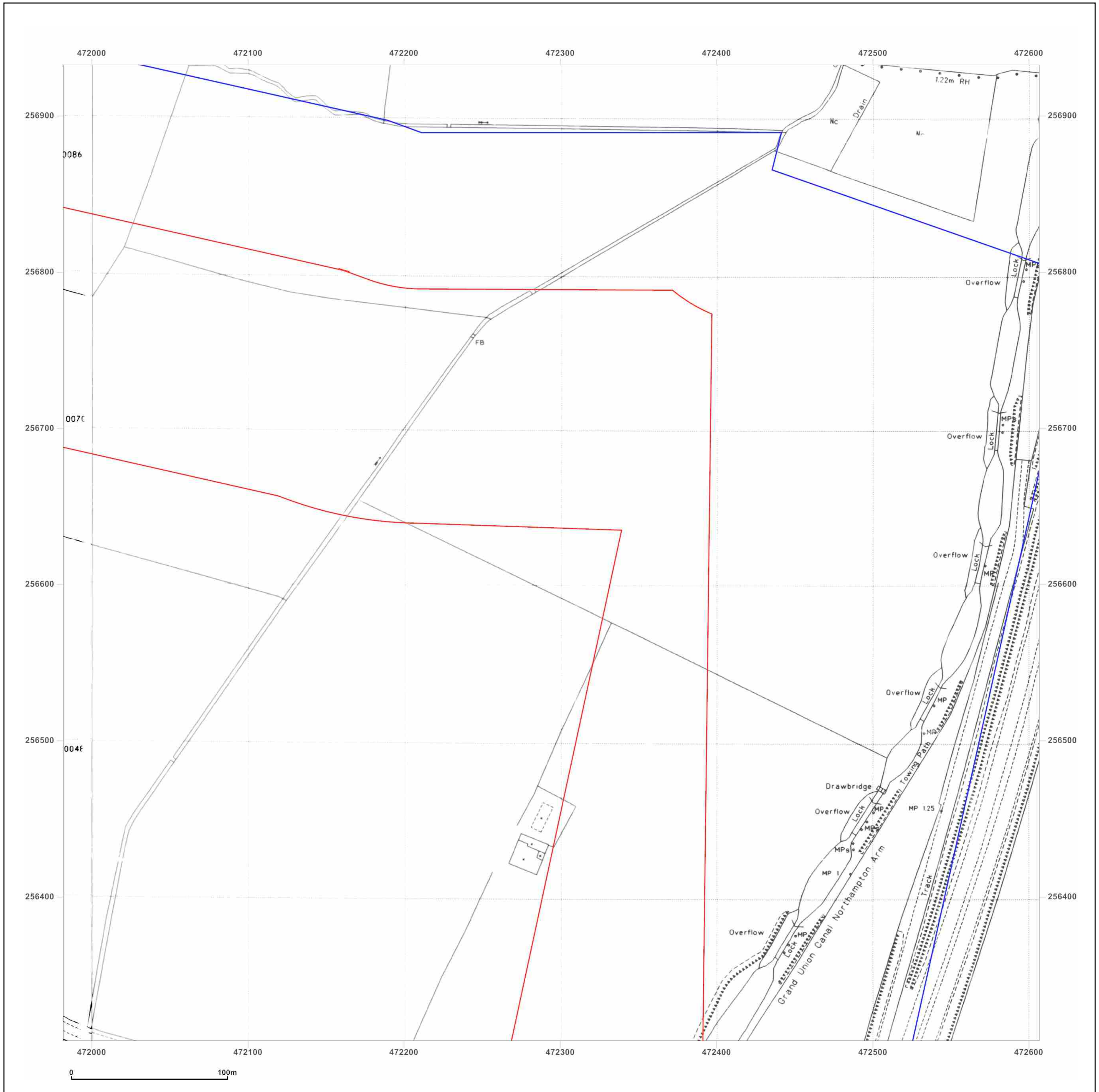

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_2
Grid Ref: 472294, 256620

Map Name: National Grid

Map date: 1993

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed N/A
Revised N/A
Edition N/A
Copyright 1993
Levelled N/A

Surveyed 1993
Revised 1993
Edition N/A
Copyright N/A
Levelled N/A

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Production date: 19 June 2017

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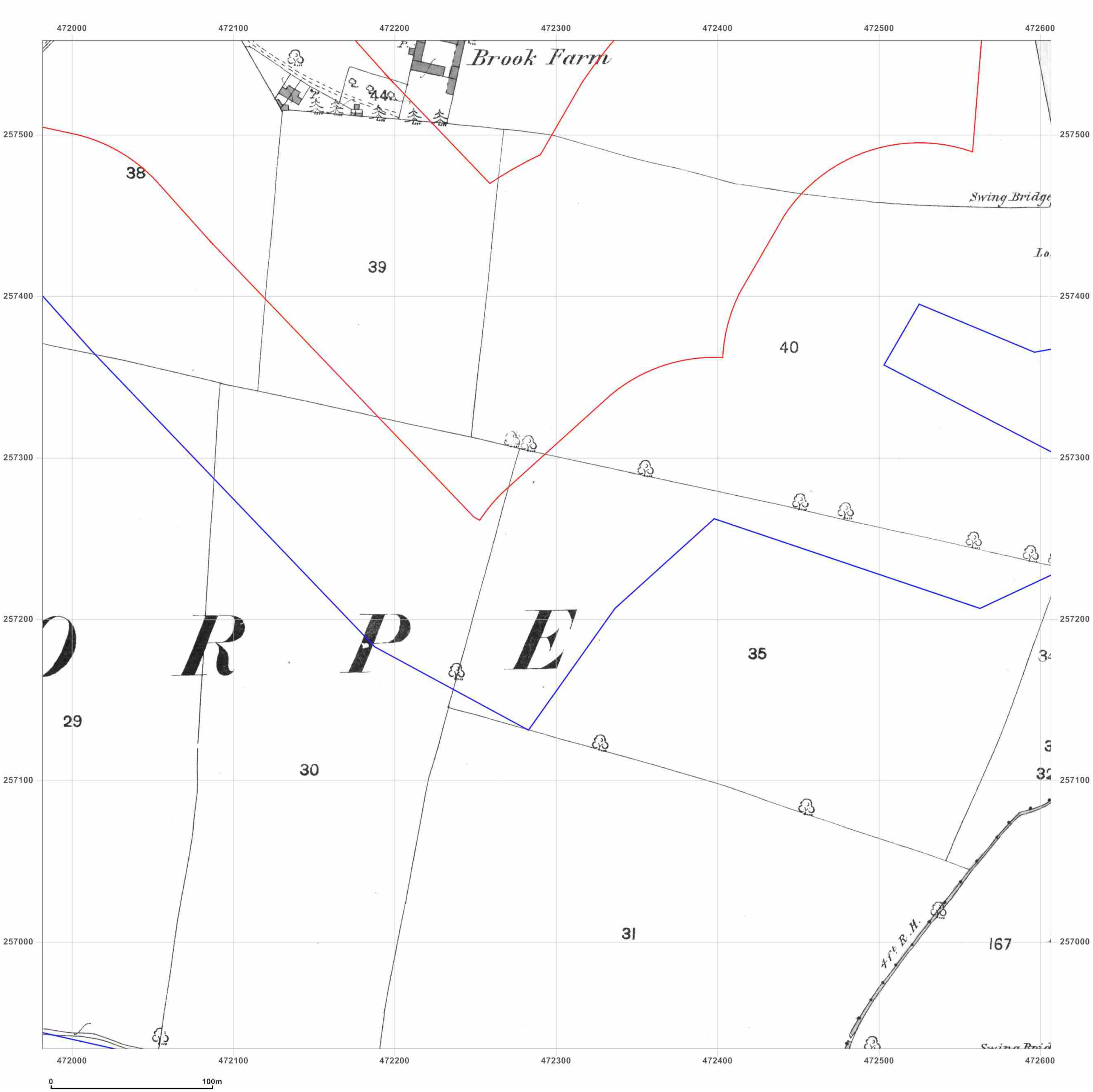

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_3
Grid Ref: 472294, 257246

Map Name: County Series

Map date: **1885**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1885
Revised 1885
Edition N/A
Copyright N/A
Levelled N/A

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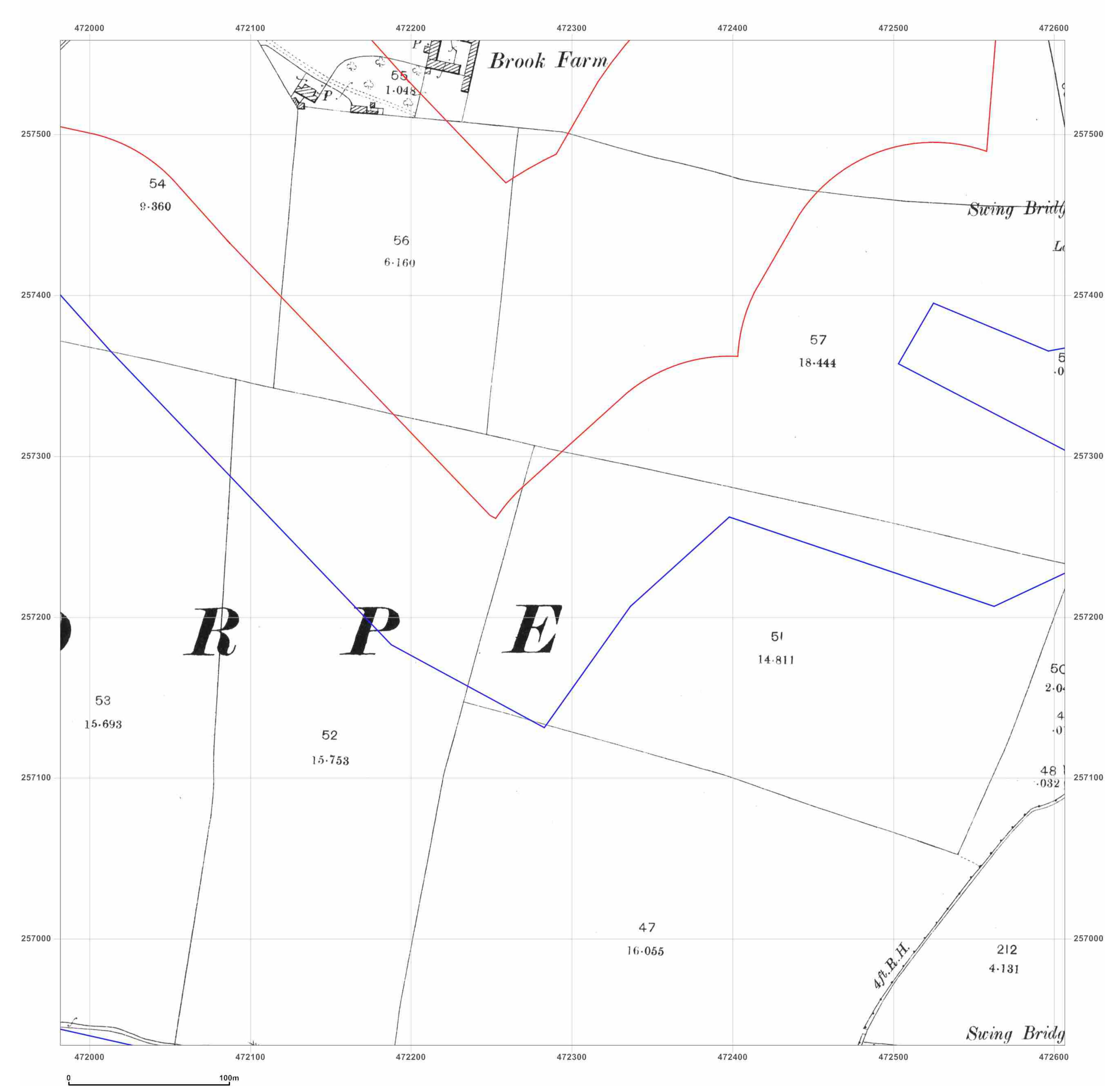
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_3
Grid Ref: 472294, 257246

Map Name: County Series

Map date: 1900

Scale: 1:2,500

Printed at: 1:2,500

Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

Powered by

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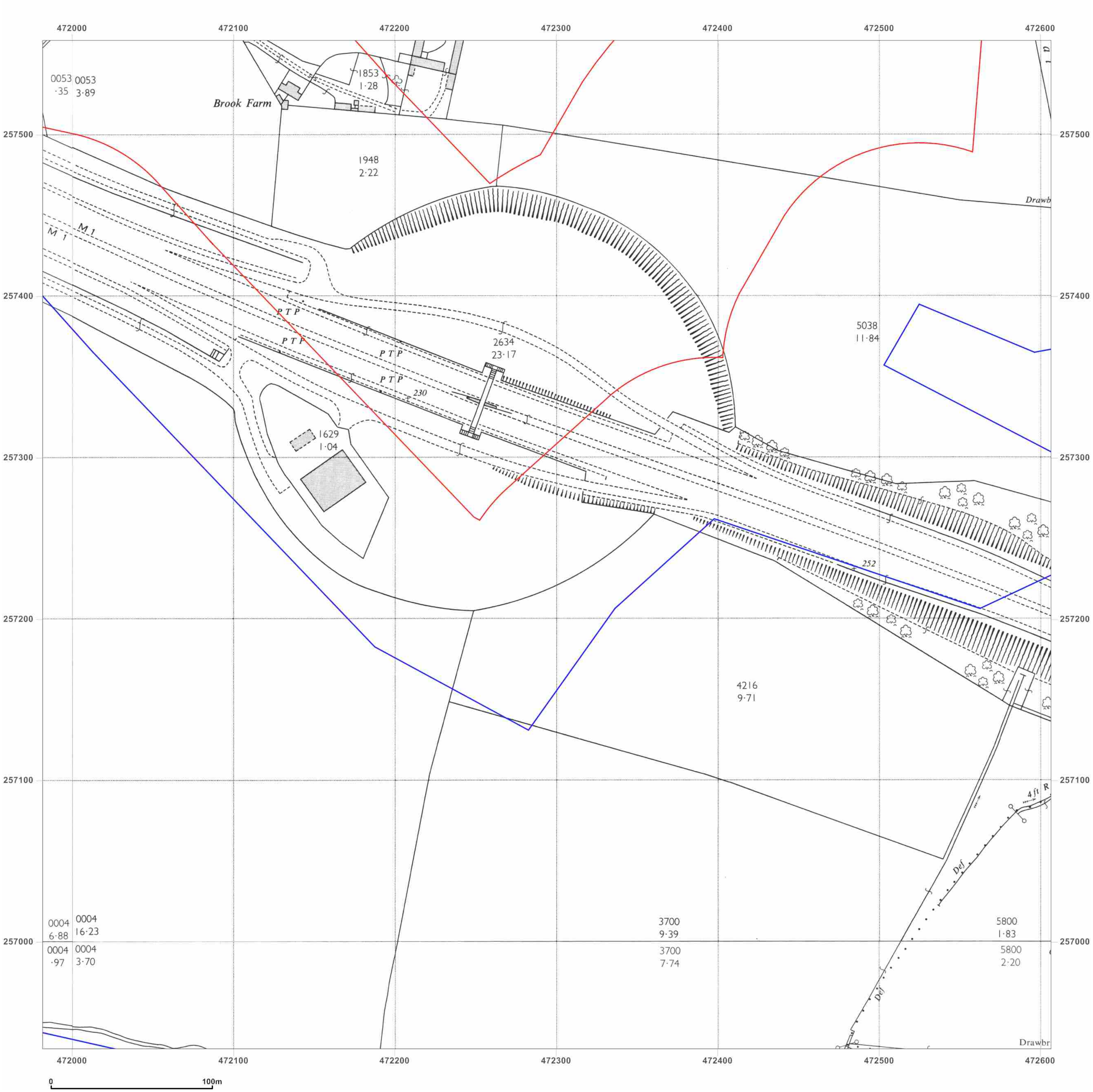
Production date: 19 June 2017

To view map legend click here *Legend*



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_3
Grid Ref: 472294, 257246

Map Name: National Grid

Map date: 1964

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1961

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

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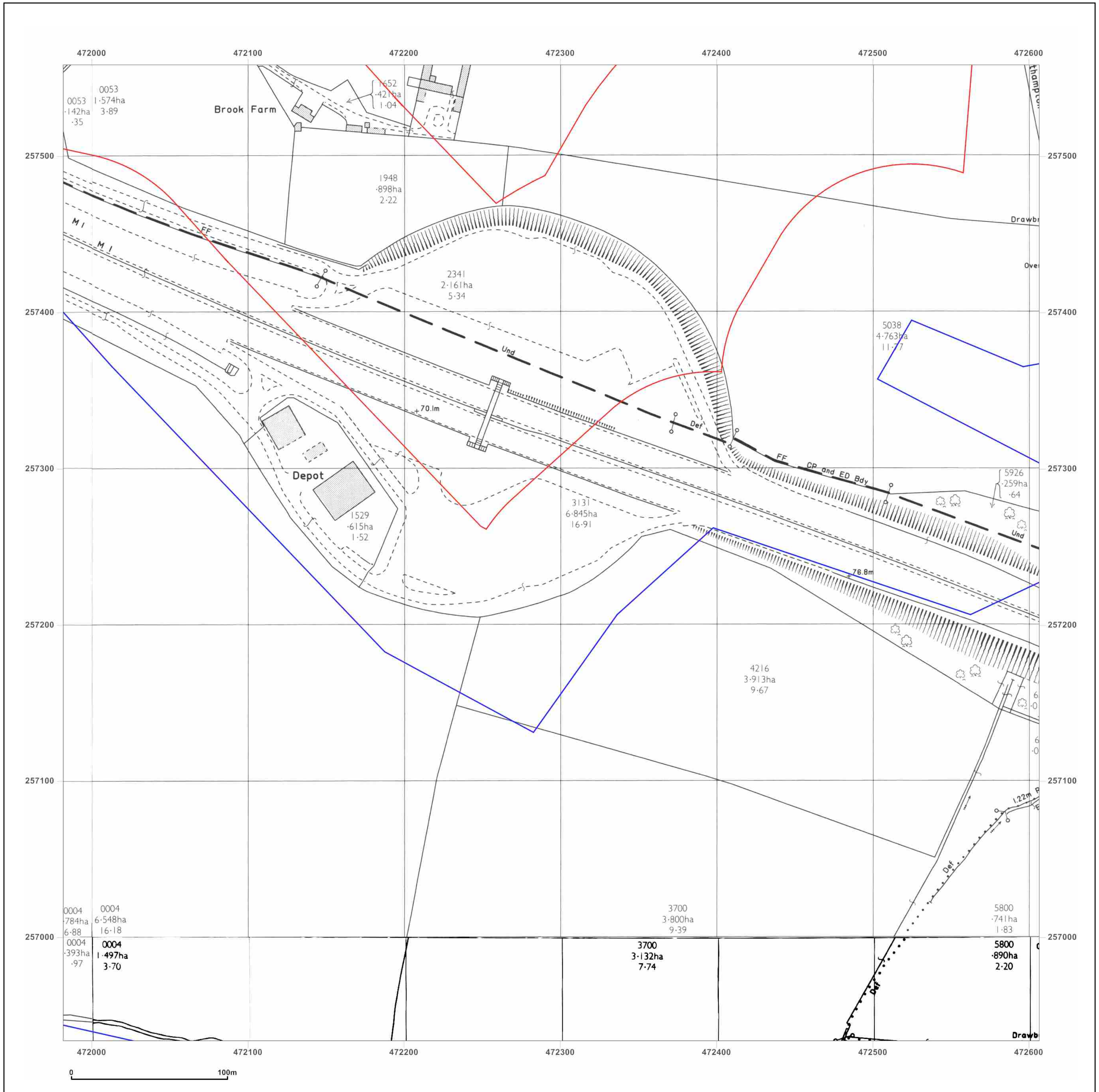
Production date: 19 June 2017

To view map legend click here *Legend*



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_3
Grid Ref: 472294, 257246

Map Name: National Grid

Map date: **1976-1977**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1976 Revised 1976 Edition N/A Copyright 1977 Levelled 1960	Surveyed 1977 Revised 1977 Edition N/A Copyright 1978 Levelled 1961
Surveyed 1976 Revised 1976 Edition N/A Copyright 1977 Levelled 1960	Surveyed N/A Revised N/A Edition N/A Copyright N/A Levelled N/A

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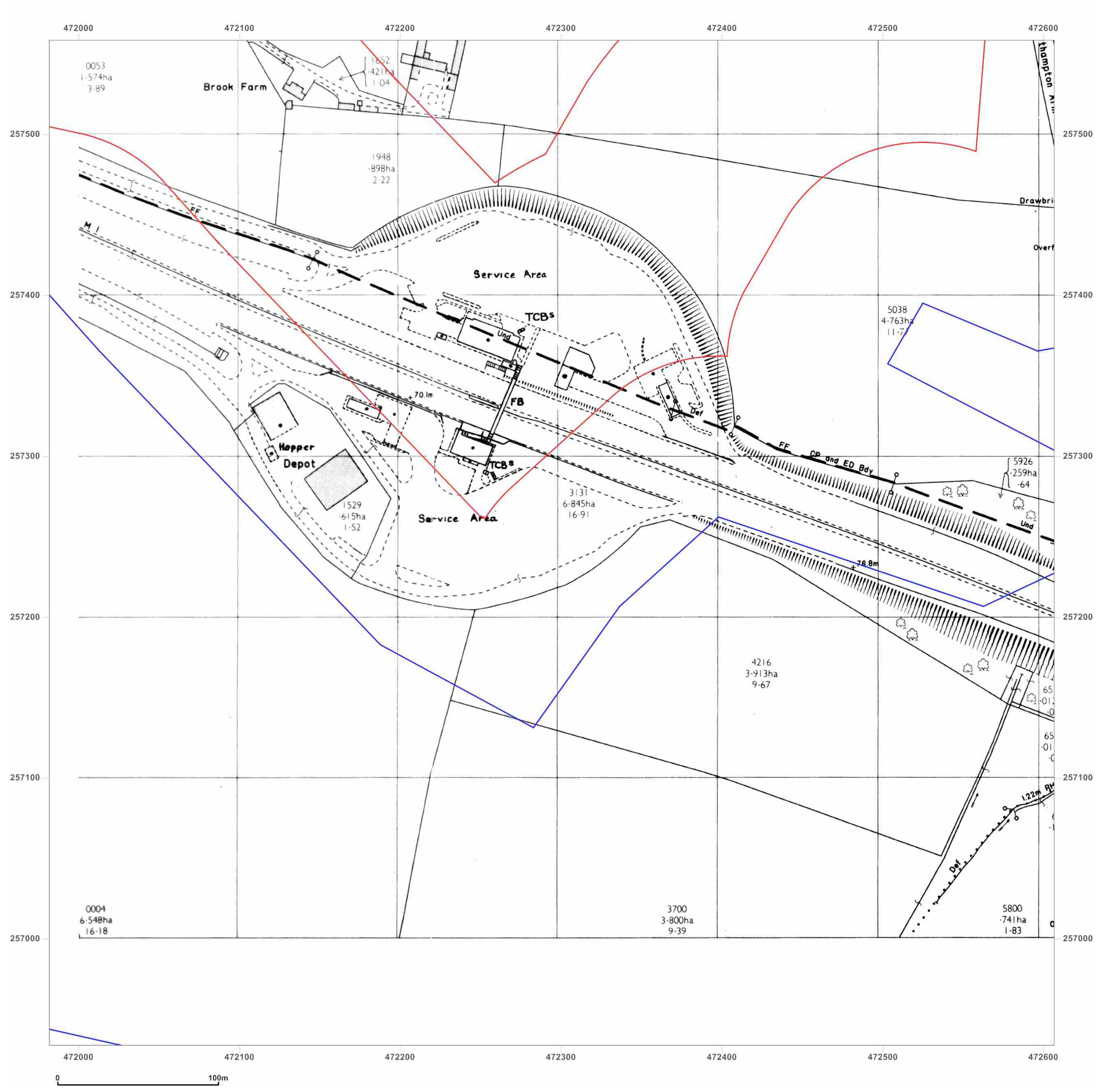
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_3
Grid Ref: 472294, 257246

Map Name: National Grid

Map date: **1988**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1988
Revised 1988
Edition N/A
Copyright 1988
Levelled N/A

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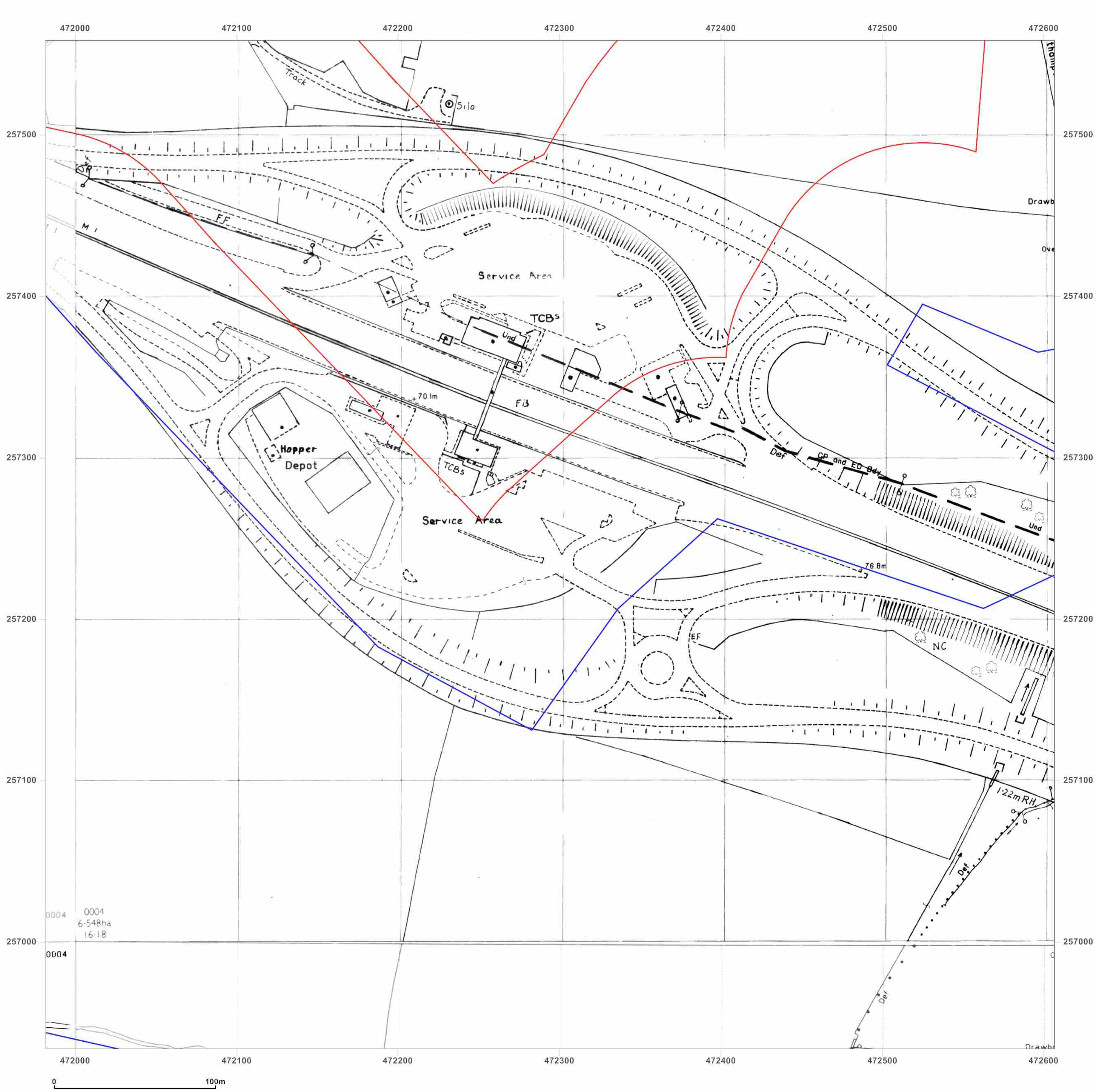
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_3
Grid Ref: 472294, 257246

Map Name: National Grid

Map date: **1992-1993**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1993 Revised 1993 Edition N/A Copyright N/A Levelled N/A	Surveyed 1986 Revised 1992 Edition N/A Copyright 1992 Levelled 1986
Surveyed N/A Revised N/A Edition N/A Copyright 1993 Levelled N/A	Surveyed 1993 Revised 1993 Edition N/A Copyright N/A Levelled N/A

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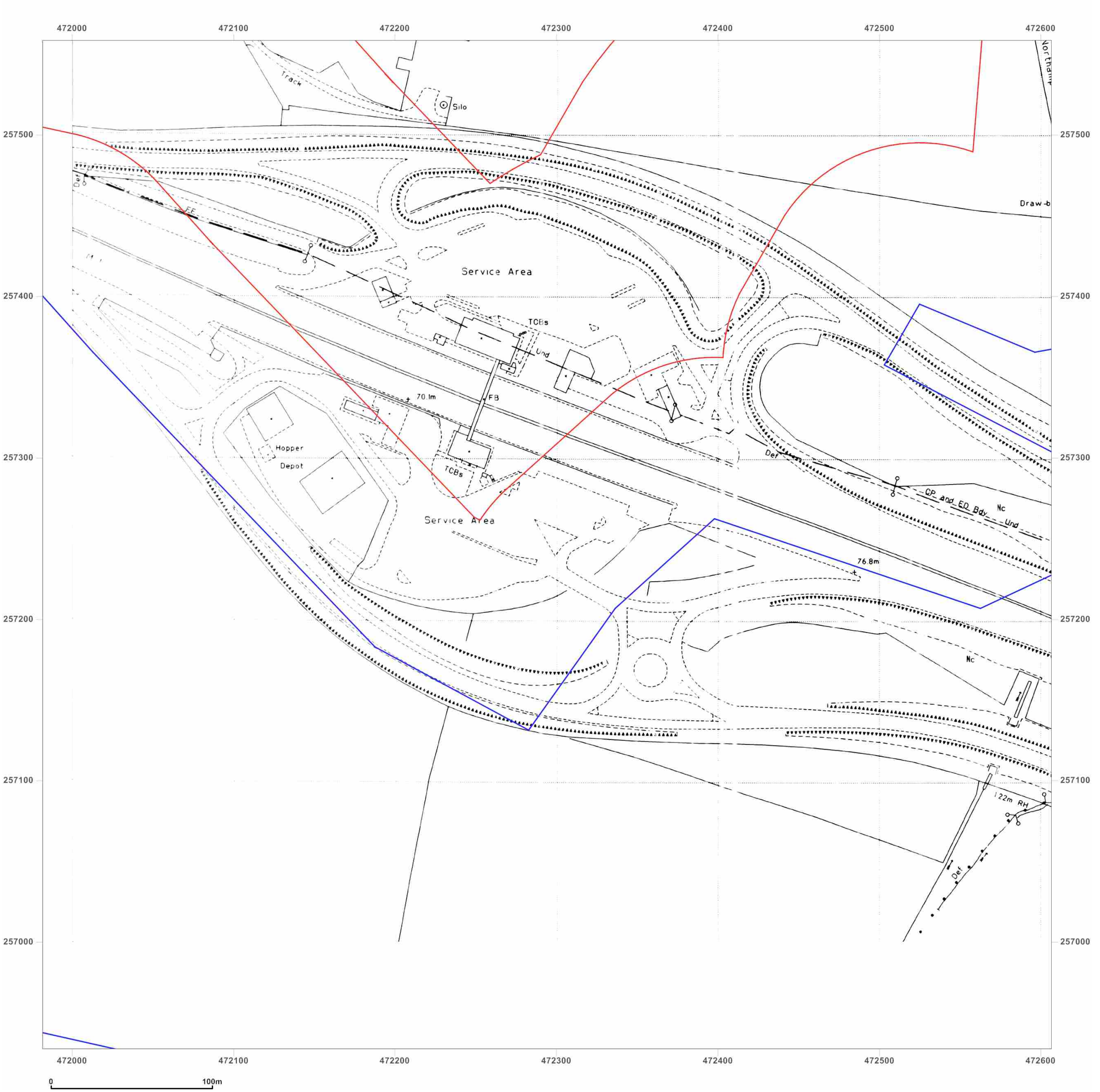
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_3
Grid Ref: 472294, 257246

Map Name: National Grid

Map date: 1993

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed N/A
Revised N/A
Edition N/A
Copyright 1993
Levelled N/A

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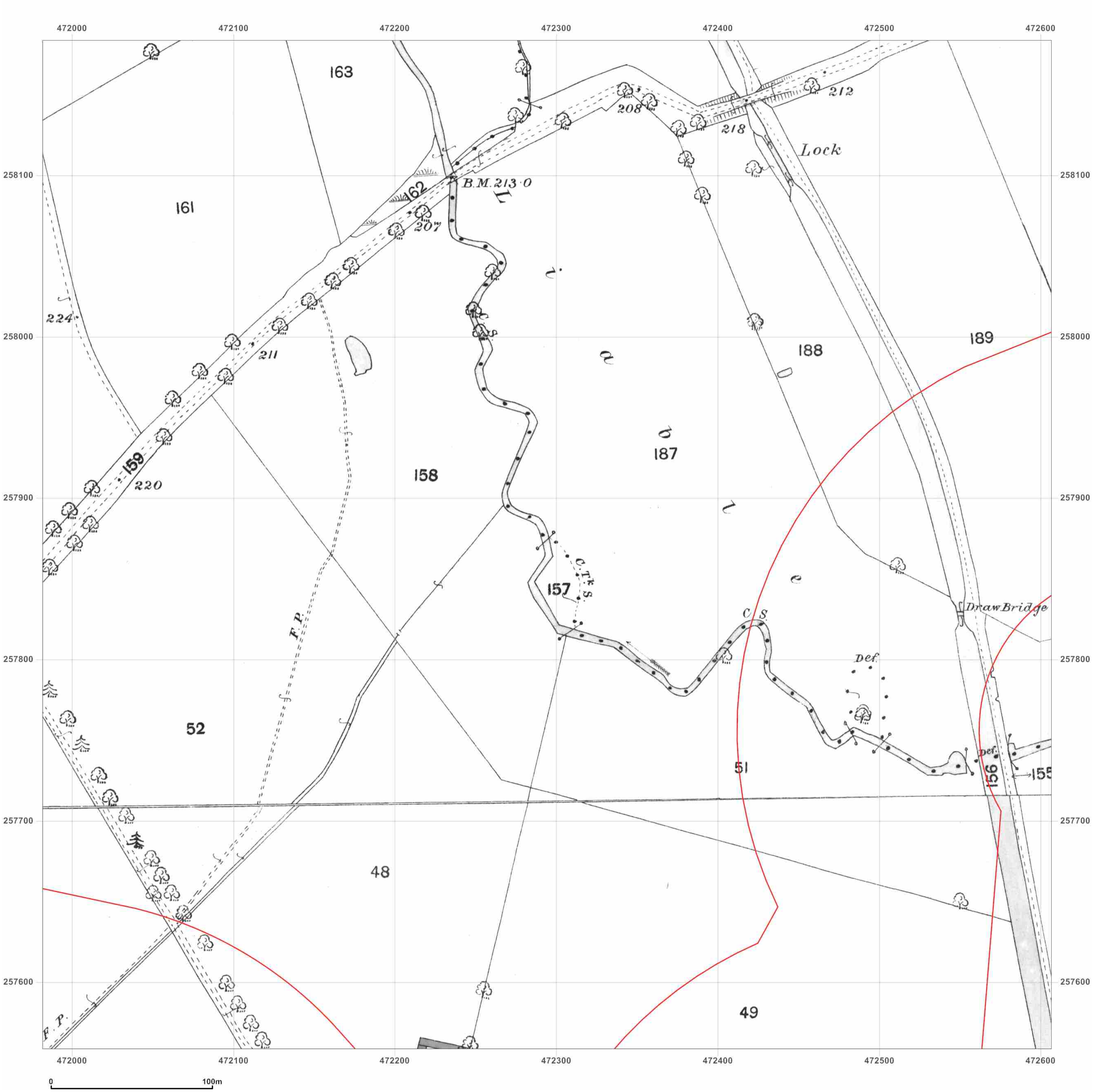
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_4
Grid Ref: 472294, 257871

Map Name: County Series

Map date: **1885-1886**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1886
Revised 1886
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1885
Revised 1885
Edition N/A
Copyright N/A
Levelled N/A

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Production date: 19 June 2017

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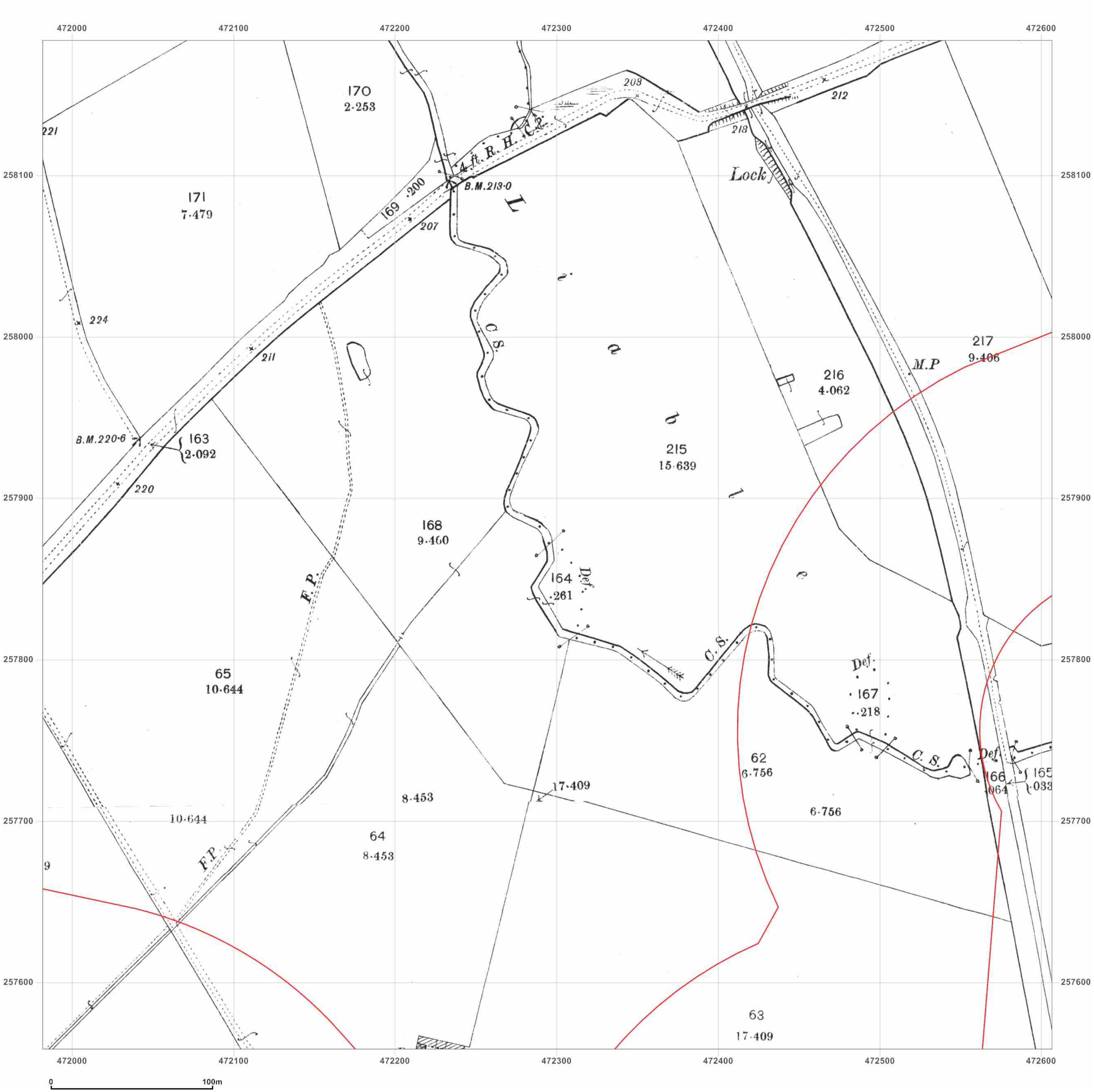

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_4
Grid Ref: 472294, 257871

Map Name: County Series

Map date: 1900

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

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W: www.groundsure.com

Production date: 19 June 2017

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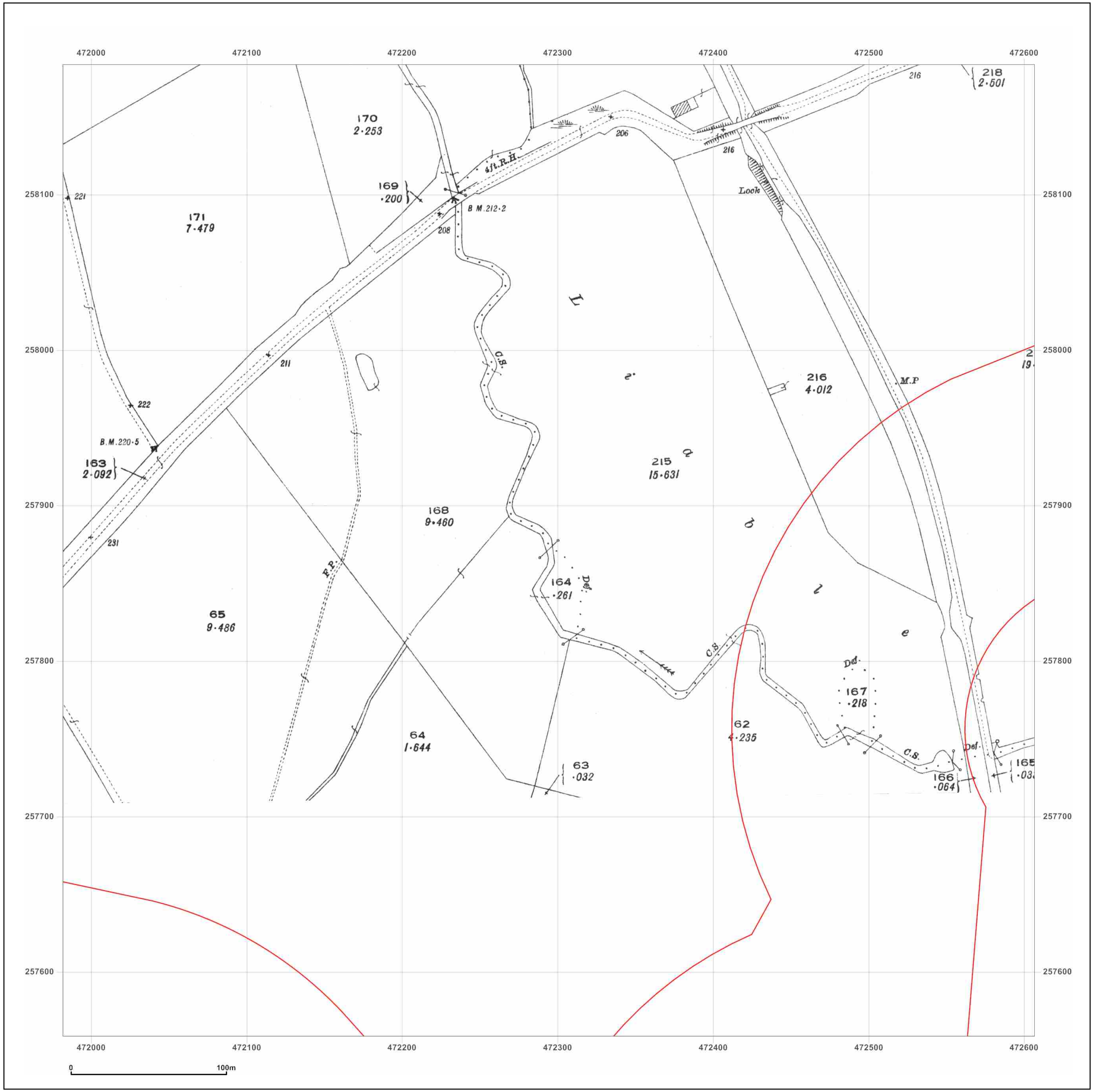

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_4
Grid Ref: 472294, 257871

Map Name: County Series

Map date: 1925

Scale: 1:2,500

Printed at: 1:2,500

N W E S

Surveyed 1925
Revised 1925
Edition N/A
Copyright N/A
Levelled N/A

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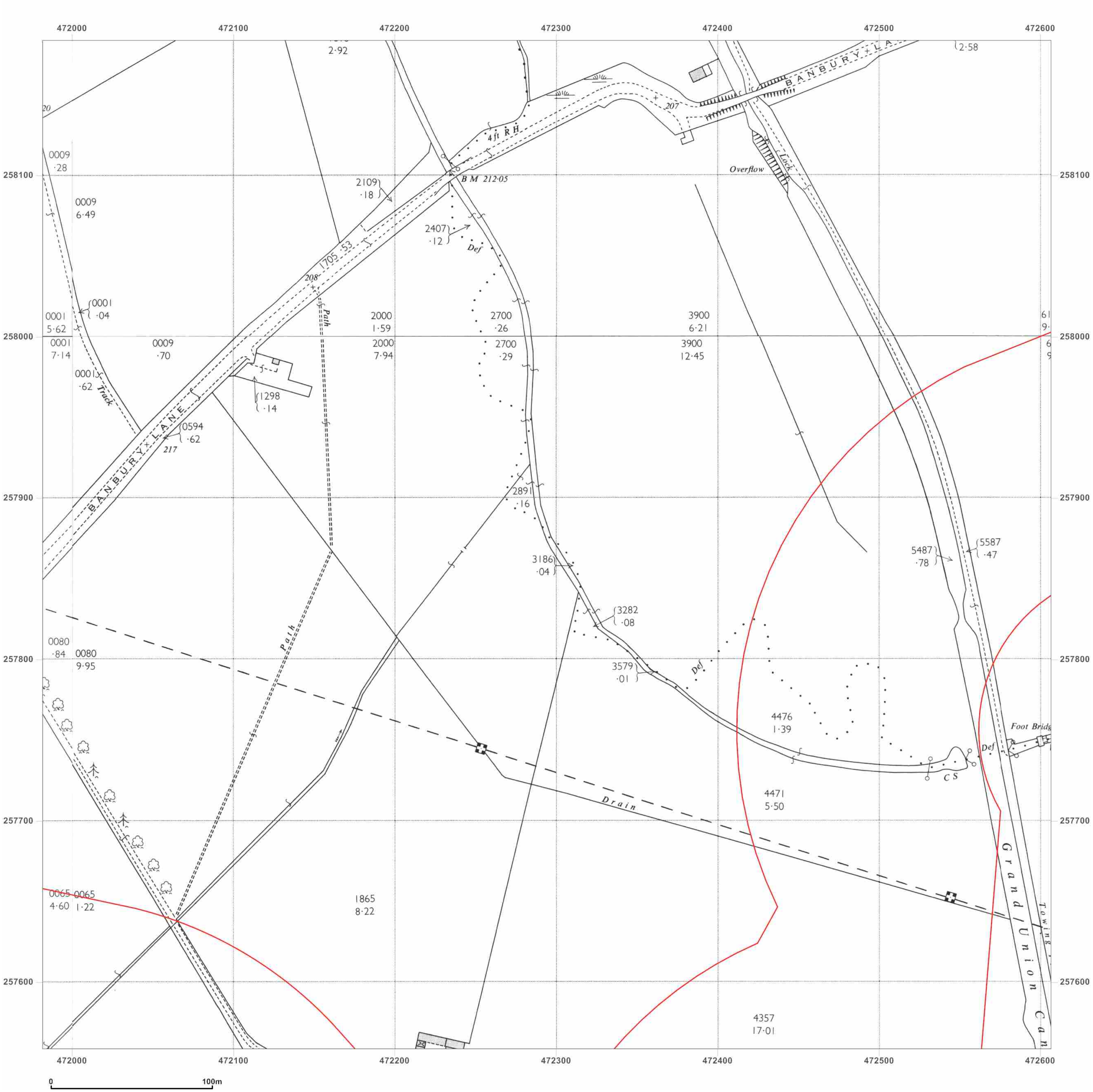

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_4
Grid Ref: 472294, 257871

Map Name: National Grid

Map date: 1964

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1961

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

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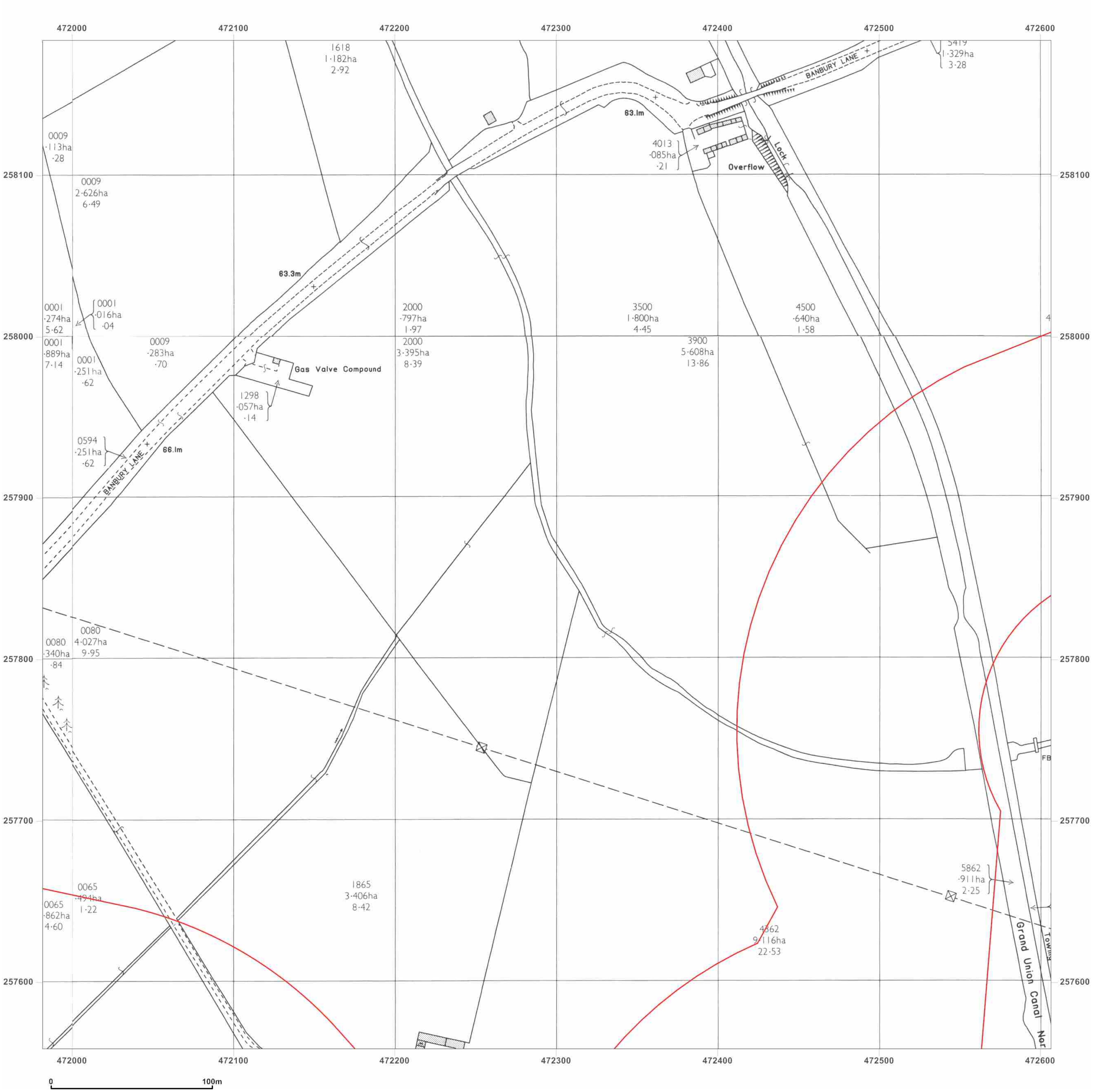

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_4
Grid Ref: 472294, 257871

Map Name: National Grid

Map date: **1976-1978**

Scale: 1:2,500

Printed at: 1:2,500

Surveyed 1977
Revised 1977
Edition N/A
Copyright 1978
Levelled 1961

Surveyed 1978
Revised 1978
Edition N/A
Copyright 1980
Levelled 1981

Surveyed 1976
Revised 1976
Edition N/A
Copyright 1977
Levelled 1960

Surveyed 1977
Revised 1977
Edition N/A
Copyright 1978
Levelled 1961

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Production date: 19 June 2017

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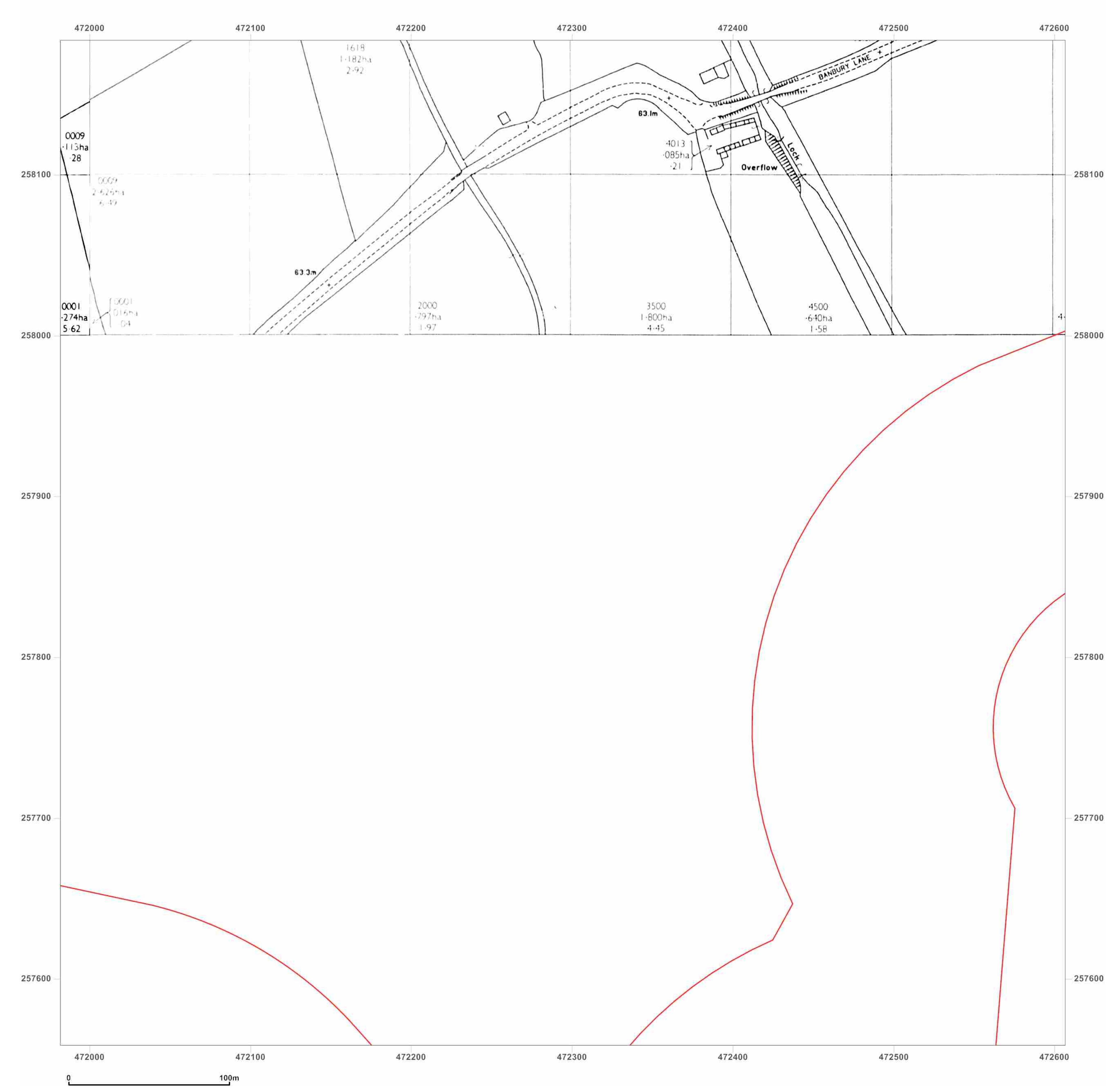

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_4
Grid Ref: 472294, 257871

Map Name: National Grid

Map date: 1978-1982

Scale: 1:2,500

Printed at: 1:2,500

N W E S

Surveyed N/A	Surveyed 1961
Revised N/A	Revised 1982
Edition N/A	Edition N/A
Copyright N/A	Copyright 1982
Levelled N/A	Levelled 1961

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Production date: 19 June 2017

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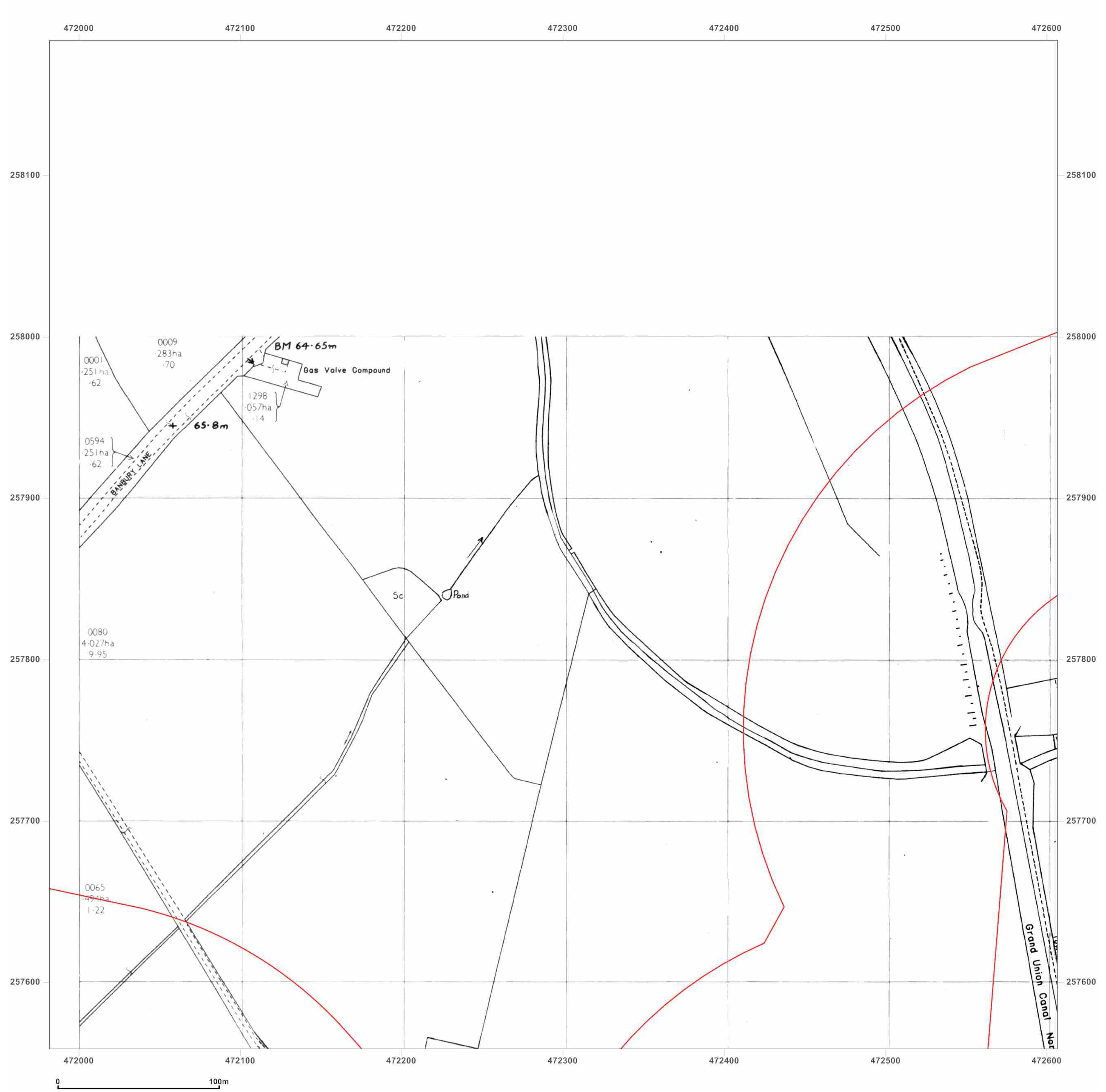

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_4
Grid Ref: 472294, 257871

Map Name: National Grid

Map date: 1992

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed 1986
Revised 1992
Edition N/A
Copyright 1992
Levelled 1986

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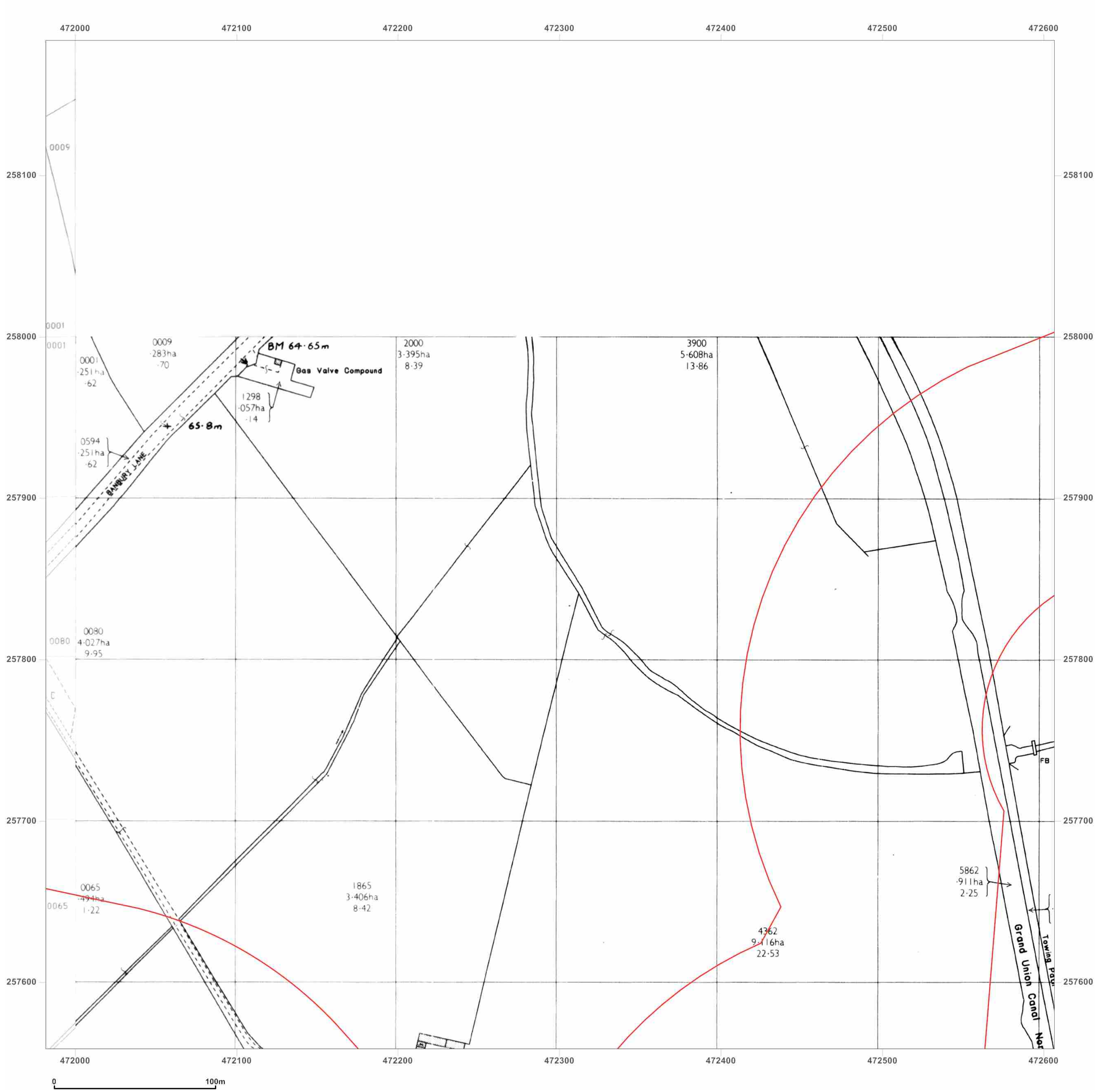

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_4
Grid Ref: 472294, 257871

Map Name: National Grid

Map date: **1988-1993**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1993
Revised 1993
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1993
Revised 1993
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1988
Revised 1988
Edition N/A
Copyright 1988
Levelled N/A

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Production date: 19 June 2017

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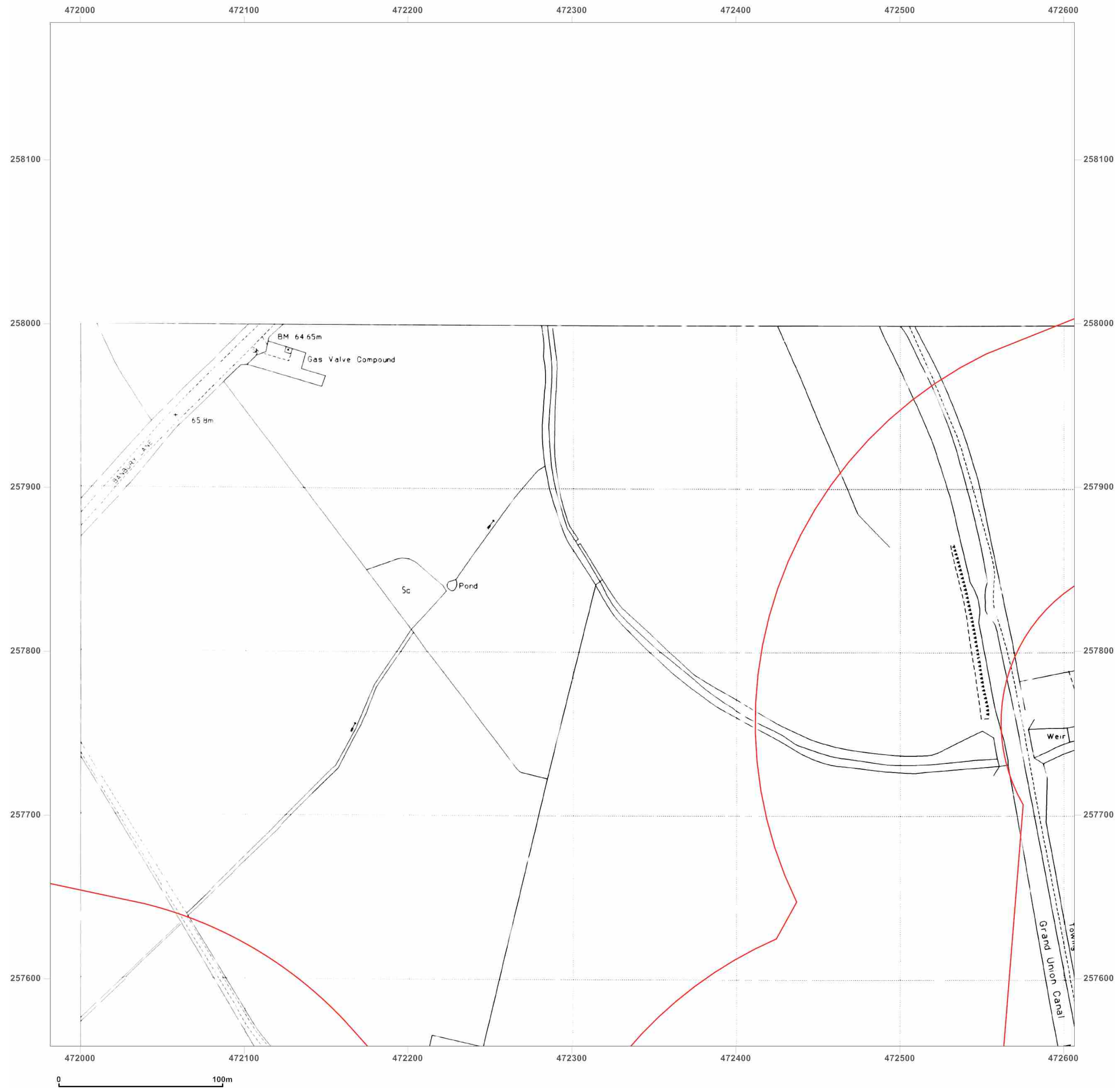

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_2_4
Grid Ref: 472294, 257871

Map Name: National Grid

Map date: 1993

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed N/A
Revised N/A
Edition N/A
Copyright 1993
Levelled N/A

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Production date: 19 June 2017

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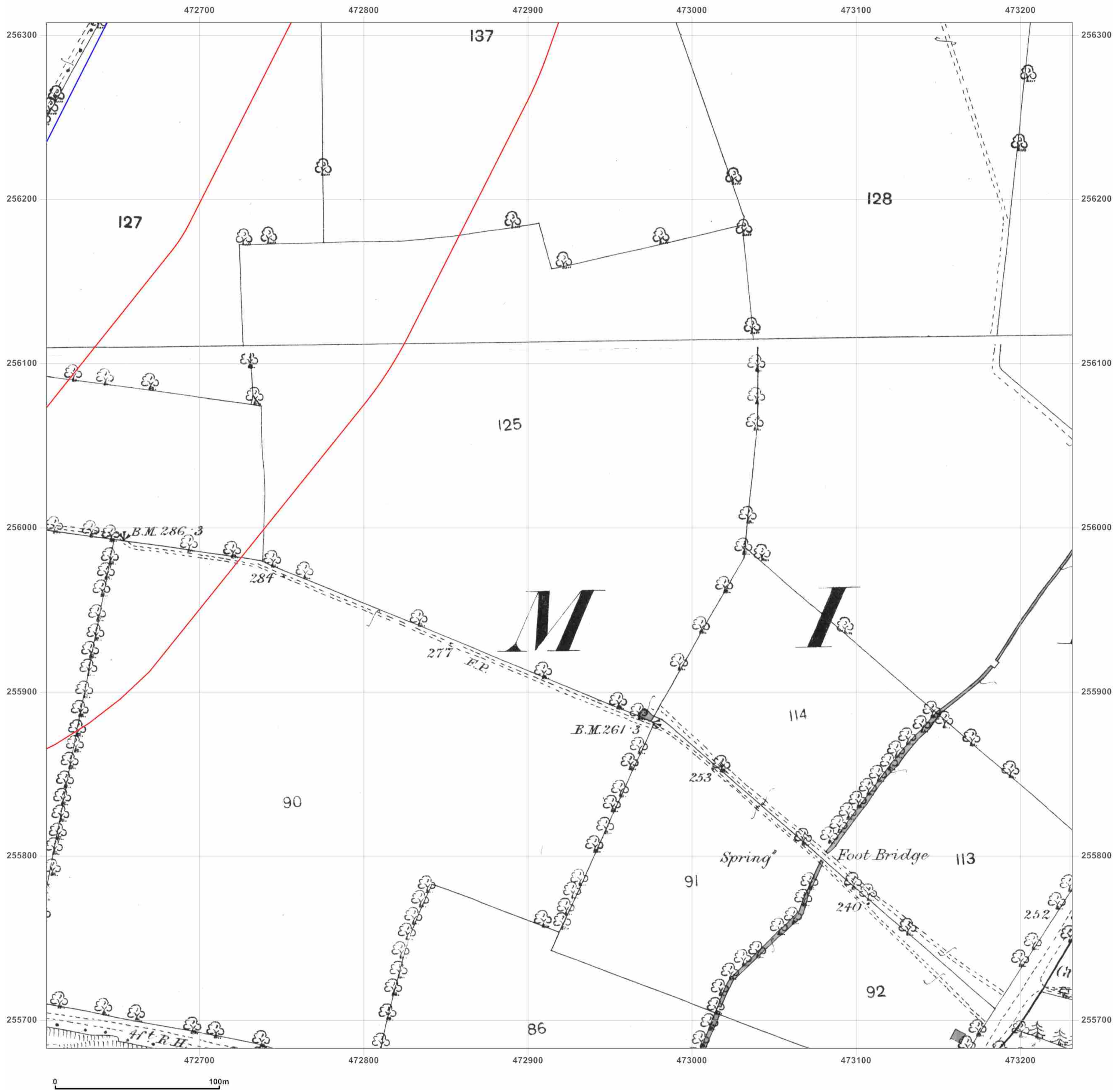


Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_1
Grid Ref: 472919, 255995

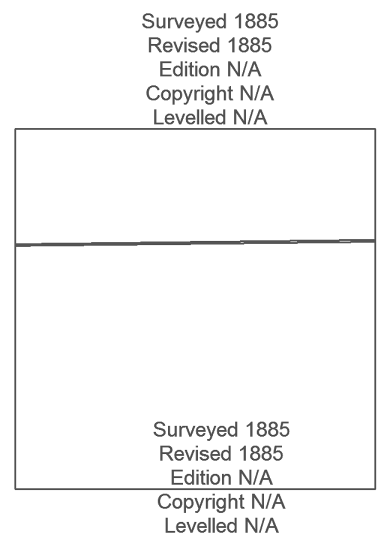
Map Name: County Series

Map date: **1885**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S



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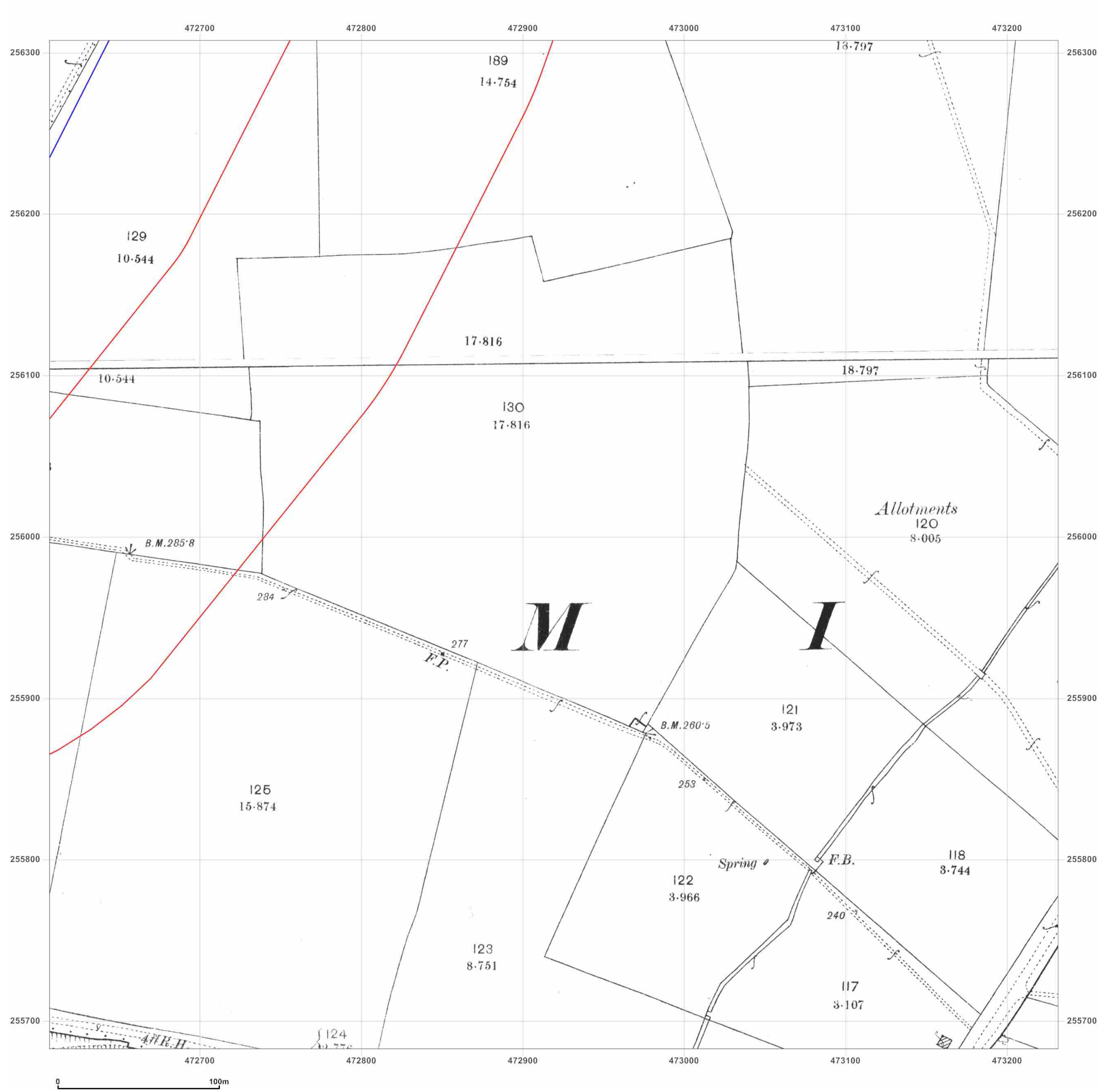
Production date: 19 June 2017

To view map legend click here *Legend*

Groundsure INSIGHTS



Site Details:

472716, 257183

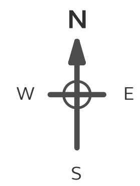
Client Ref: POP009664
Report Ref: GS-4001370_LS_3_1
Grid Ref: 472919, 255995

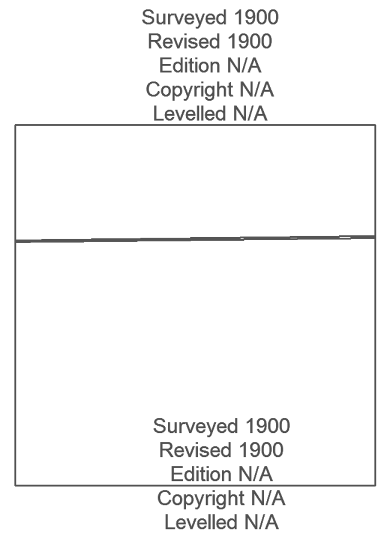
Map Name: County Series

Map date: **1900**

Scale: 1:2,500

Printed at: 1:2,500





Powered by

Produced by
Groundsure Insights
T: 08444 159000
E: info@groundsure.com
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_1
Grid Ref: 472919, 255995

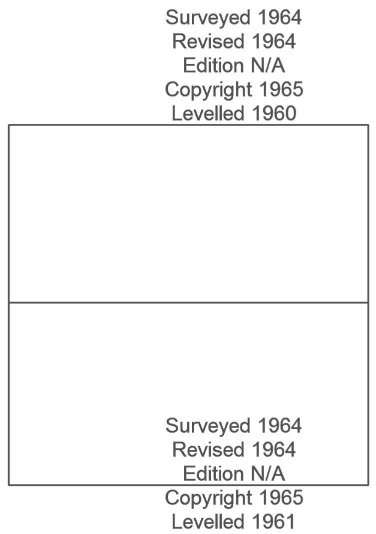
Map Name: National Grid

Map date: 1964

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S



Produced by
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T: 08444 159000
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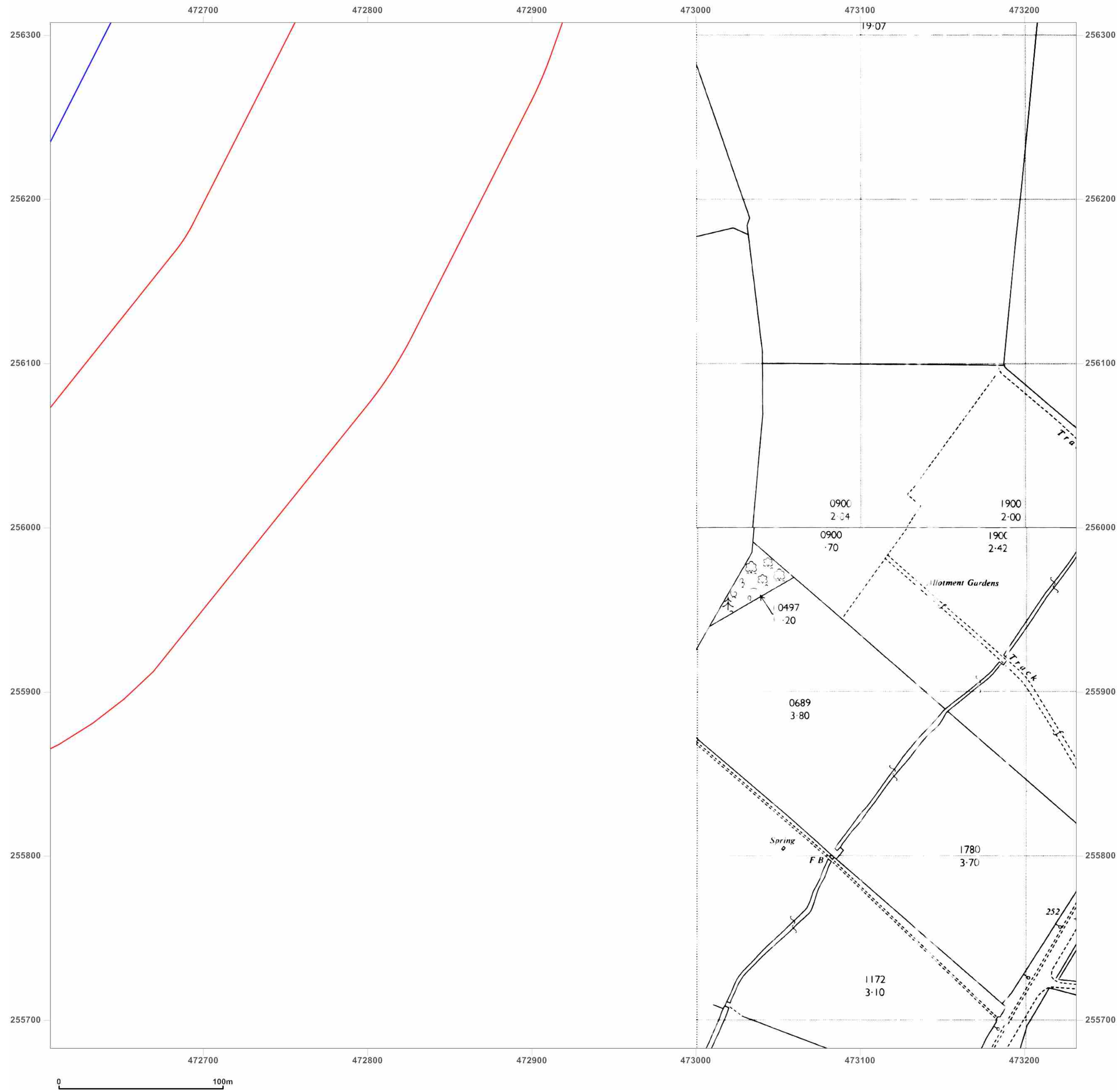
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*

Groundsure INSIGHTS



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_1
Grid Ref: 472919, 255995

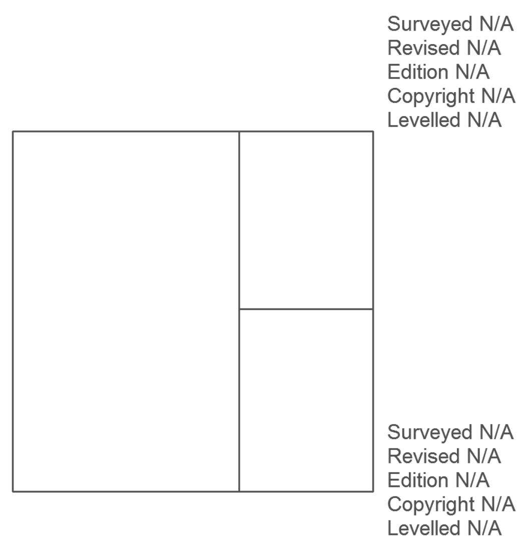
Map Name: National Grid

Map date: **1965**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S



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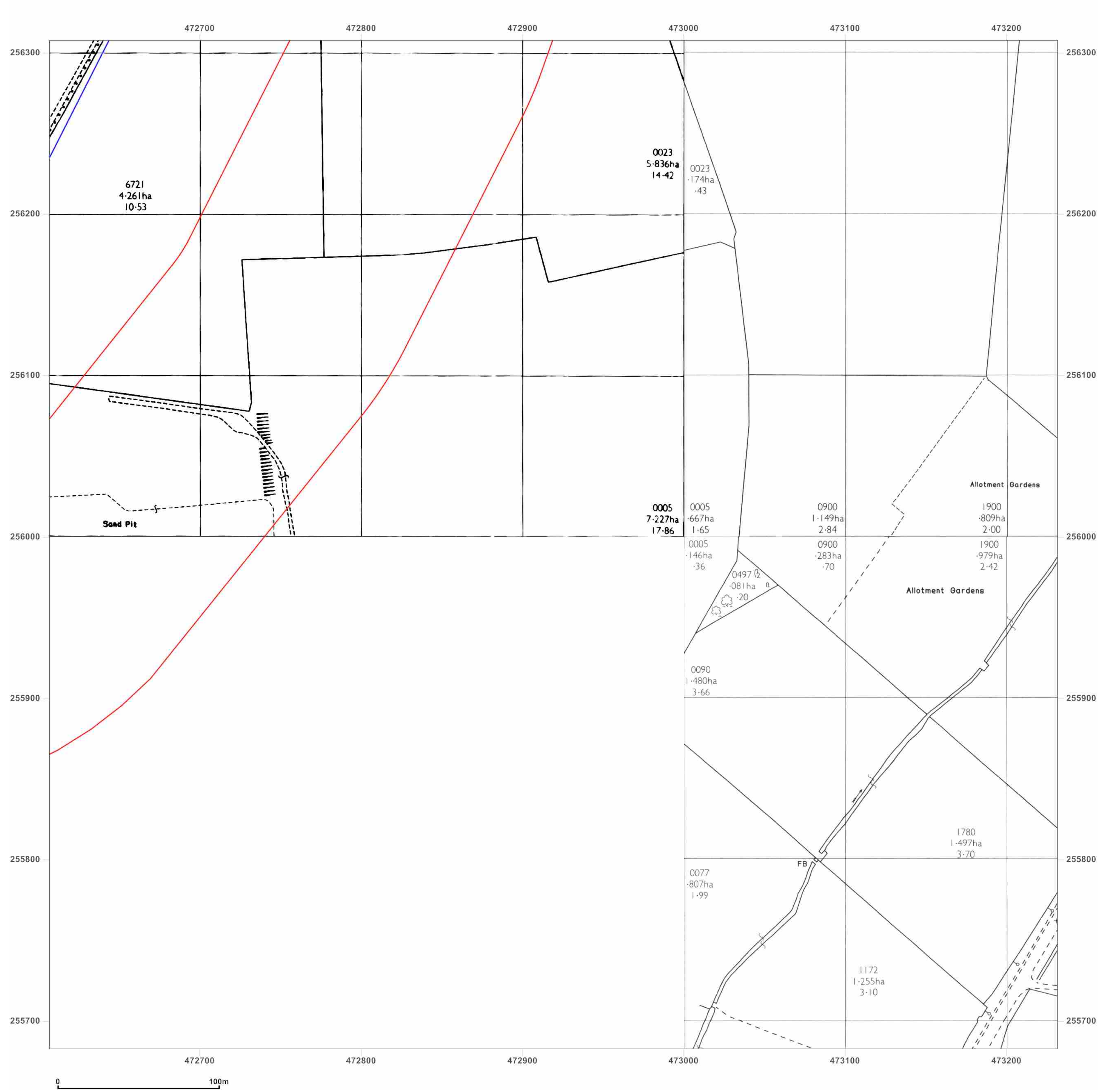
Production date: 19 June 2017

To view map legend click here *Legend*



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_1
Grid Ref: 472919, 255995

Map Name: National Grid

Map date: **1976-1977**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

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

Surveyed 1977
Revised 1977
Edition N/A
Copyright 1979
Levelled 1960

Surveyed 1976
Revised 1976
Edition N/A
Copyright 1978
Levelled 1960

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Production date: 19 June 2017

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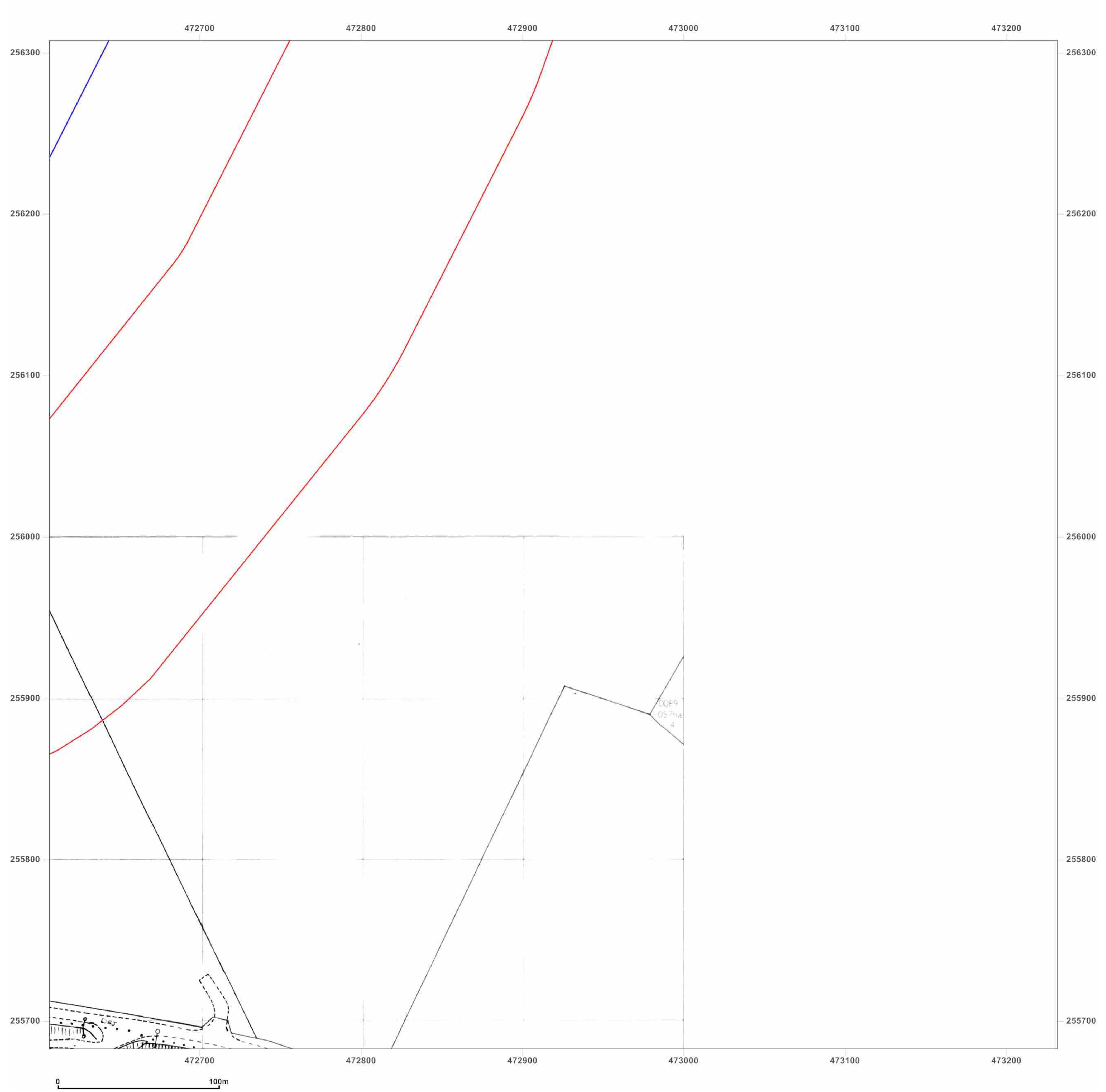

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_1
Grid Ref: 472919, 255995

Map Name: National Grid

Map date: **1992**

Scale: 1:2,500

Printed at: 1:2,500

N W E S

Surveyed 1992
Revised 1992
Edition N/A
Copyright 1992
Levelled N/A

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Production date: 19 June 2017

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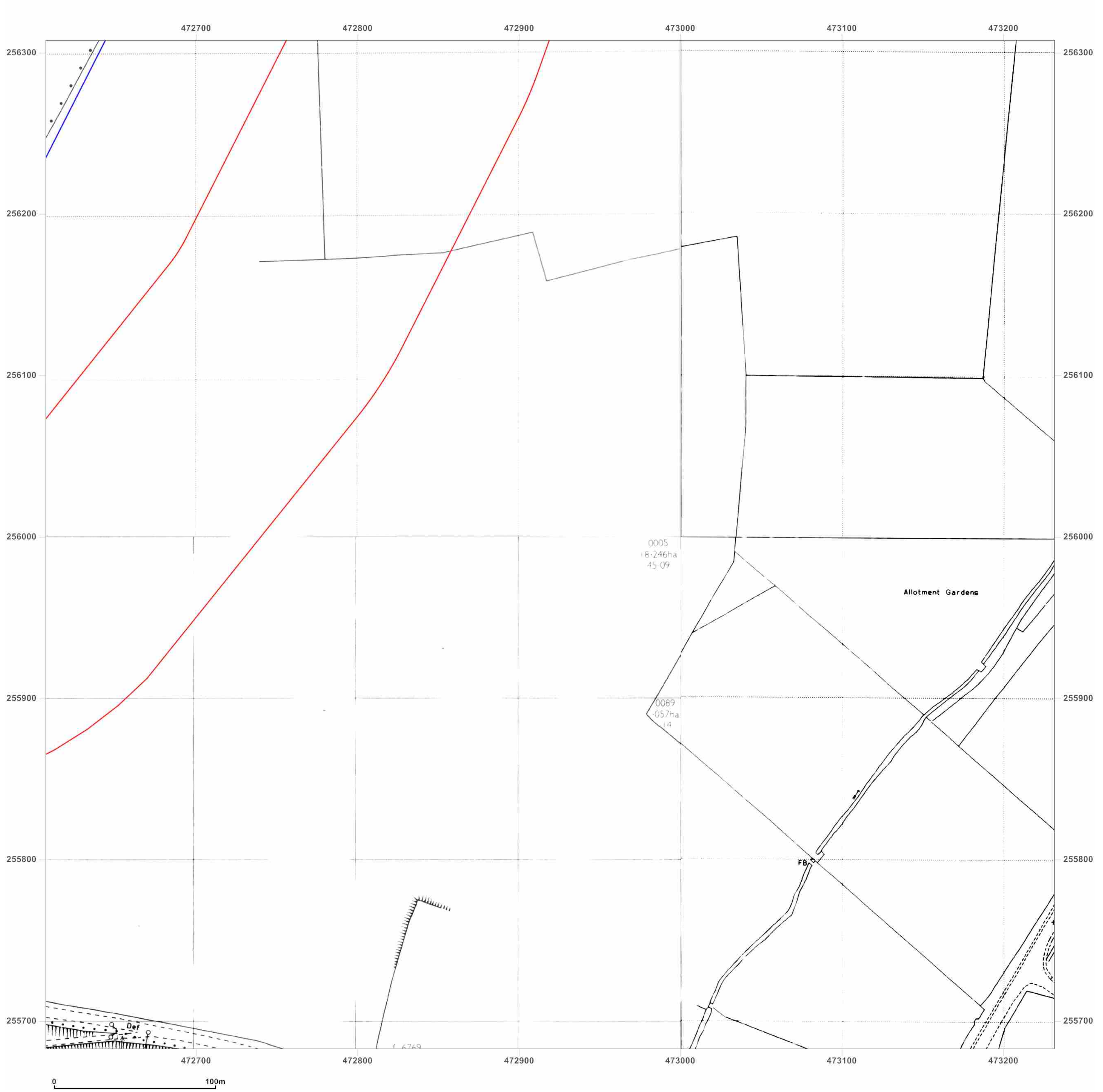

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_1
Grid Ref: 472919, 255995

Map Name: National Grid

Map date: 1989-1993

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1993 Revised 1993 Edition N/A Copyright N/A Levelled N/A	Surveyed N/A Revised N/A Edition N/A Copyright 1993 Levelled N/A
Surveyed 1989 Revised 1989 Edition N/A Copyright 1989 Levelled N/A	Surveyed N/A Revised N/A Edition N/A Copyright 1993 Levelled N/A

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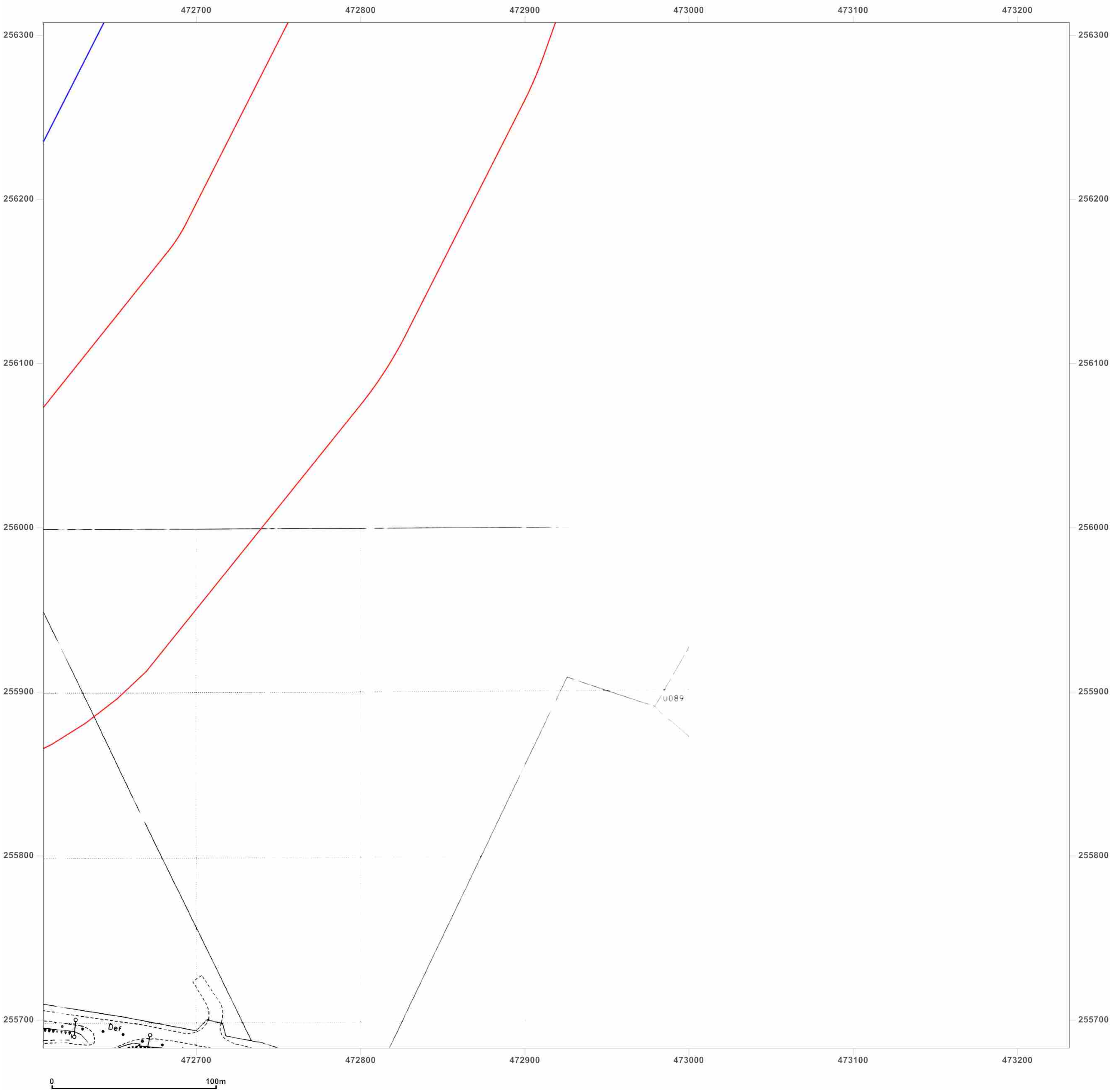

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_1
Grid Ref: 472919, 255995

Map Name: National Grid

Map date: **1993**

Scale: 1:2,500

Printed at: 1:2,500

N W E S

Surveyed N/A
Revised N/A
Edition N/A
Copyright 1993
Levelled N/A

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Production date: 19 June 2017

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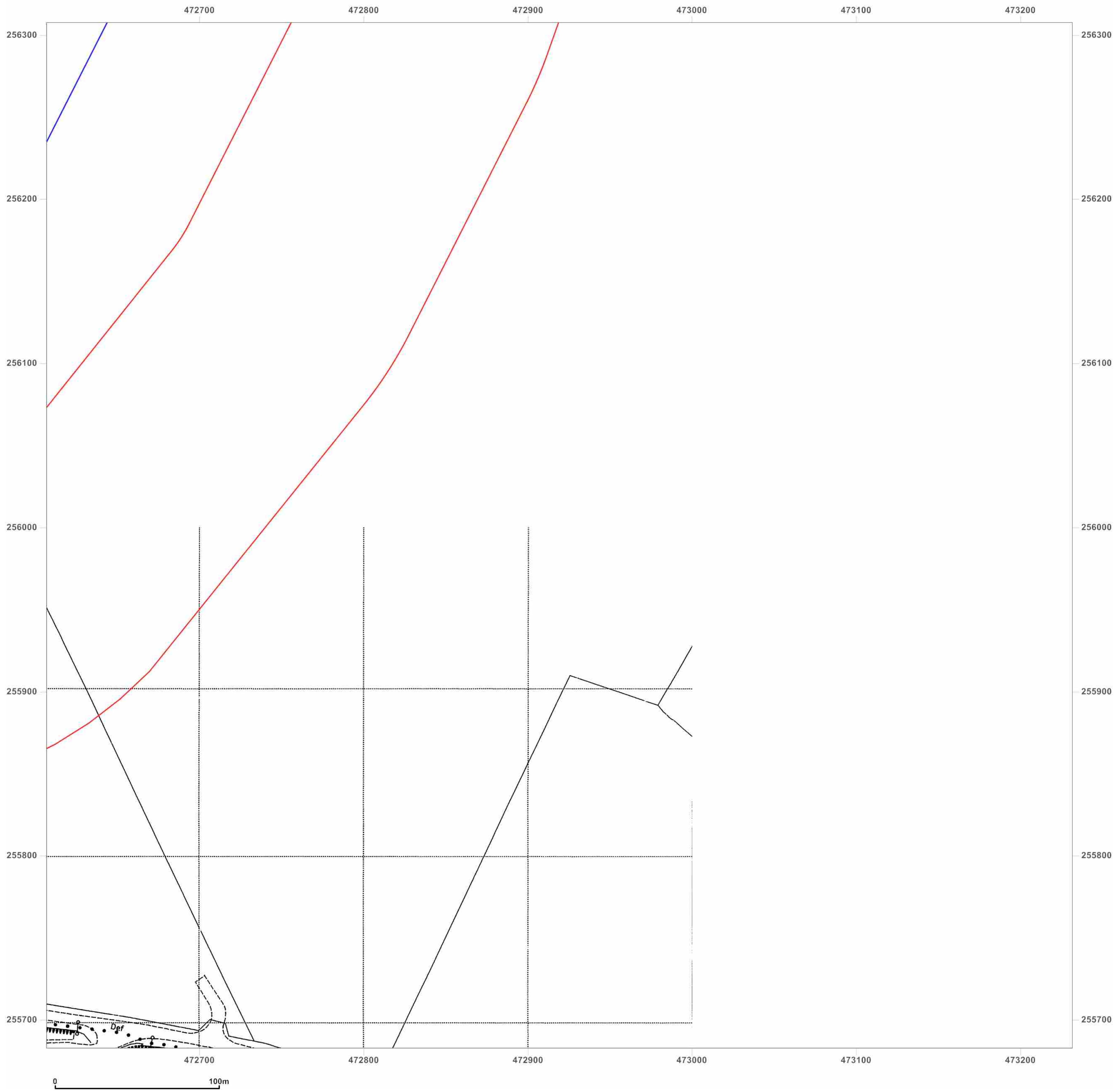
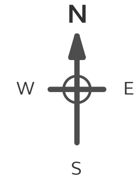




Site Details:

472716, 257183

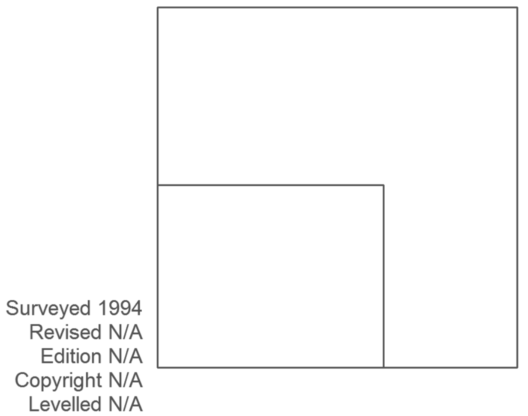
Client Ref: POP009664
Report Ref: GS-4001370_LS_3_1
Grid Ref: 472919, 255995

Map Name: National Grid

Map date: **1994**

Scale: 1:2,500

Printed at: 1:2,500



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Production date: 19 June 2017

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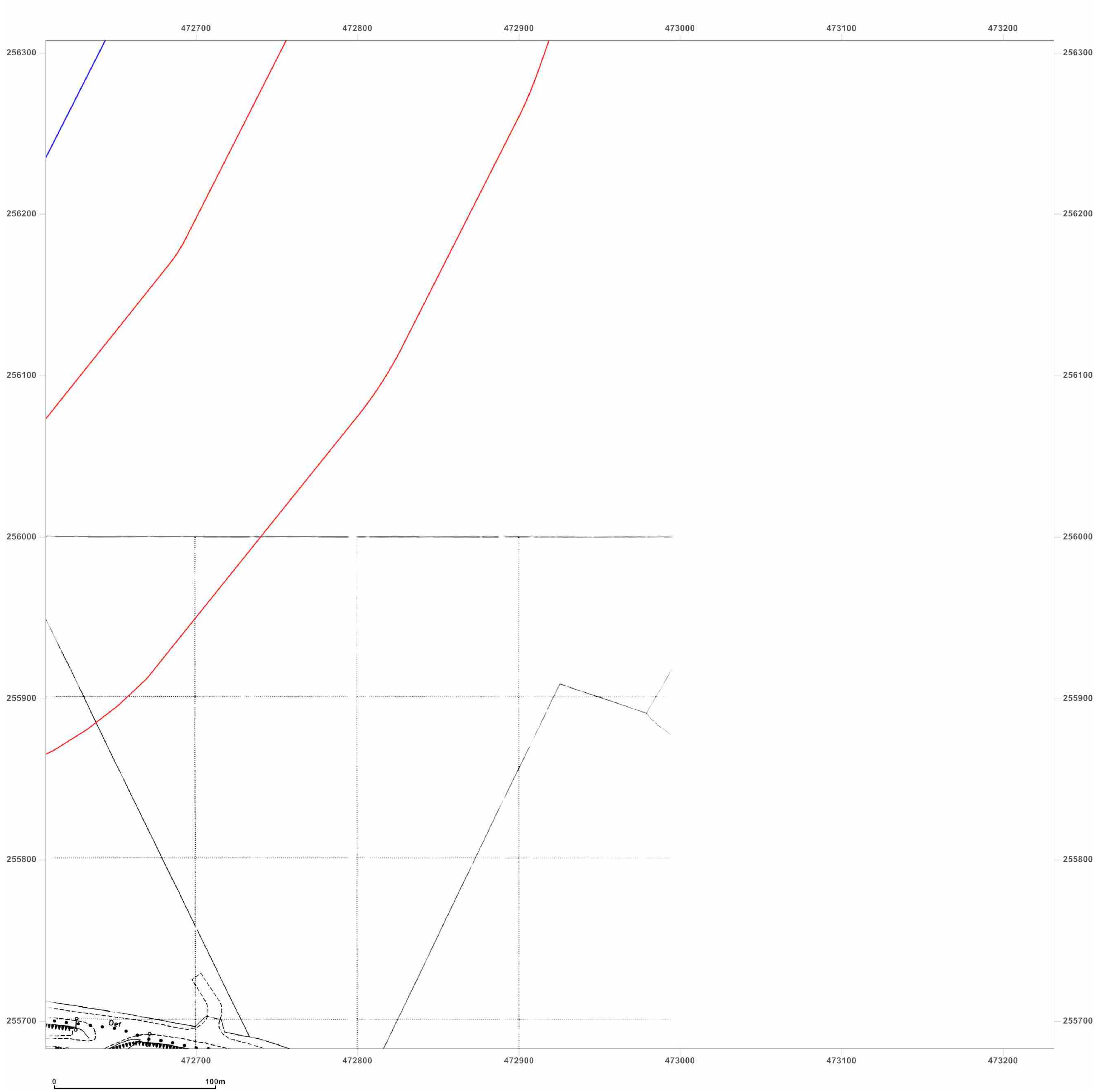

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_1
Grid Ref: 472919, 255995

Map Name: National Grid

Map date: **1994**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed N/A
Revised N/A
Edition N/A
Copyright 1994
Levelled N/A

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Production date: 19 June 2017

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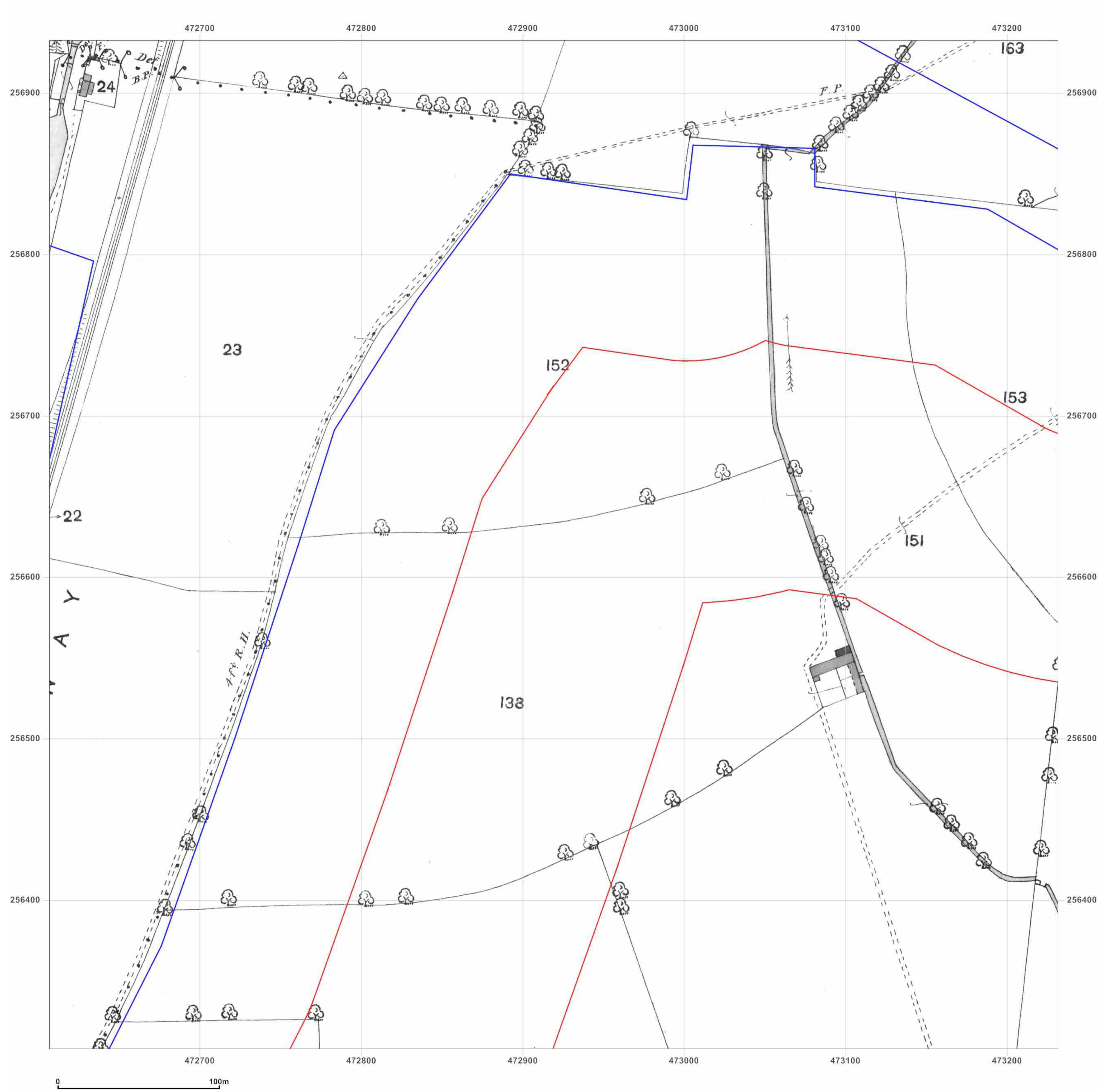

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_2
Grid Ref: 472919, 256620

Map Name: County Series

Map date: 1885

Scale: 1:2,500

Printed at: 1:2,500

Surveyed 1885
Revised 1885
Edition N/A
Copyright N/A
Levelled N/A

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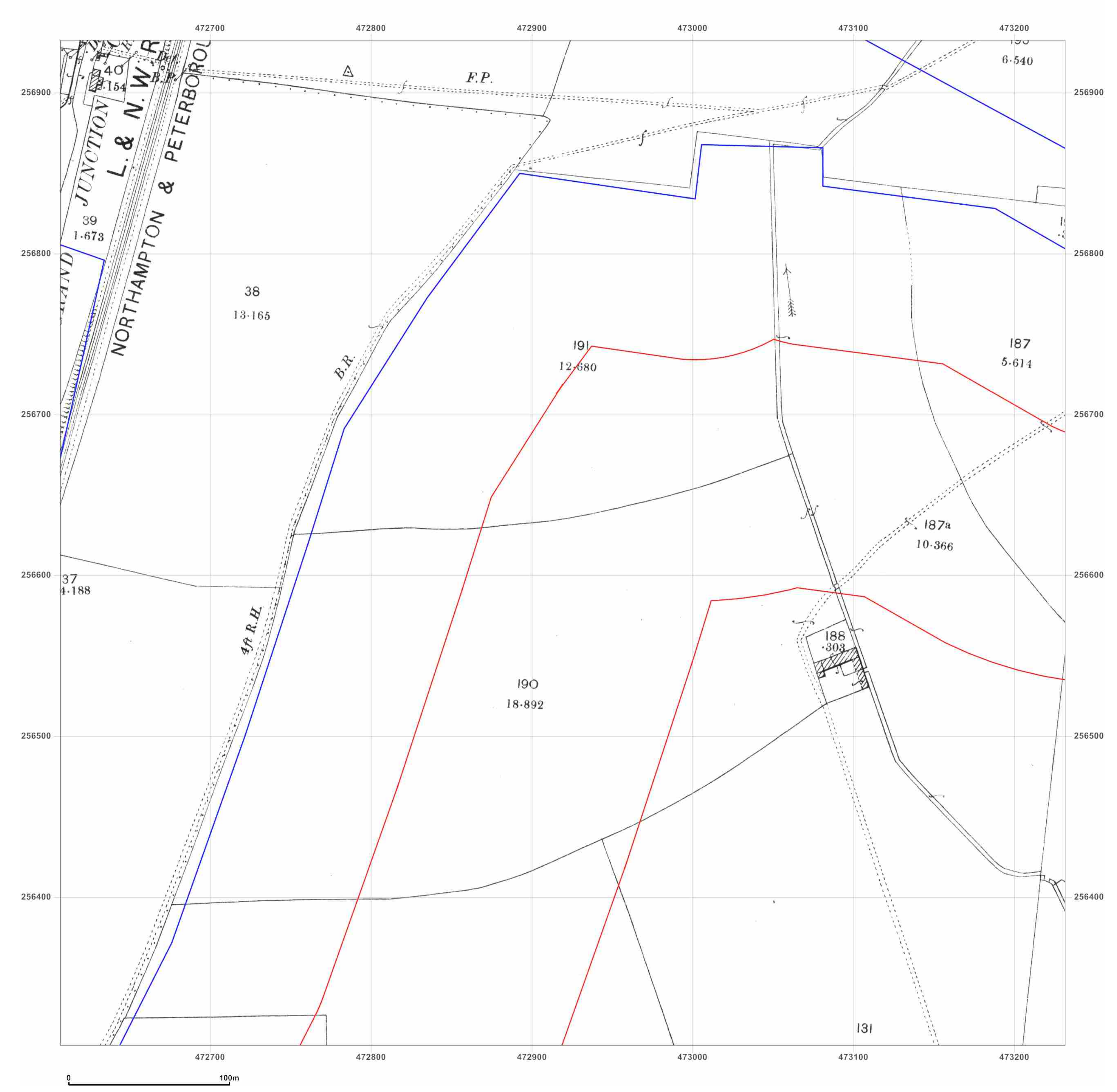

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_2
Grid Ref: 472919, 256620

Map Name: County Series

Map date: 1900

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

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Production date: 19 June 2017

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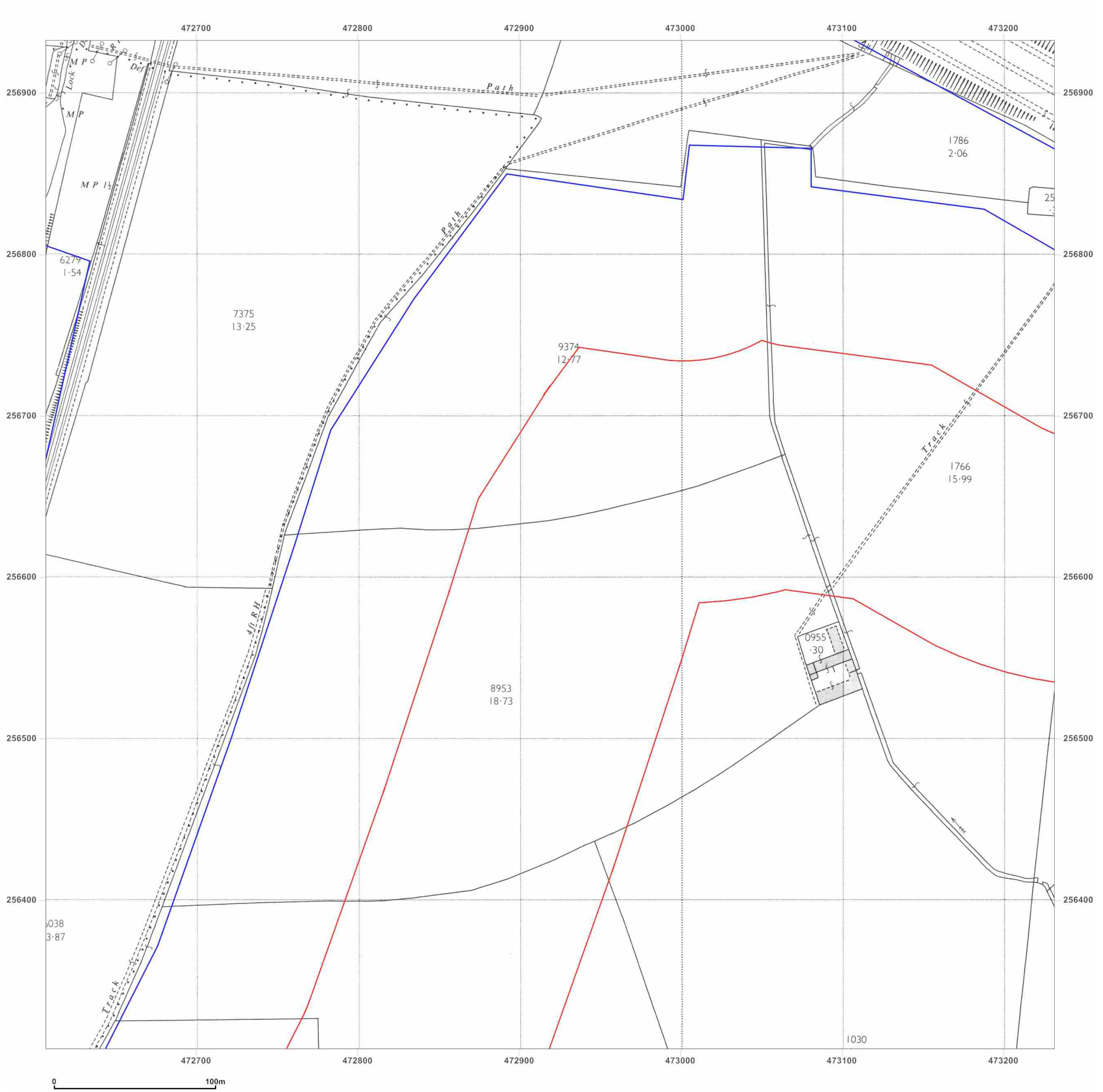

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_2
Grid Ref: 472919, 256620

Map Name: National Grid

Map date: 1964

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

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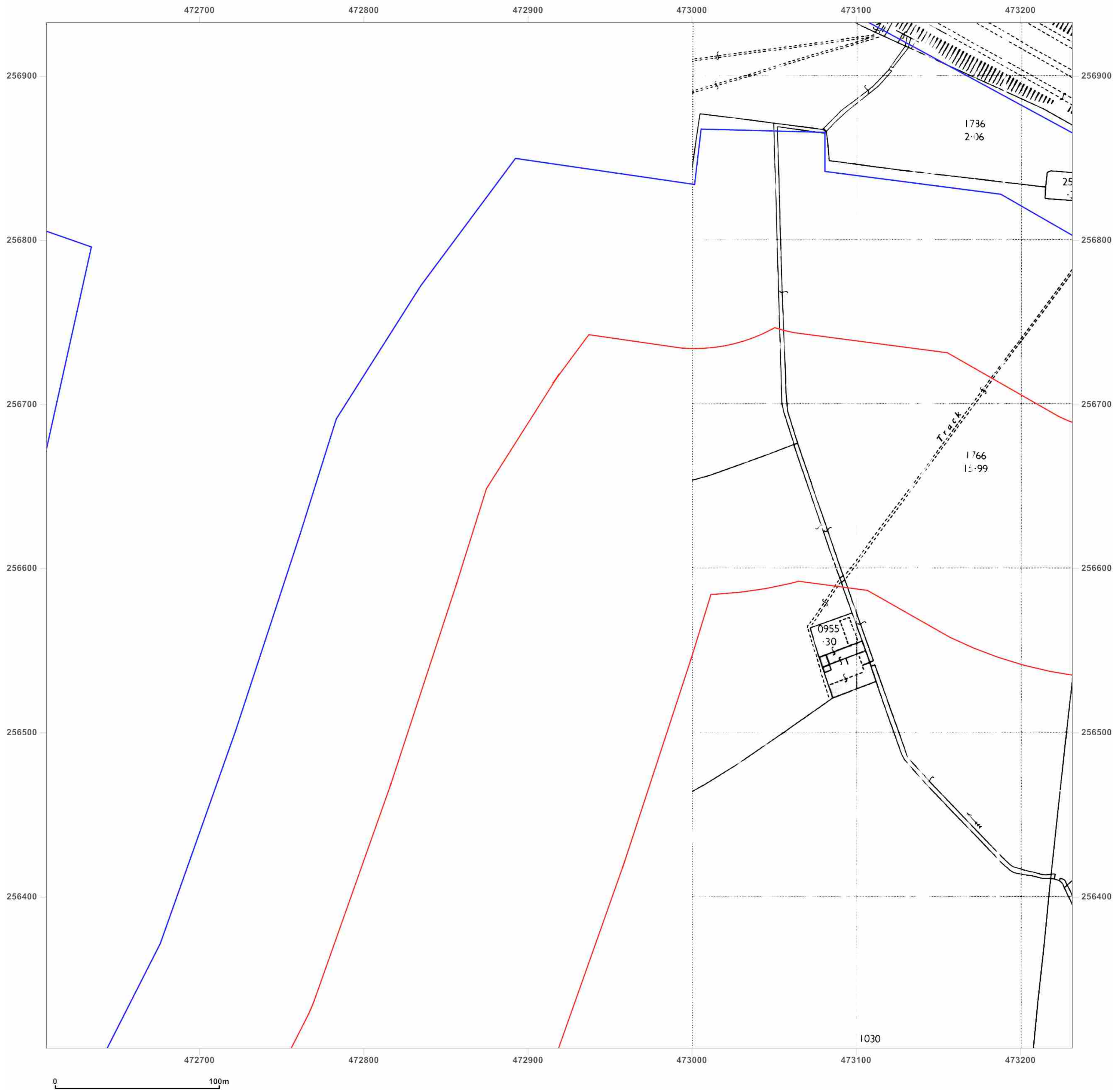
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_2
Grid Ref: 472919, 256620

Map Name: National Grid

Map date: 1965

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

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

Powered by

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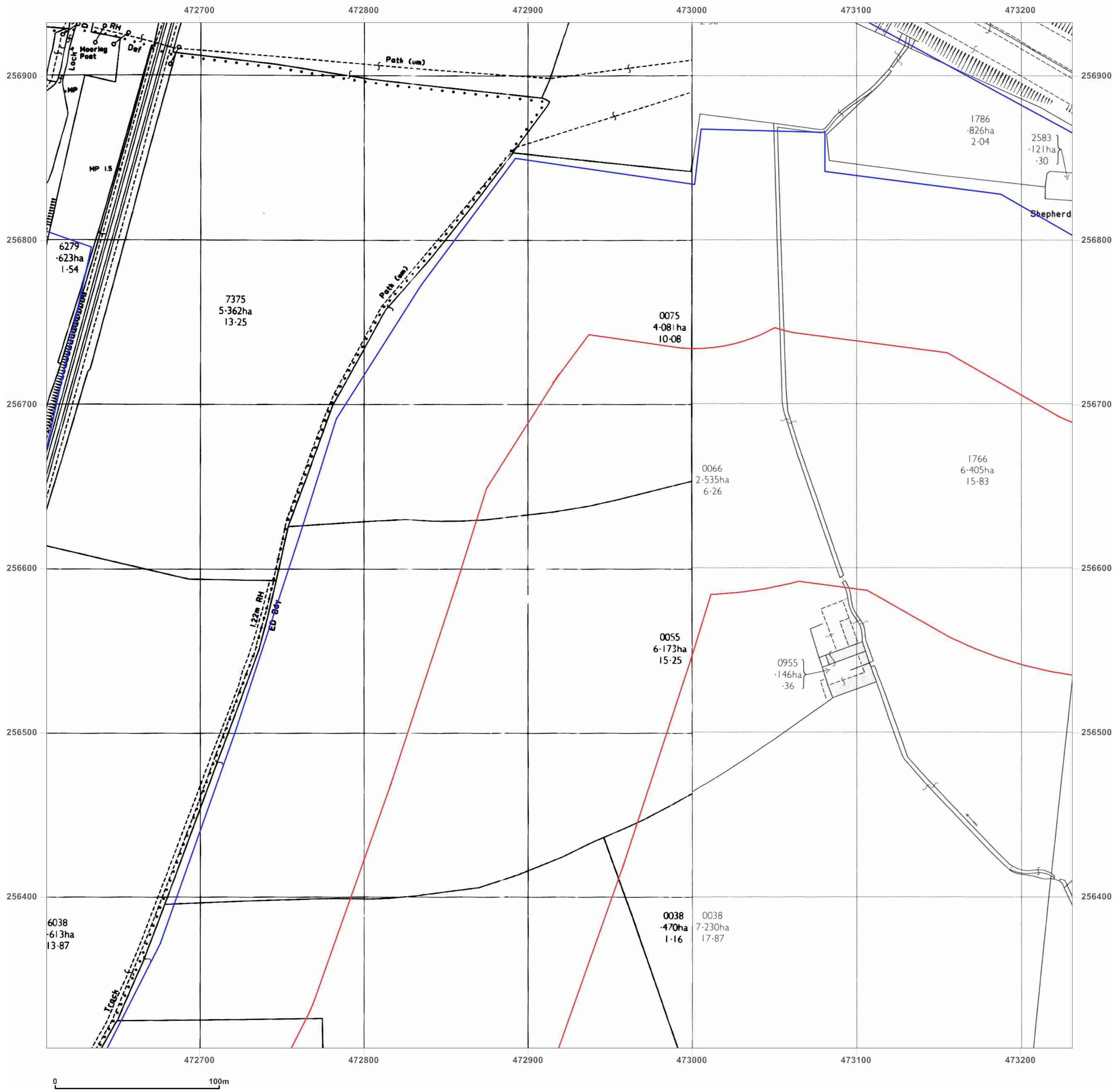
Production date: 19 June 2017

To view map legend click here *Legend*



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_2
Grid Ref: 472919, 256620

Map Name: National Grid

Map date: **1976-1977**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1977
Revised 1977
Edition N/A
Copyright 1979
Levelled 1960

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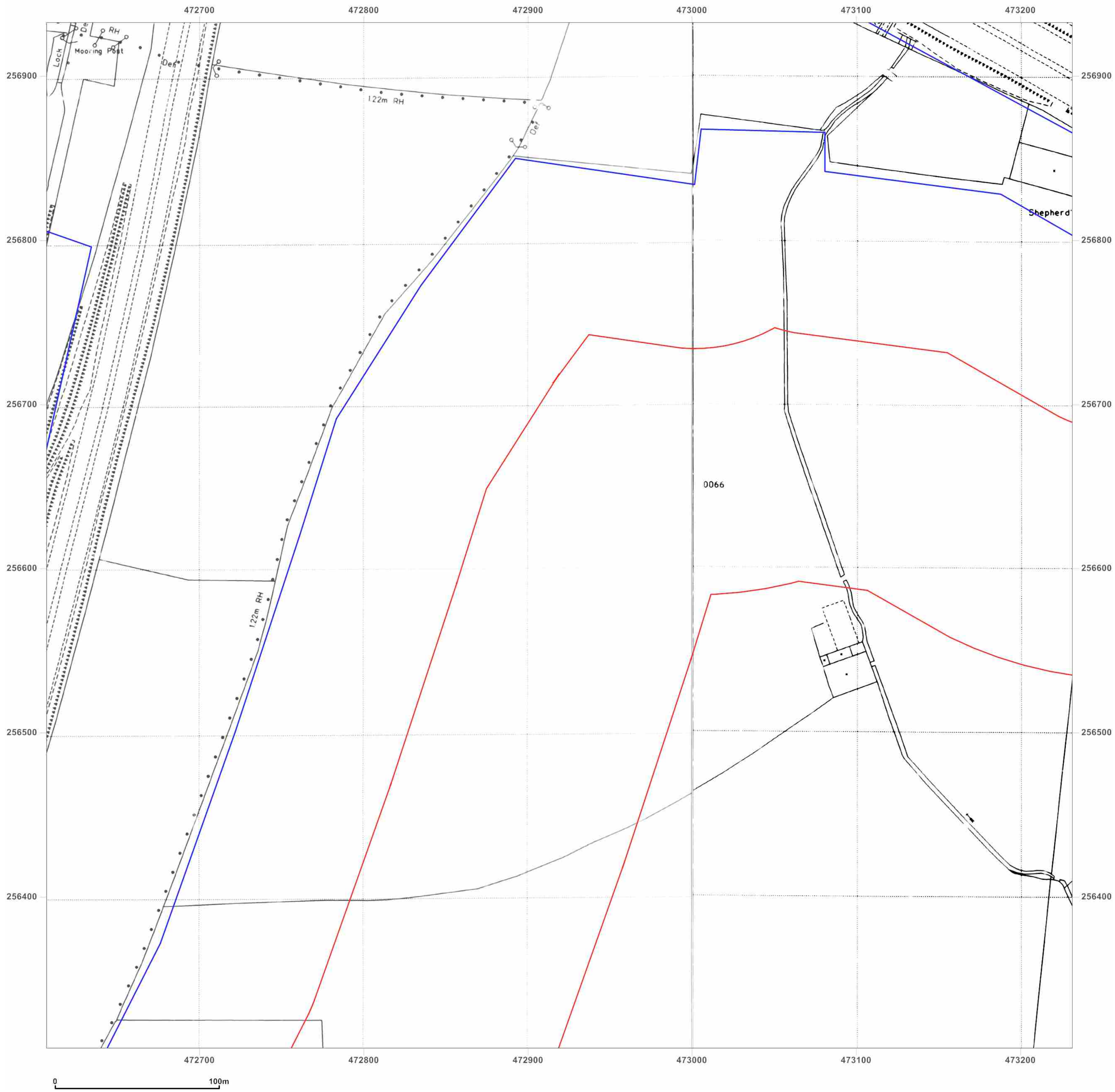
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_2
Grid Ref: 472919, 256620

Map Name: National Grid

Map date: **1993**

Scale: 1:2,500

Printed at: 1:2,500

N W E S

Surveyed 1993
Revised 1993
Edition N/A
Copyright N/A
Levelled N/A

Surveyed N/A
Revised N/A
Edition N/A
Copyright 1993
Levelled N/A

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Production date: 19 June 2017

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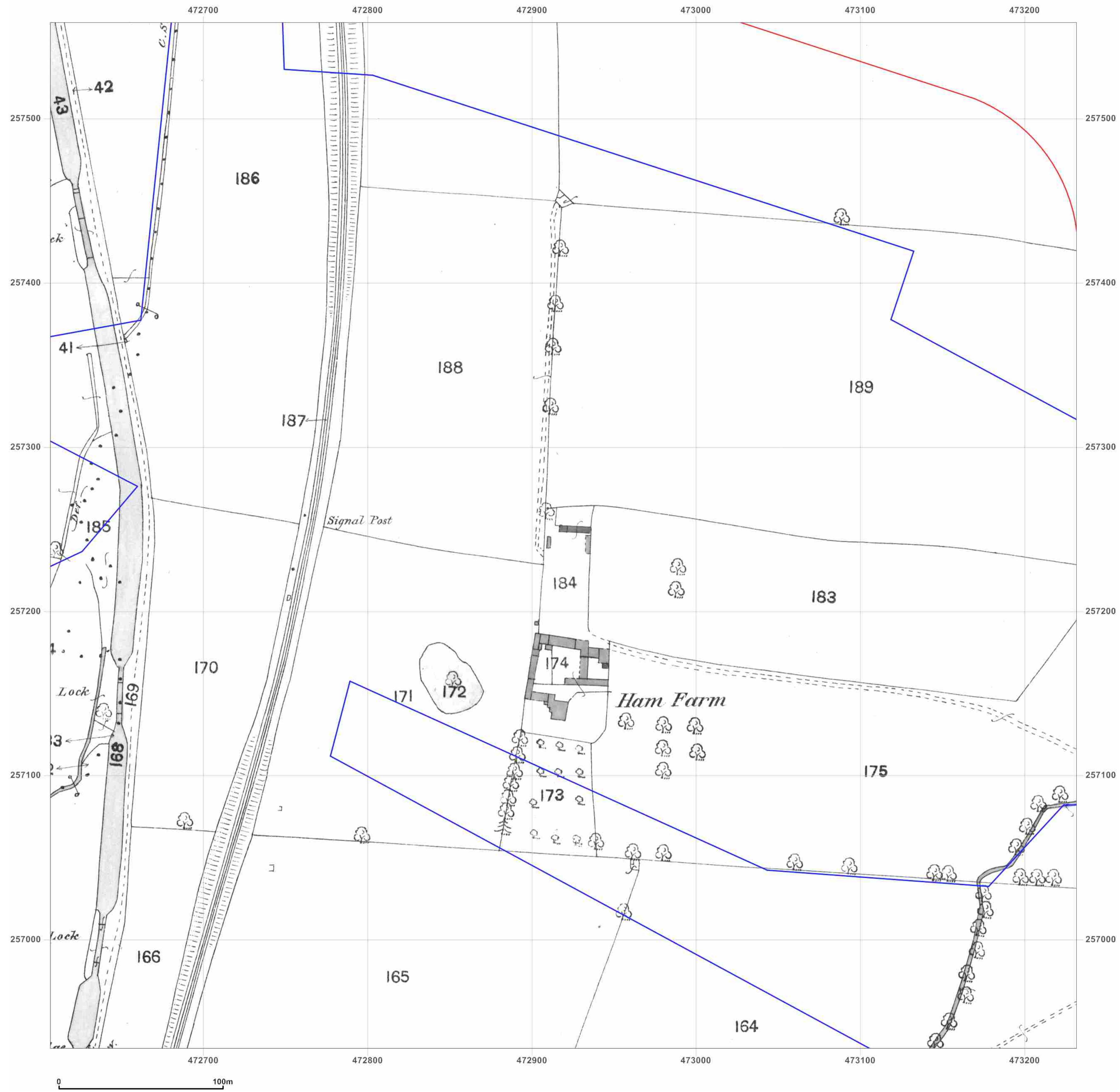

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_3
Grid Ref: 472919, 257246

Map Name: County Series

Map date: **1885**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed 1885
Revised 1885
Edition N/A
Copyright N/A
Levelled N/A

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Production date: 19 June 2017

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Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_3
Grid Ref: 472919, 257246

Map Name: County Series

Map date: 1900

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

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Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_3
Grid Ref: 472919, 257246

Map Name: National Grid

Map date: 1964

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

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Production date: 19 June 2017

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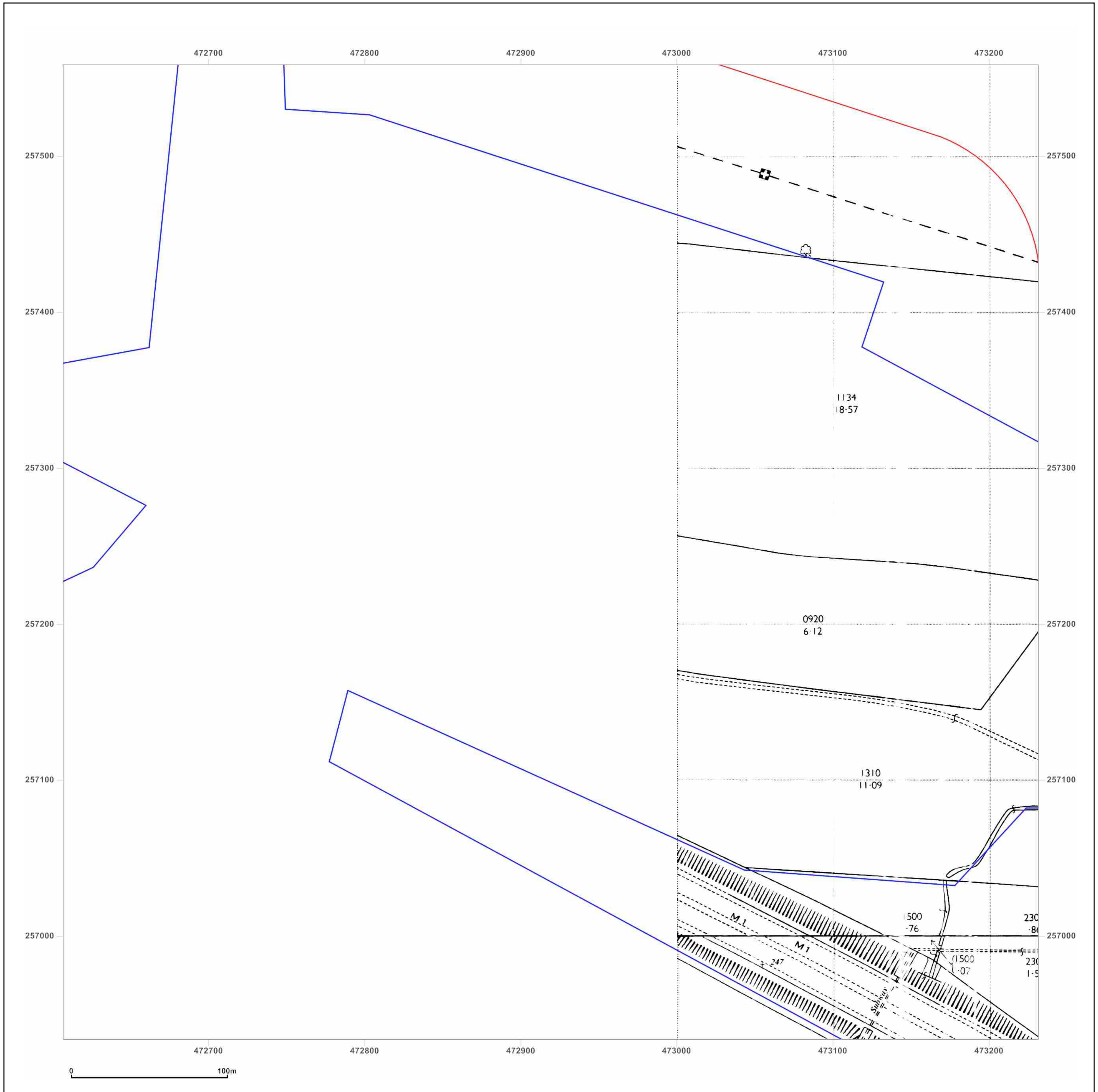

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_3
Grid Ref: 472919, 257246

Map Name: National Grid

Map date: **1965**

Scale: 1:2,500

Printed at: 1:2,500

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

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

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Production date: 19 June 2017

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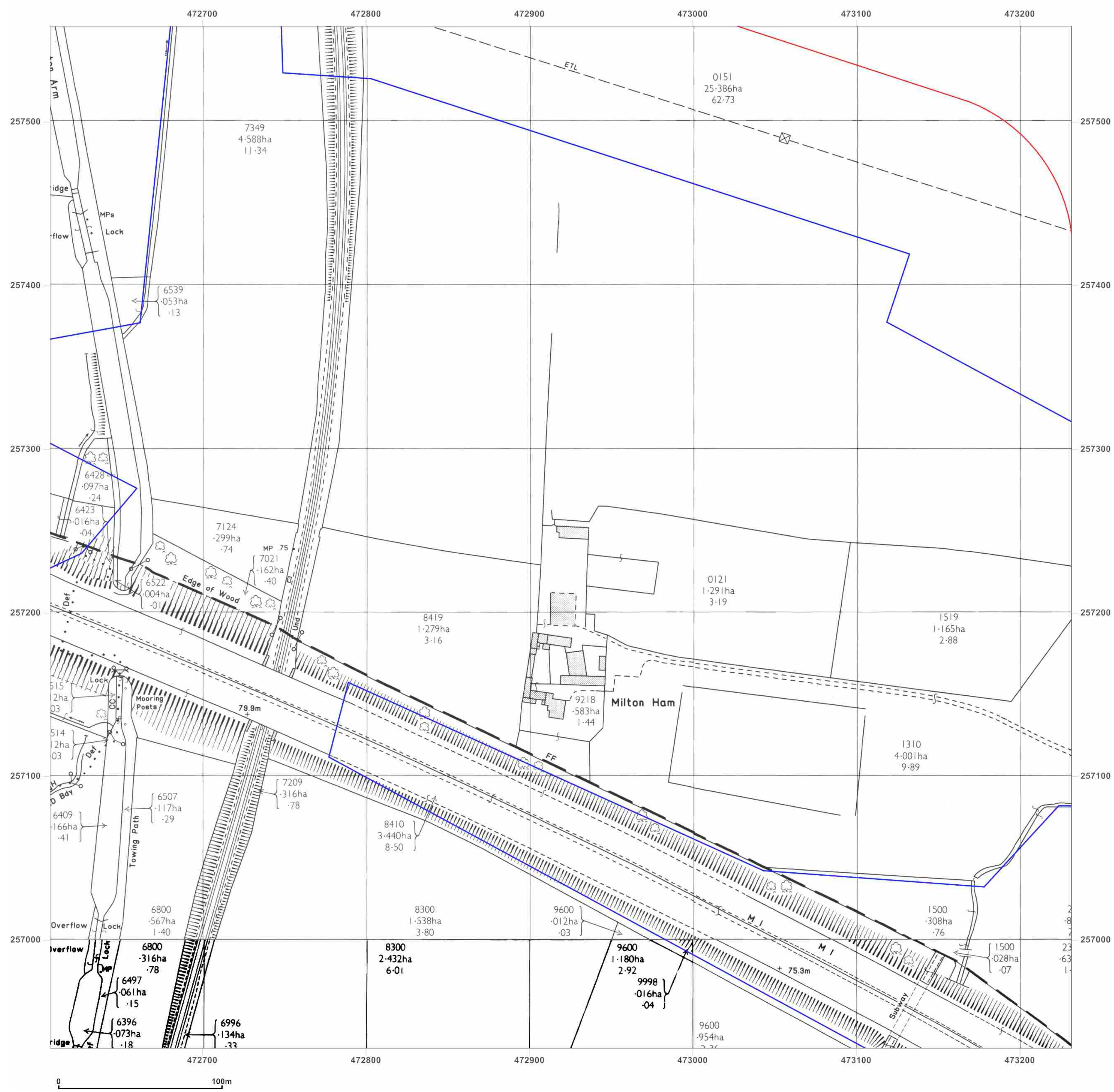

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_3
Grid Ref: 472919, 257246

Map Name: National Grid

Map date: **1976-1977**

Scale: 1:2,500

Printed at: 1:2,500

N
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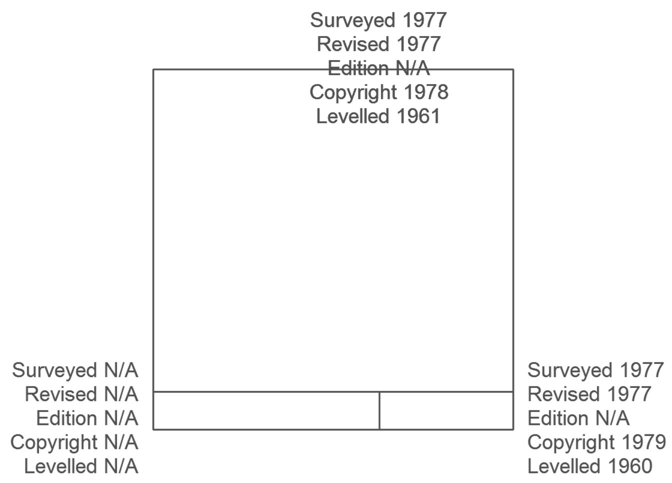

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Production date: 19 June 2017

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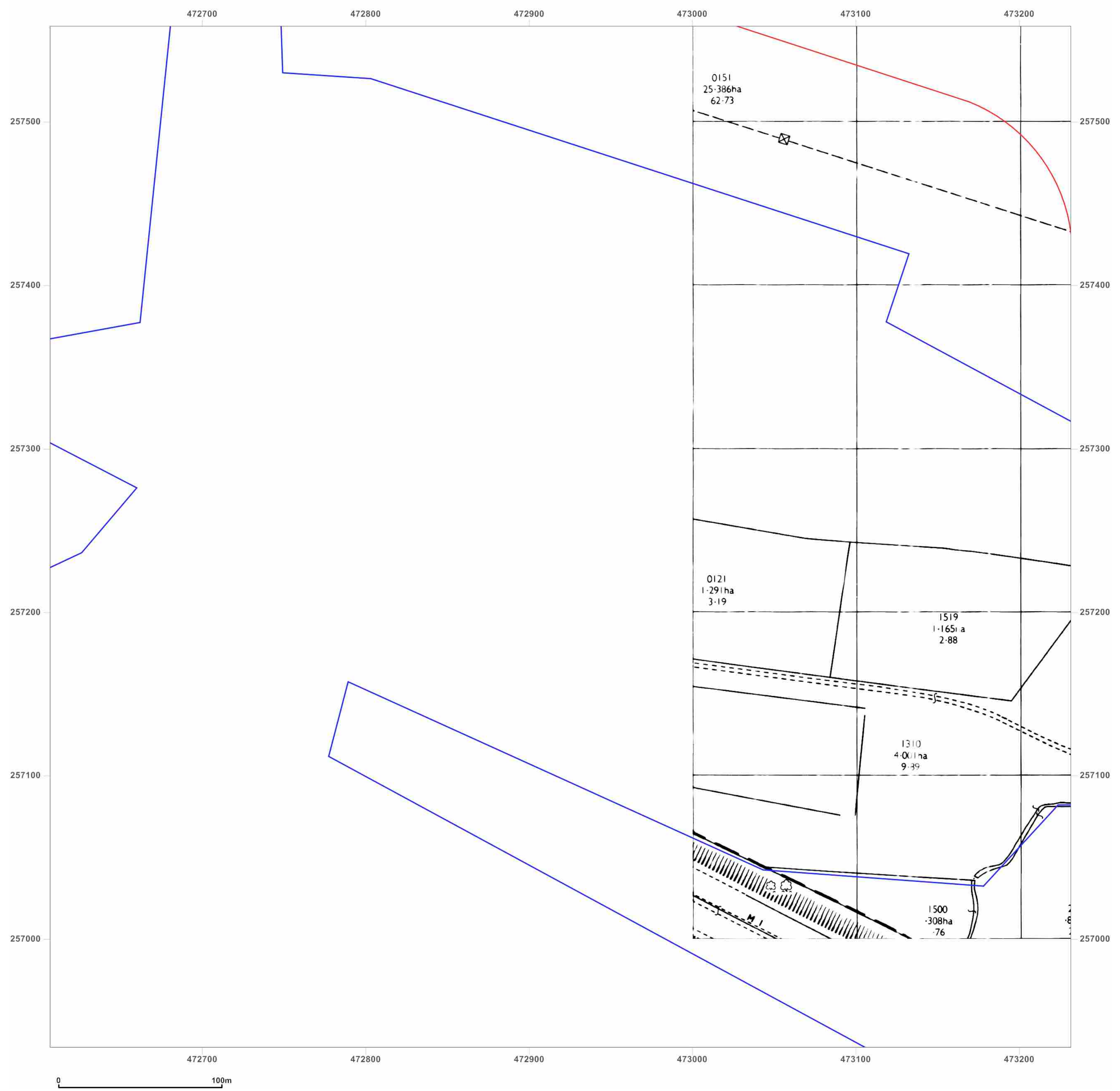

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_3
Grid Ref: 472919, 257246

Map Name: National Grid

Map date: **1978**

Scale: 1:2,500

Printed at: 1:2,500

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

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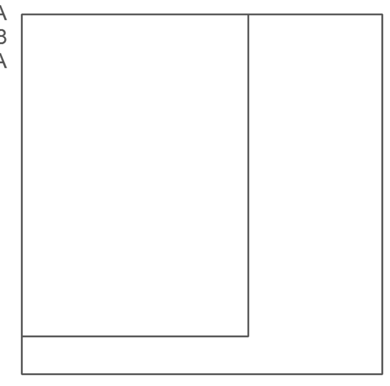

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_3
Grid Ref: 472919, 257246

Map Name: National Grid

Map date: **1988**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1988
Revised 1988
Edition N/A
Copyright 1988
Levelled N/A

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Production date: 19 June 2017

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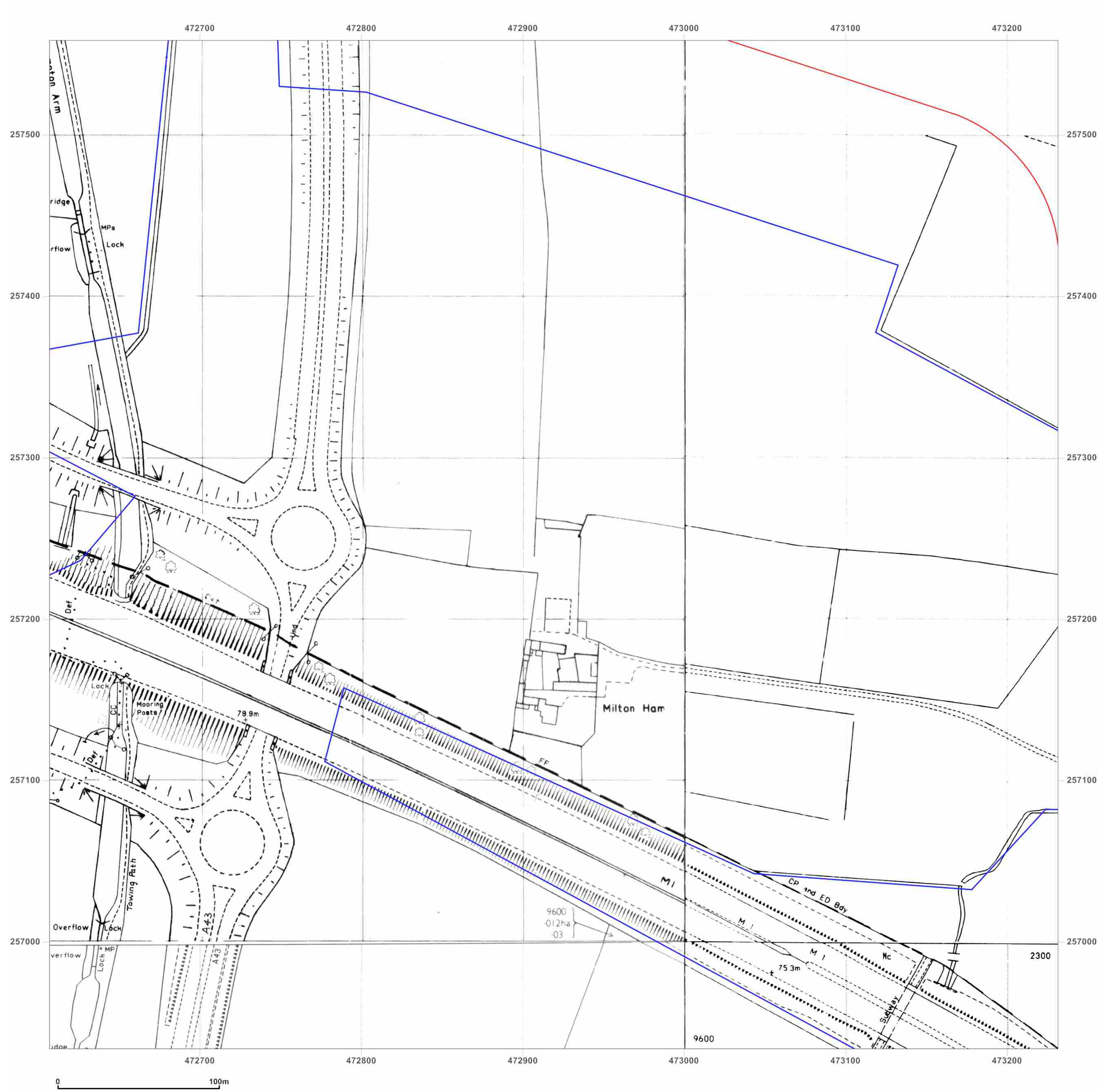

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_3
Grid Ref: 472919, 257246

Map Name: National Grid

Map date: **1992-1993**

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1986 Revised 1992 Edition N/A Copyright 1992 Levelled 1986	Surveyed N/A Revised N/A Edition N/A Copyright 1993 Levelled N/A
Surveyed 1993 Revised 1993 Edition N/A Copyright N/A Levelled N/A	Surveyed N/A Revised N/A Edition N/A Copyright 1993 Levelled N/A

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Production date: 19 June 2017

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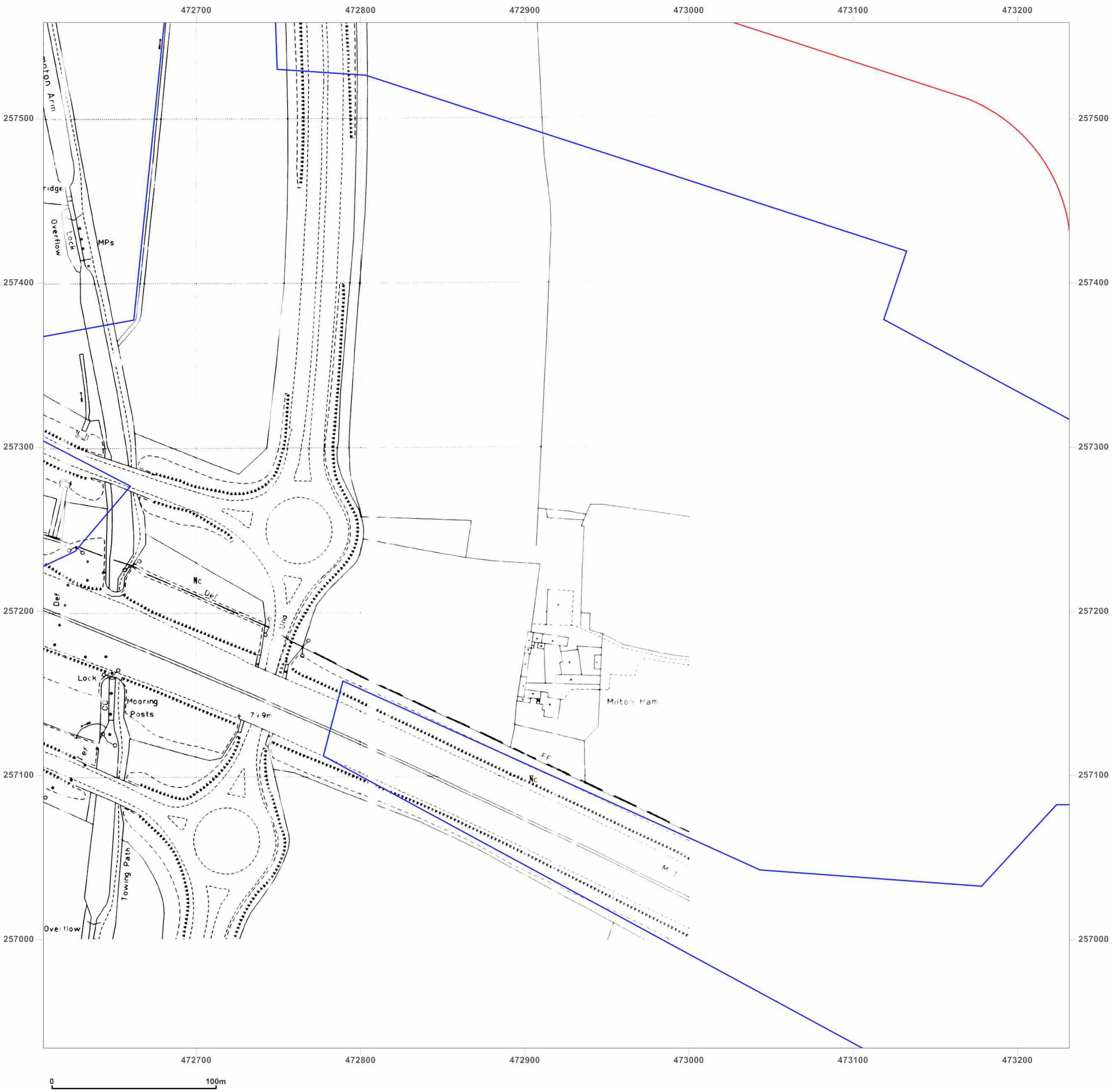

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_3
Grid Ref: 472919, 257246

Map Name: National Grid

Map date: 1993

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed N/A
Revised N/A
Edition N/A
Copyright 1993
Levelled N/A

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Production date: 19 June 2017

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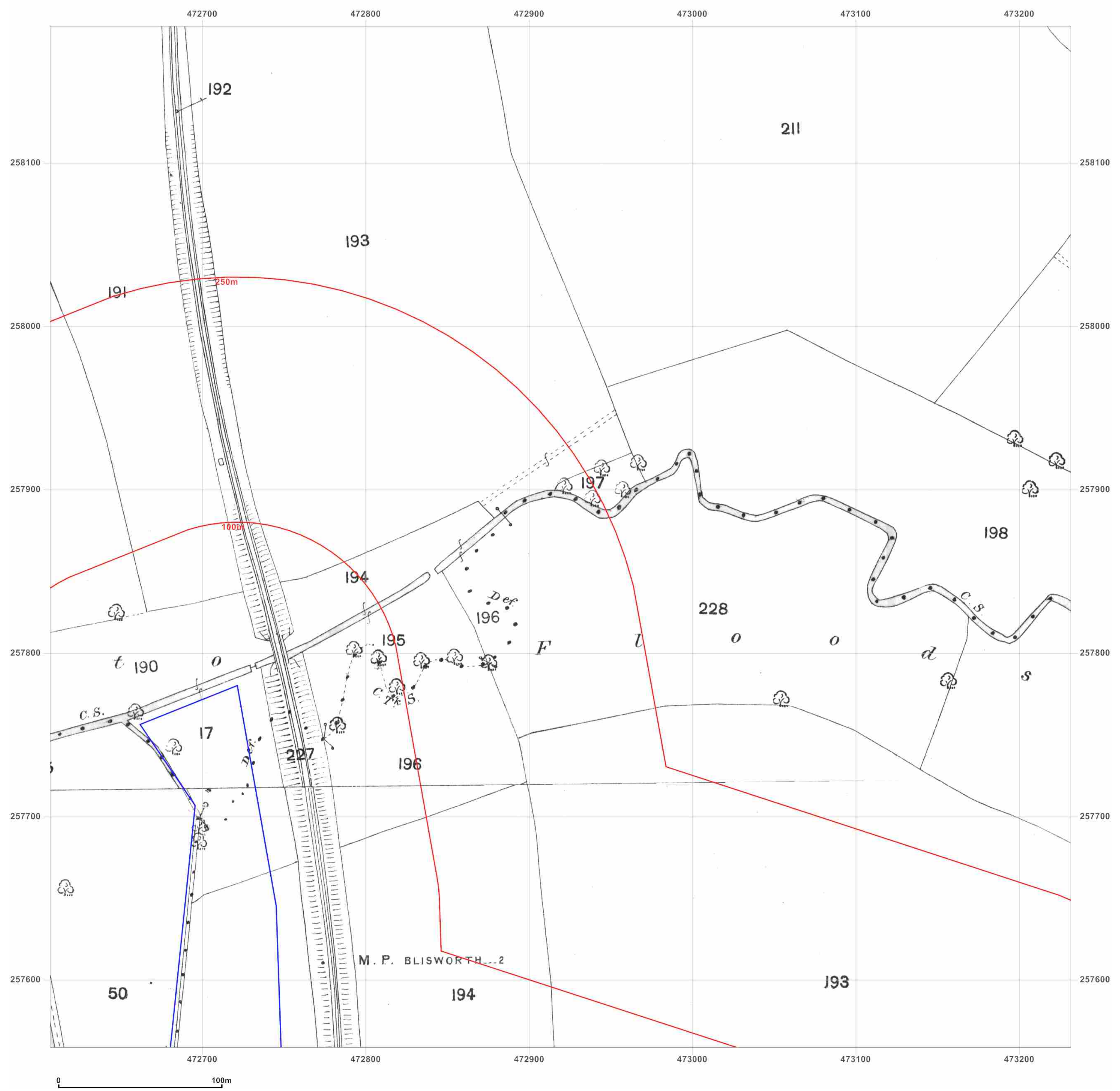

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_4
Grid Ref: 472919, 257871

Map Name: County Series

Map date: **1885-1886**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed 1886
Revised 1886
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1885
Revised 1885
Edition N/A
Copyright N/A
Levelled N/A

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Production date: 19 June 2017

To view map legend click here *Legend*

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_4
Grid Ref: 472919, 257871

Map Name: County Series

Map date: 1900

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

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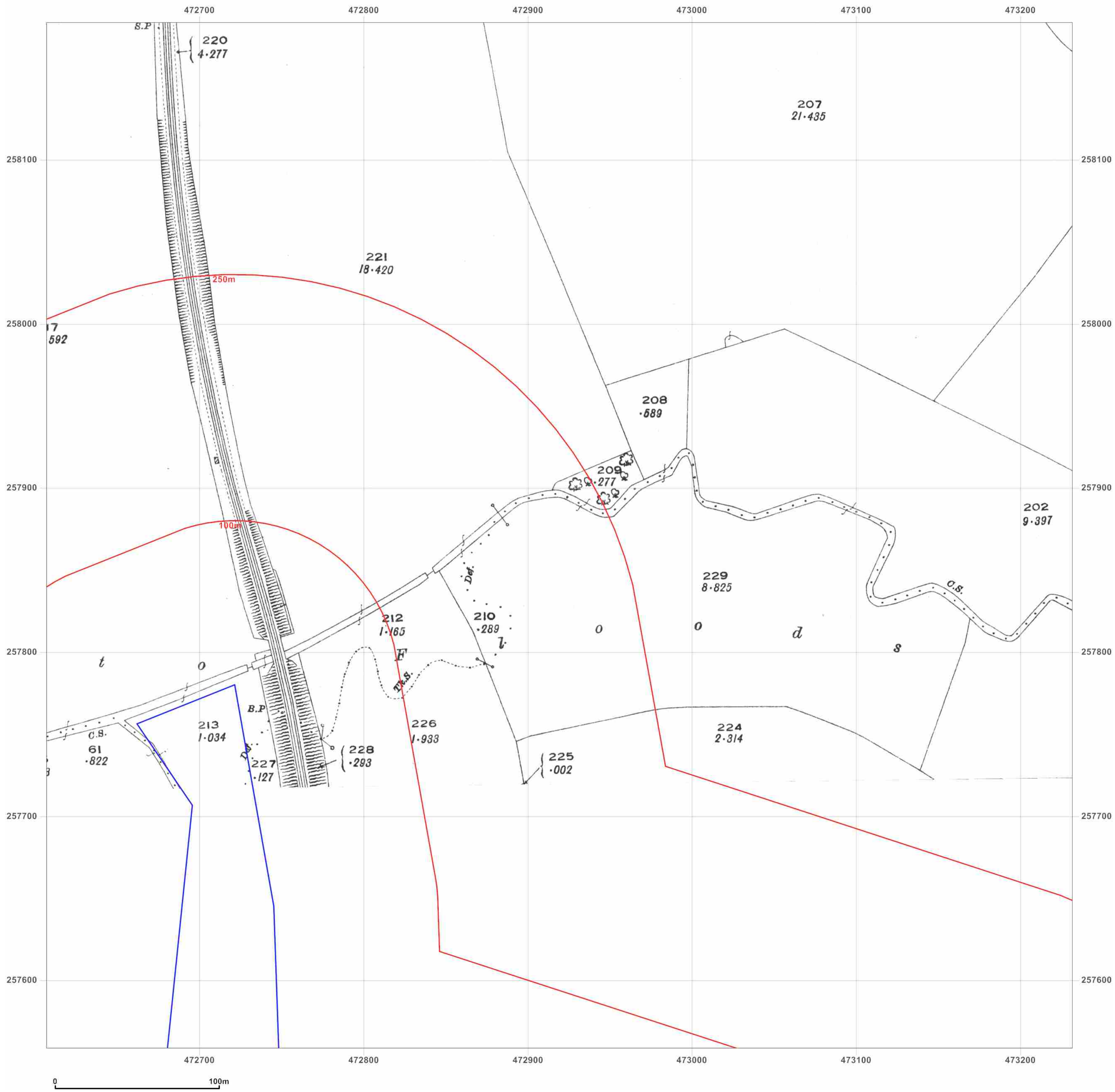
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_4
Grid Ref: 472919, 257871

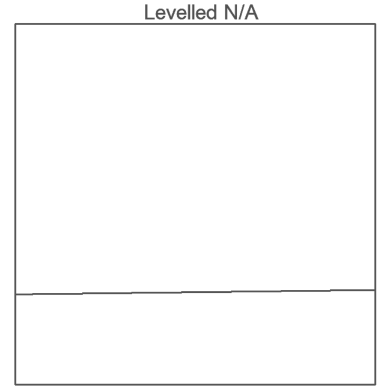
Map Name: County Series

Map date: **1925**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S



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Production date: 19 June 2017

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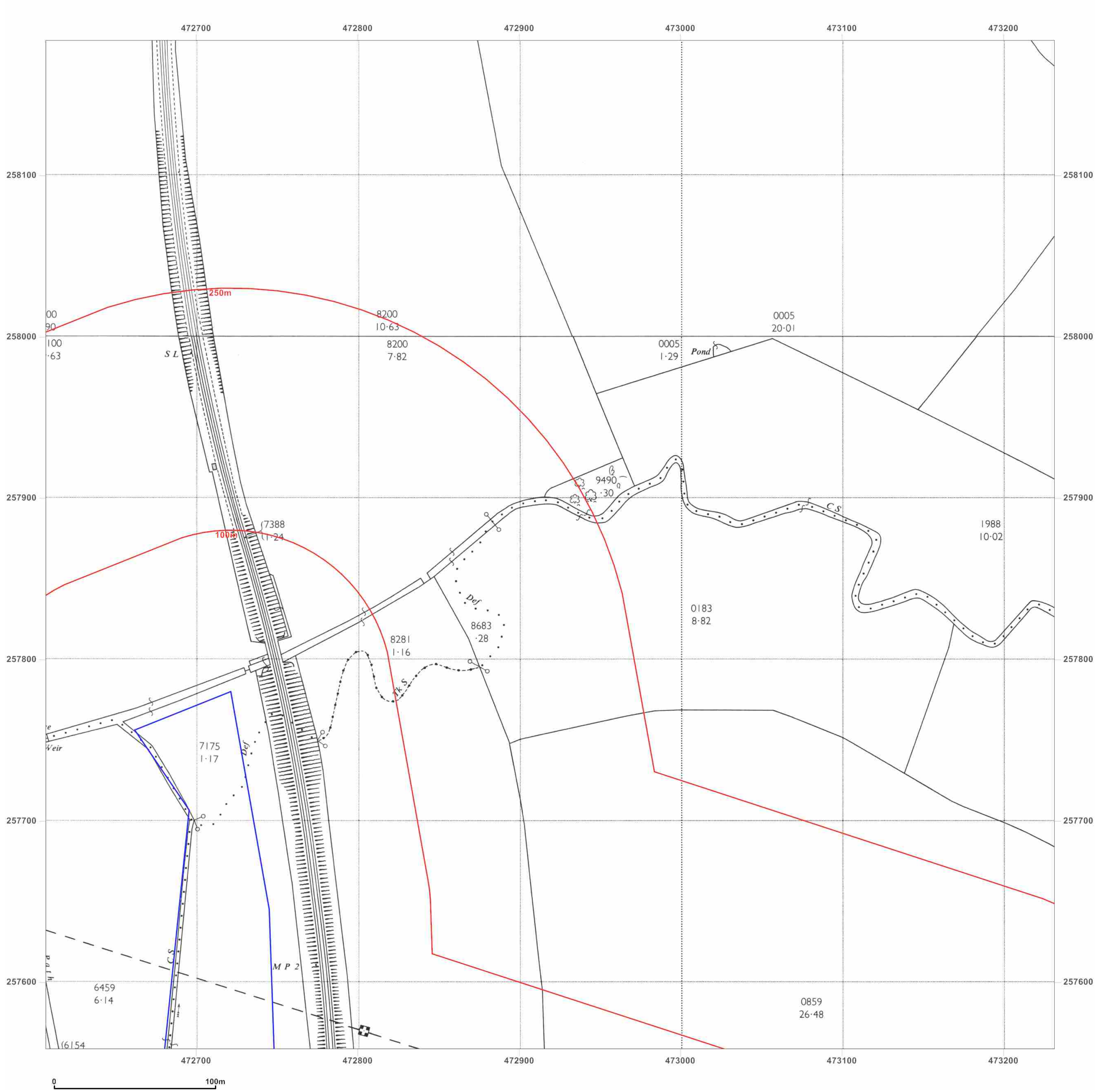

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_4
Grid Ref: 472919, 257871

Map Name: National Grid

Map date: 1964

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

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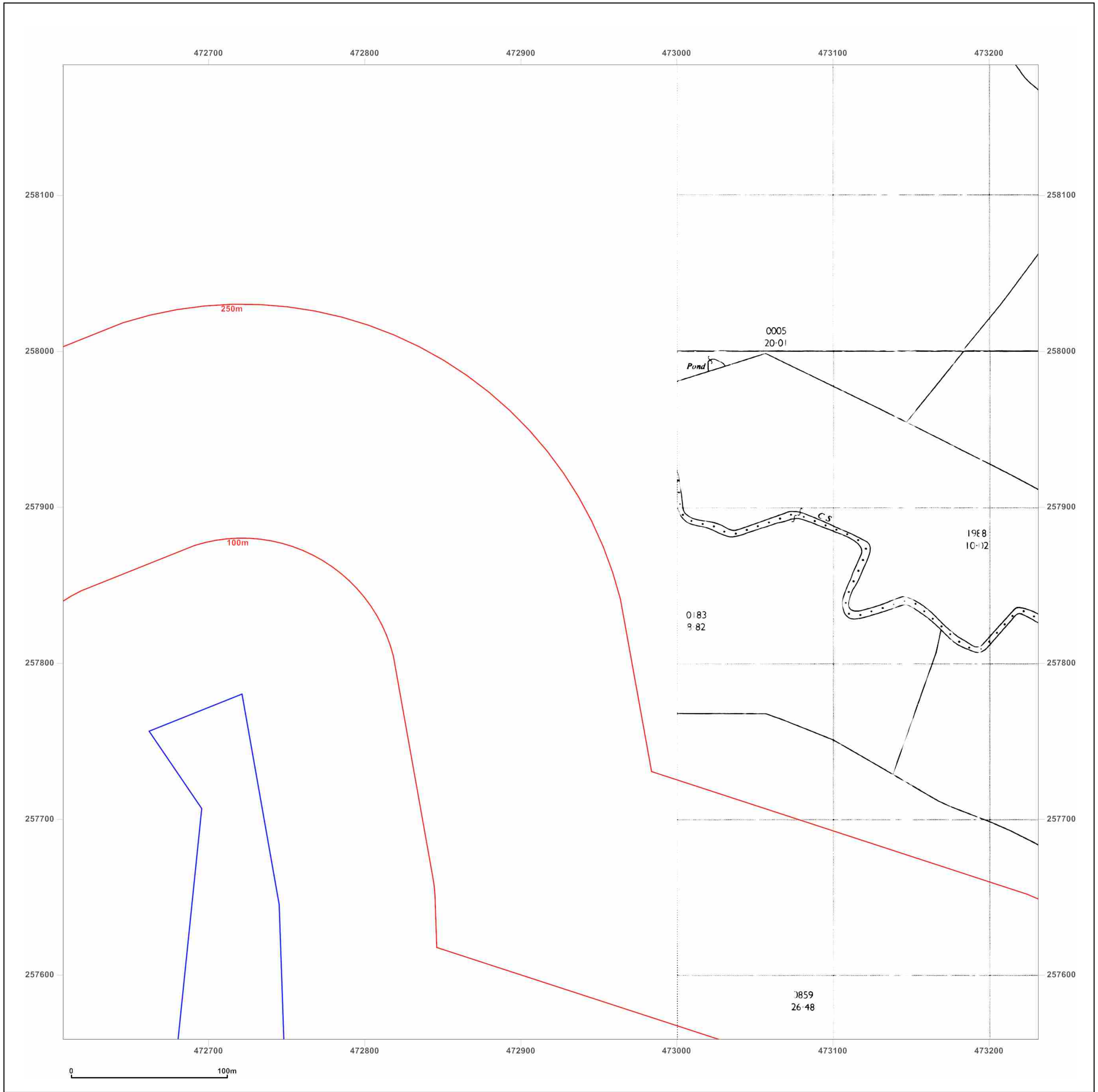
To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_4
Grid Ref: 472919, 257871

Map Name: National Grid

Map date: 1965

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

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

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

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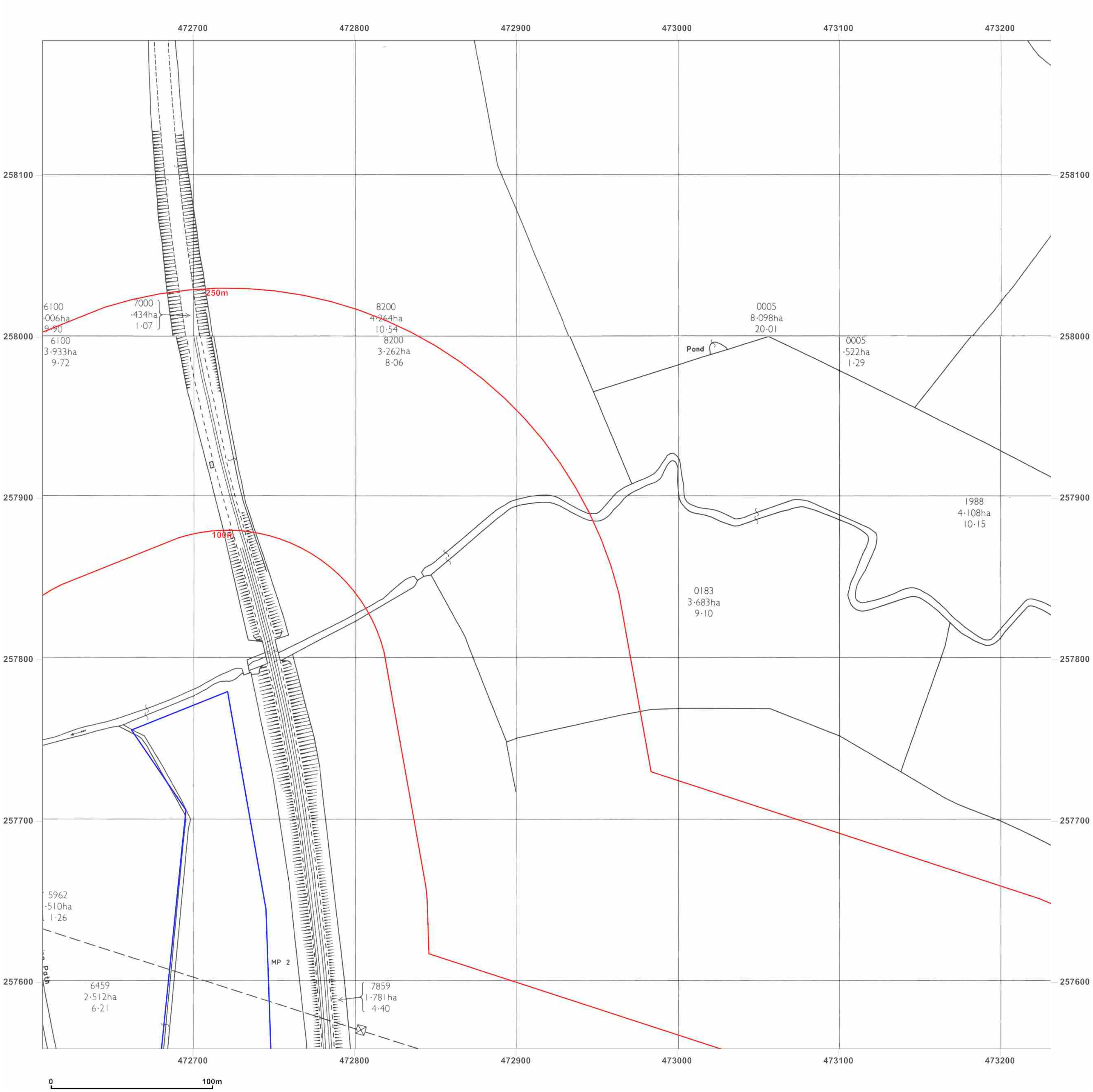
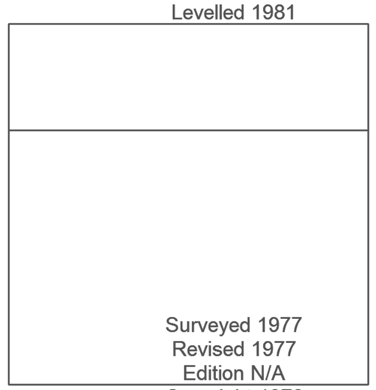
Production date: 19 June 2017

To view map legend click here *Legend*





Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_4
Grid Ref: 472919, 257871

Map Name: National Grid

Map date: 1977-1978

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1978
Revised 1978
Edition N/A
Copyright 1980
Levelled 1981

Surveyed 1977
Revised 1977
Edition N/A
Copyright 1978
Levelled 1961

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Production date: 19 June 2017

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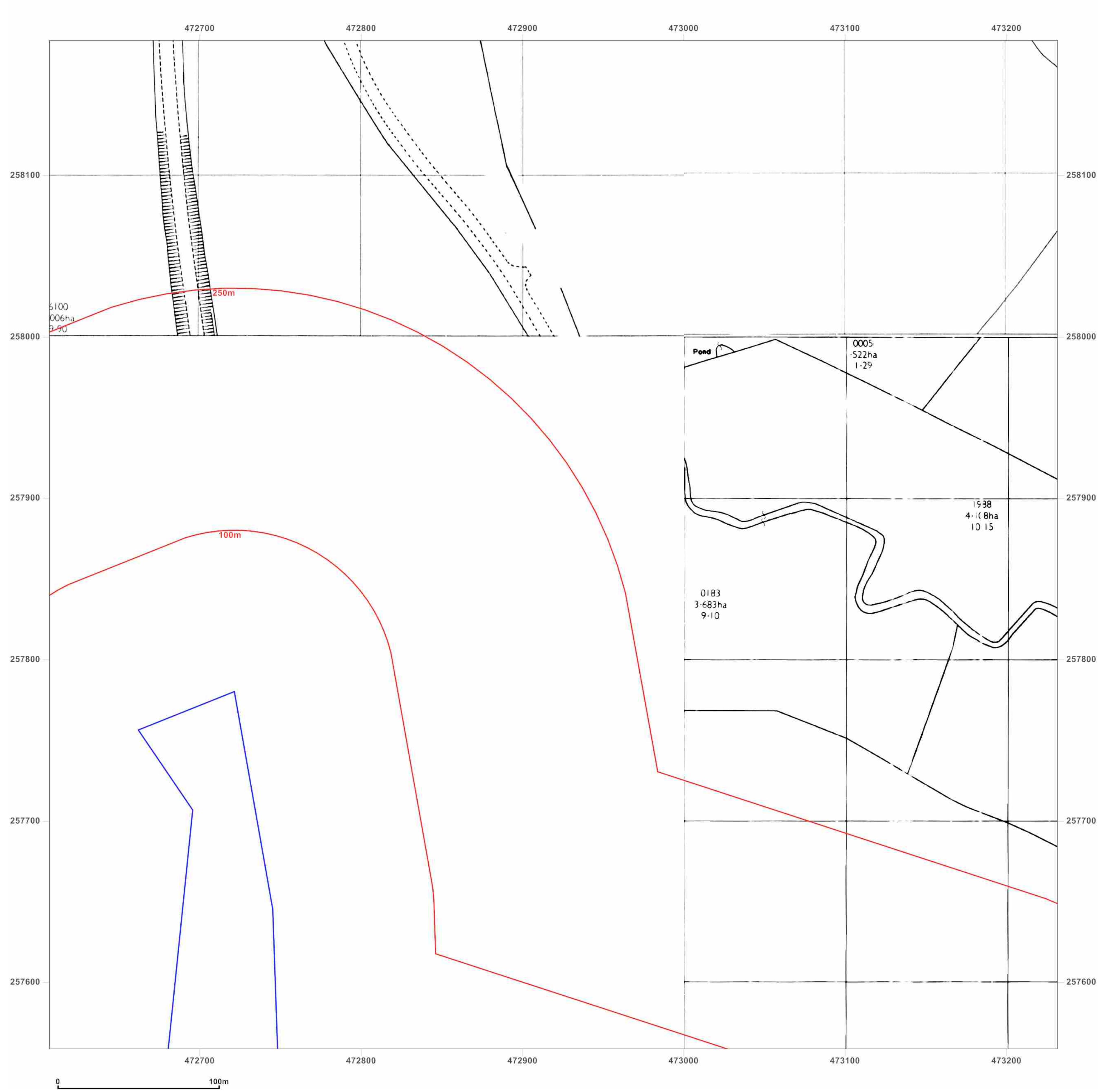

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_4
Grid Ref: 472919, 257871

Map Name: National Grid

Map date: **1978-1982**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1961
Revised 1982
Edition N/A
Copyright 1982
Levelled 1961

Surveyed 1961
Revised 1982
Edition N/A
Copyright 1982
Levelled 1961

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

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Production date: 19 June 2017

To view map legend click here *Legend*

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_4
Grid Ref: 472919, 257871

Map Name: National Grid

Map date: **1992**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1986
Revised 1992
Edition N/A
Copyright 1992
Levelled 1986

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Production date: 19 June 2017

To view map legend click here *Legend*

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_4
Grid Ref: 472919, 257871

Map Name: National Grid

Map date: 1988-1993

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1988
Revised 1988
Edition N/A
Copyright 1988
Levelled N/A

Surveyed N/A
Revised N/A
Edition N/A
Copyright 1993
Levelled N/A

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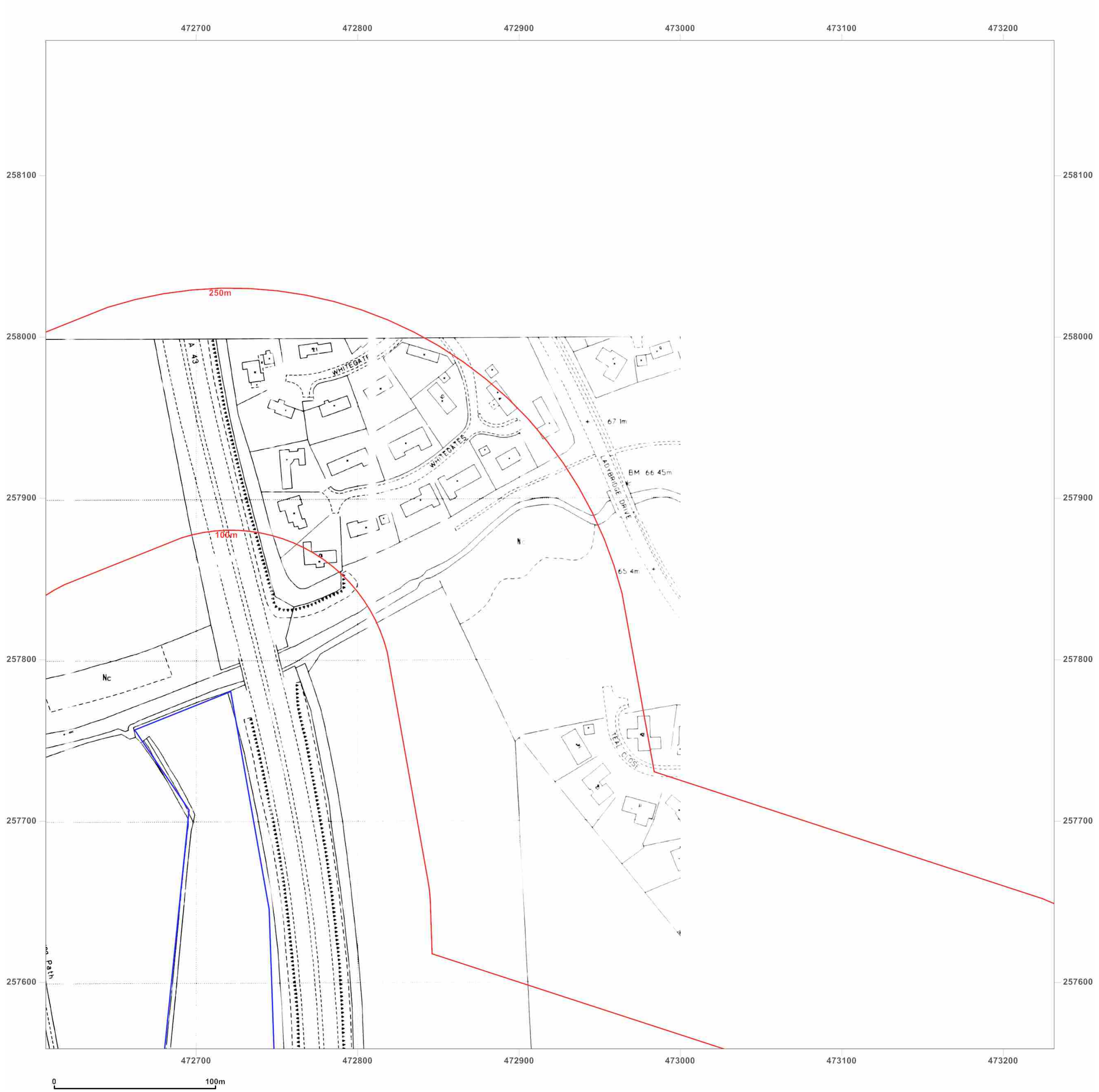
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_3_4
Grid Ref: 472919, 257871

Map Name: National Grid

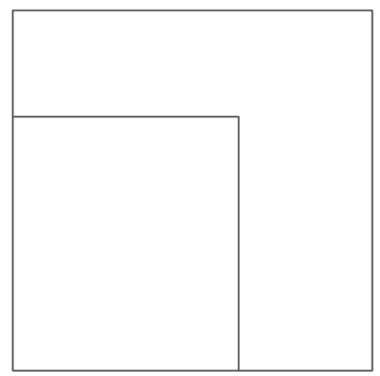
Map date: 1993

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed N/A
Revised N/A
Edition N/A
Copyright 1993
Levelled N/A



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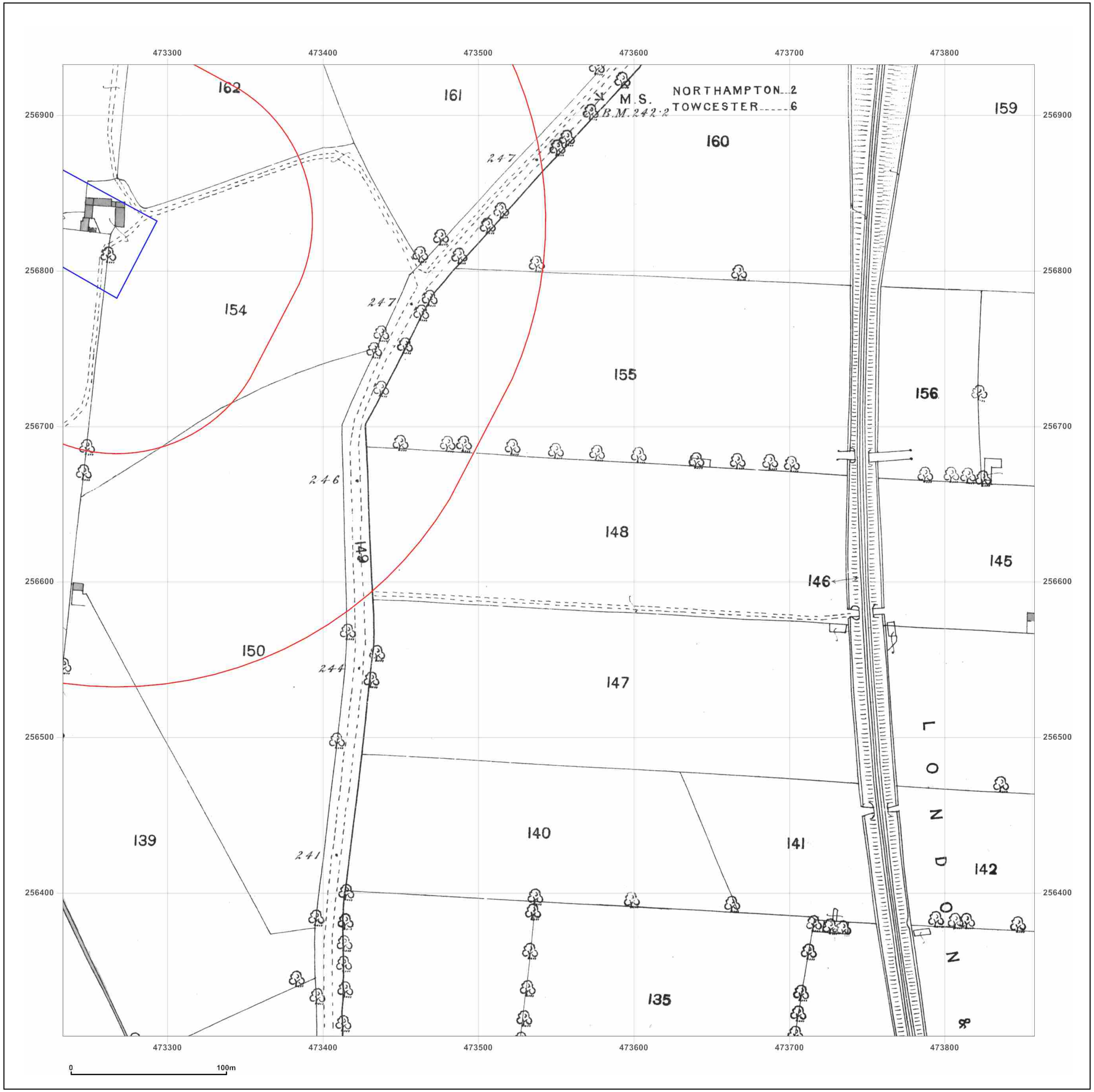
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_2
Grid Ref: 473545, 256620

Map Name: County Series

Map date: 1885

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1885
Revised 1885
Edition N/A
Copyright N/A
Levelled N/A

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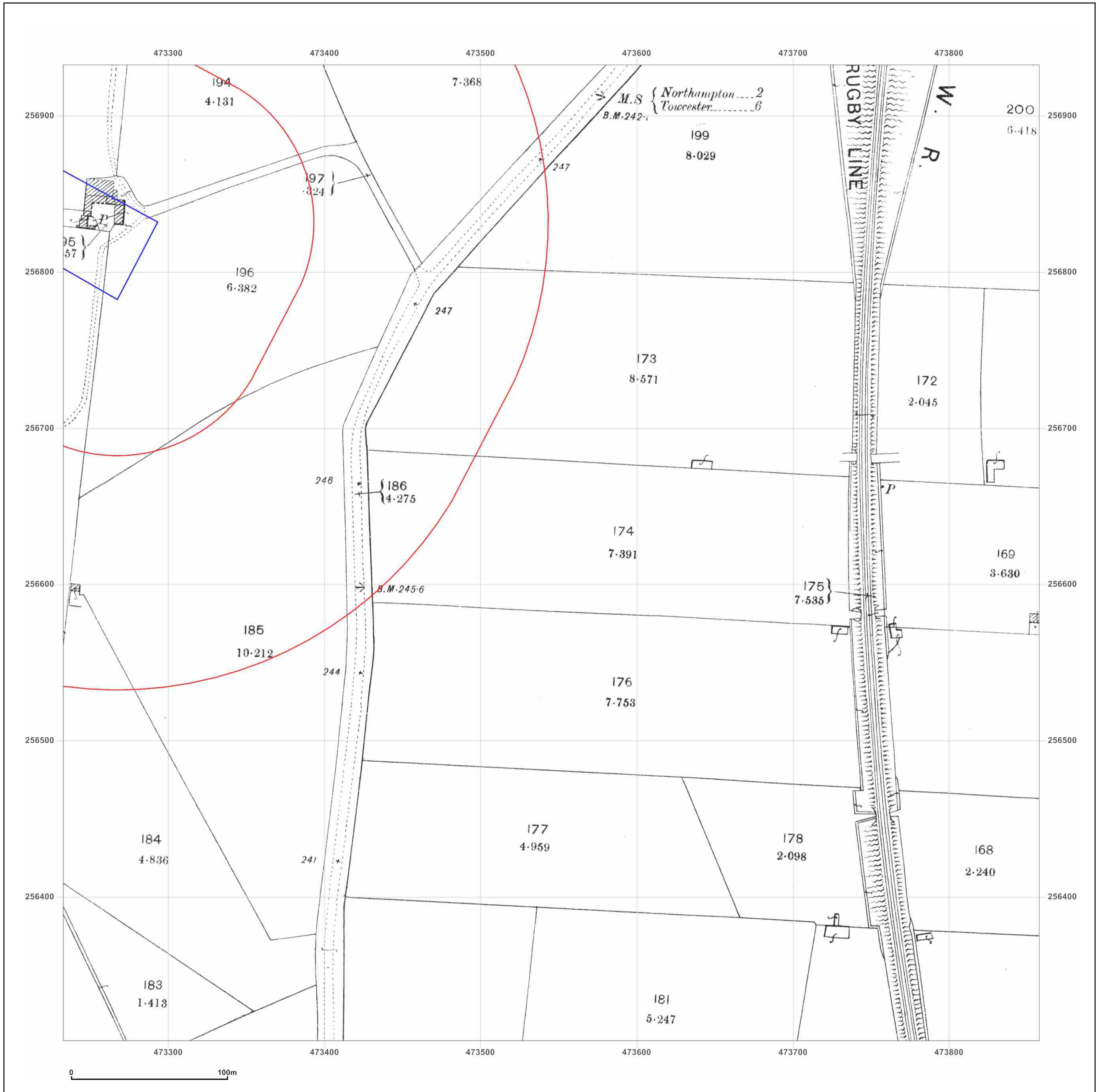
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure
INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_2
Grid Ref: 473545, 256620

Map Name: County Series

Map date: 1900

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

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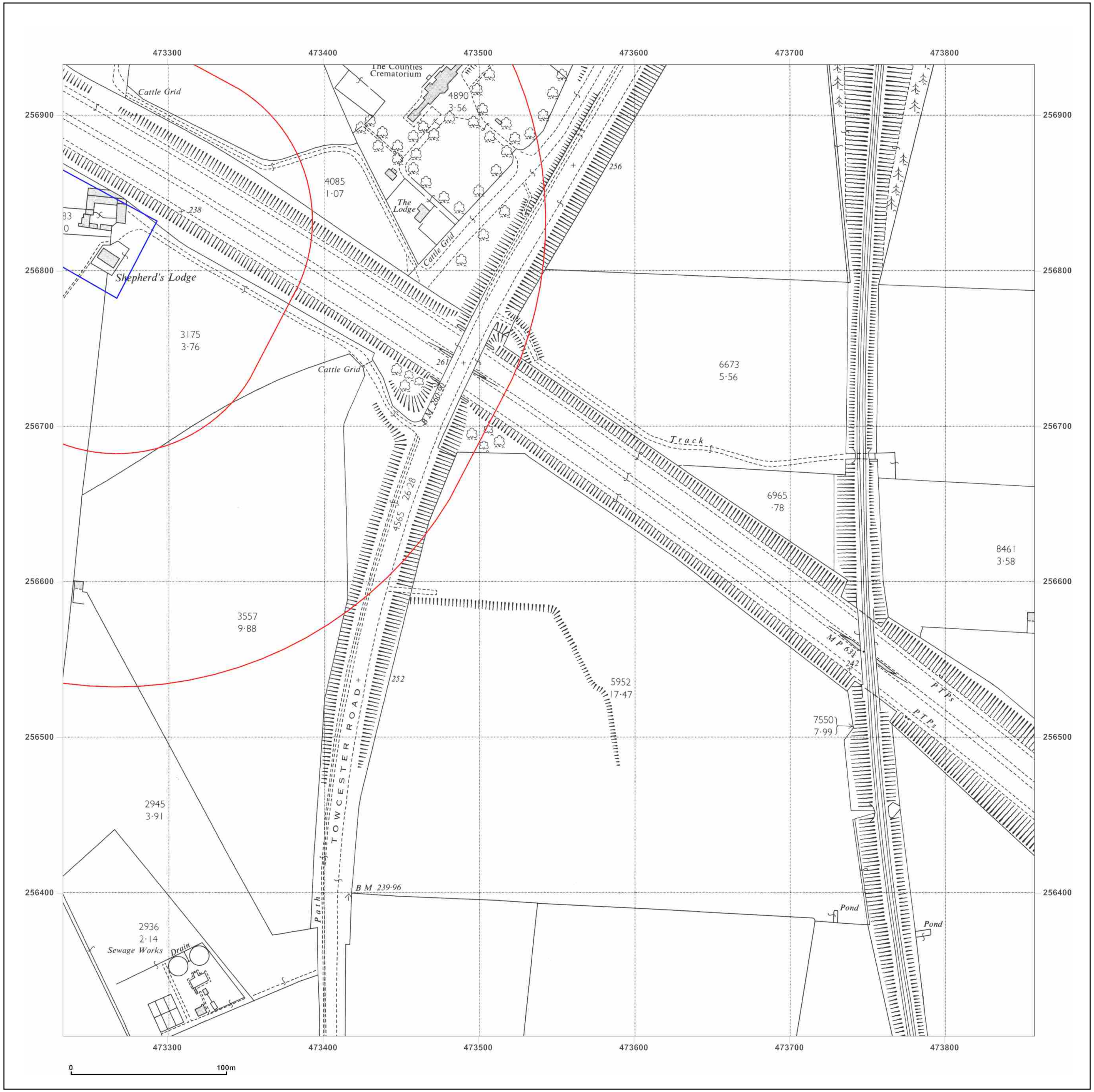
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_2
Grid Ref: 473545, 256620

Map Name: National Grid

Map date: 1964

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

Powered by

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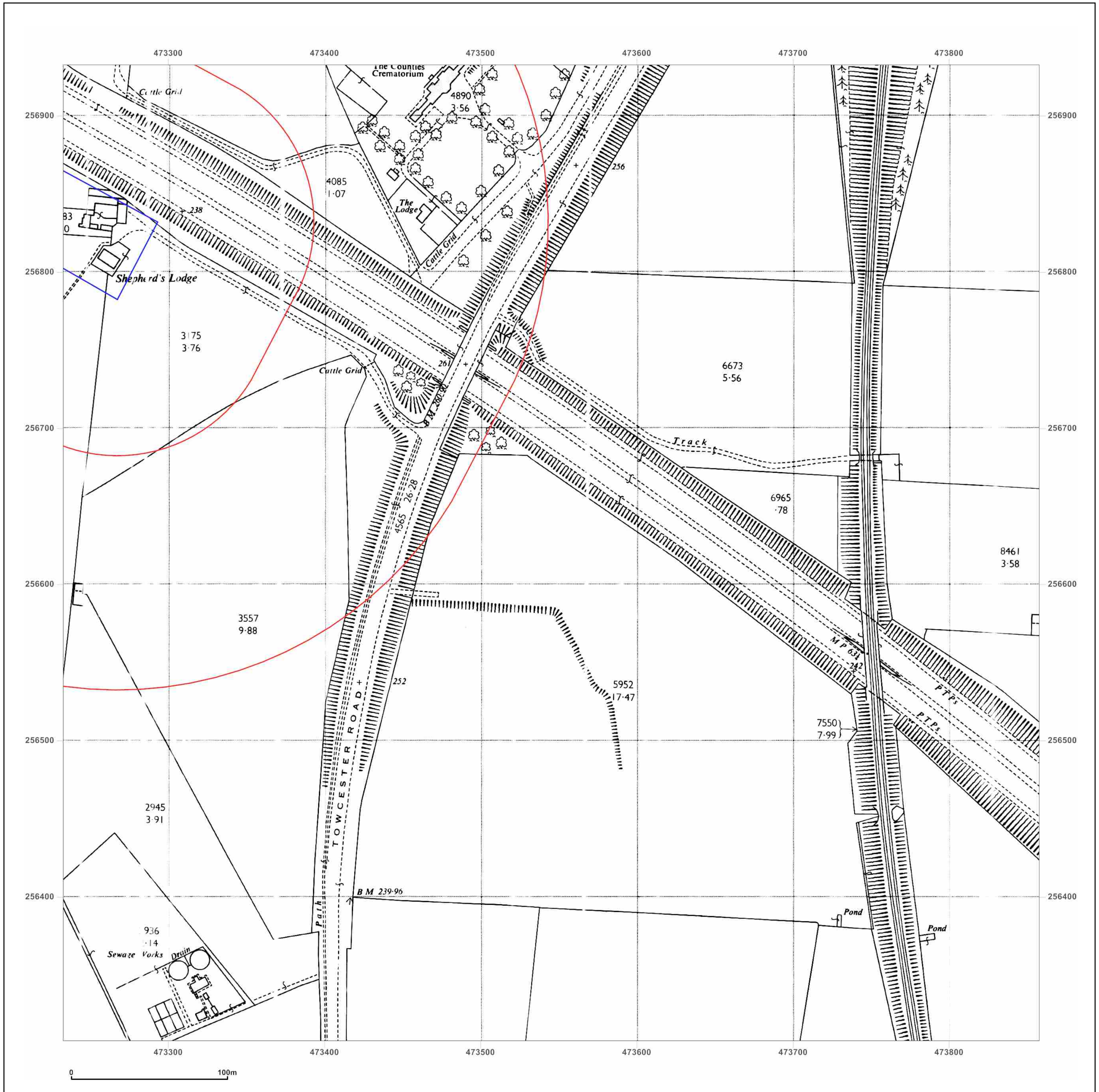
Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_2
Grid Ref: 473545, 256620

Map Name: National Grid

Map date: 1965

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

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

Powered by

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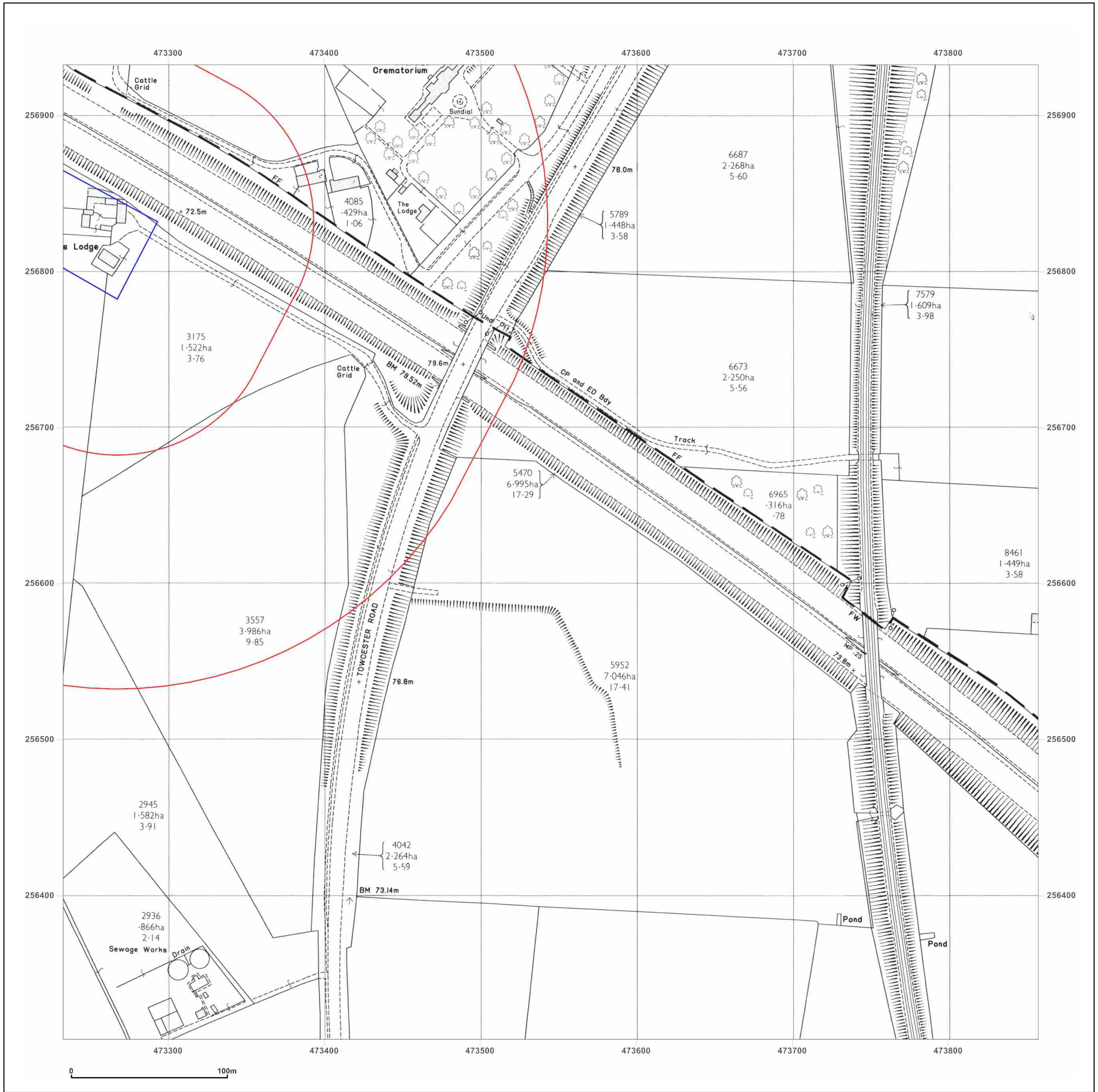
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_2
Grid Ref: 473545, 256620

Map Name: National Grid

Map date: 1977

Scale: 1:2,500

Printed at: 1:2,500

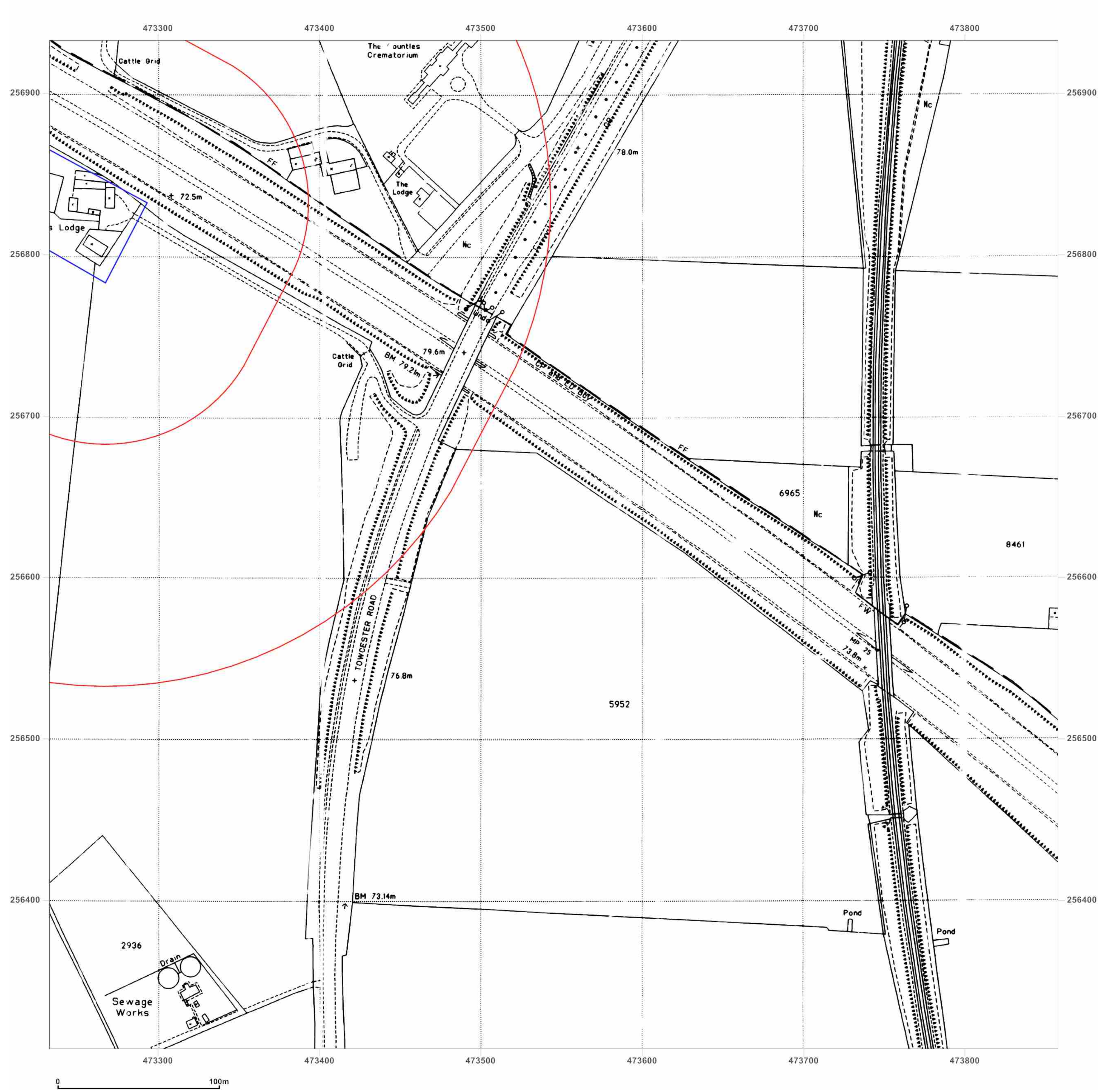
Surveyed 1977
Revised 1977
Edition N/A
Copyright 1979
Levelled 1960

Powered by

Produced by
Groundsure Insights
T: 08444 159000
E: info@groundsure.com
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here Legend



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_2
Grid Ref: 473545, 256620

Map Name: National Grid

Map date: 1993

Scale: 1:2,500

Printed at: 1:2,500

N W E S

Surveyed N/A
Revised N/A
Edition N/A
Copyright 1993
Levelled N/A

Powered by

Produced by
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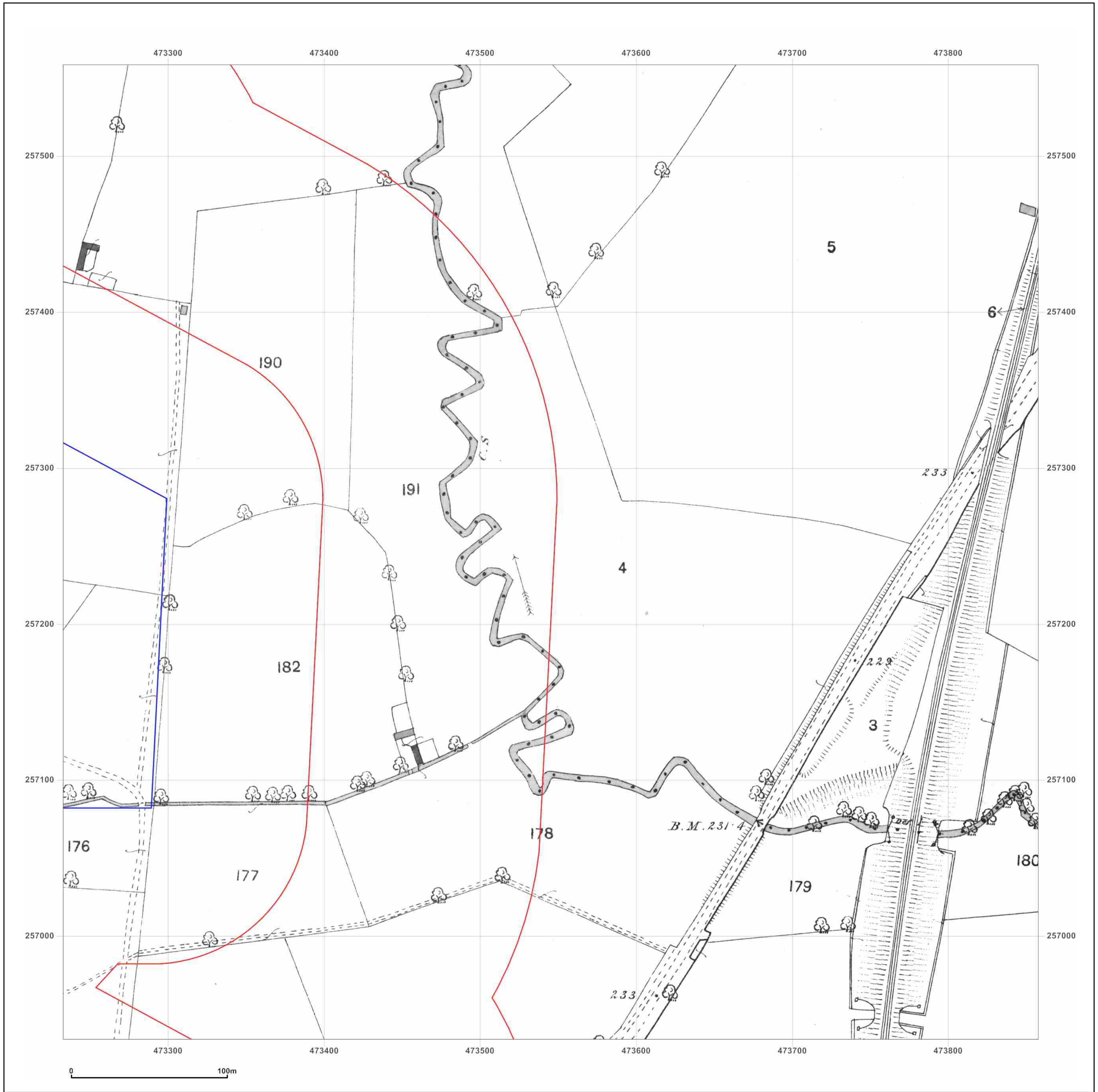
T: 08444 159000
E: info@groundsure.com
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_3
Grid Ref: 473545, 257246

Map Name: County Series

Map date: **1885**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

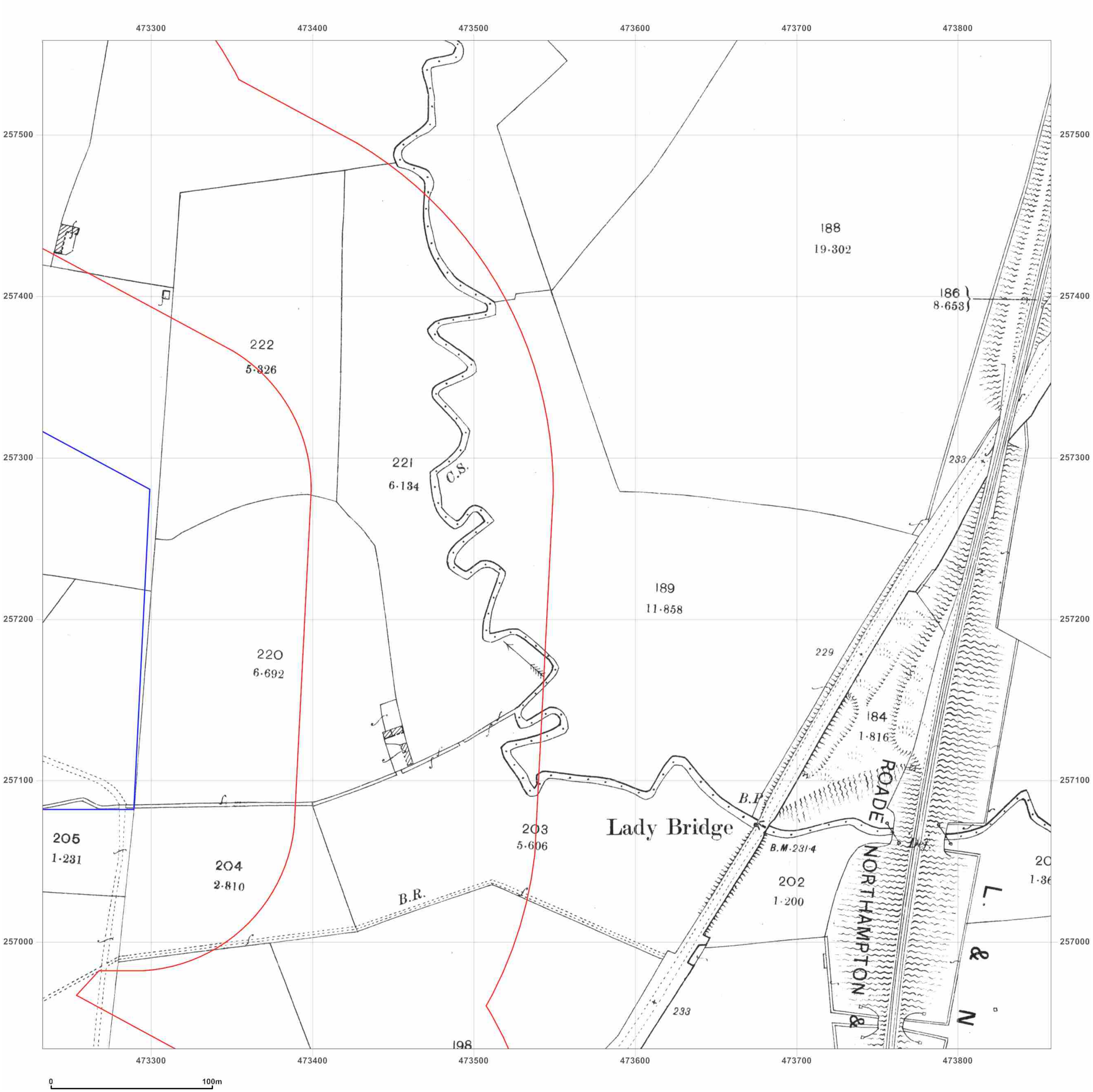
Surveyed 1885
Revised 1885
Edition N/A
Copyright N/A
Levelled N/A

Powered by OS

Produced by
Groundsure Insights
T: 08444 159000
E: info@groundsure.com
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_3
Grid Ref: 473545, 257246

Map Name: County Series

Map date: **1900**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

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Production date: 19 June 2017

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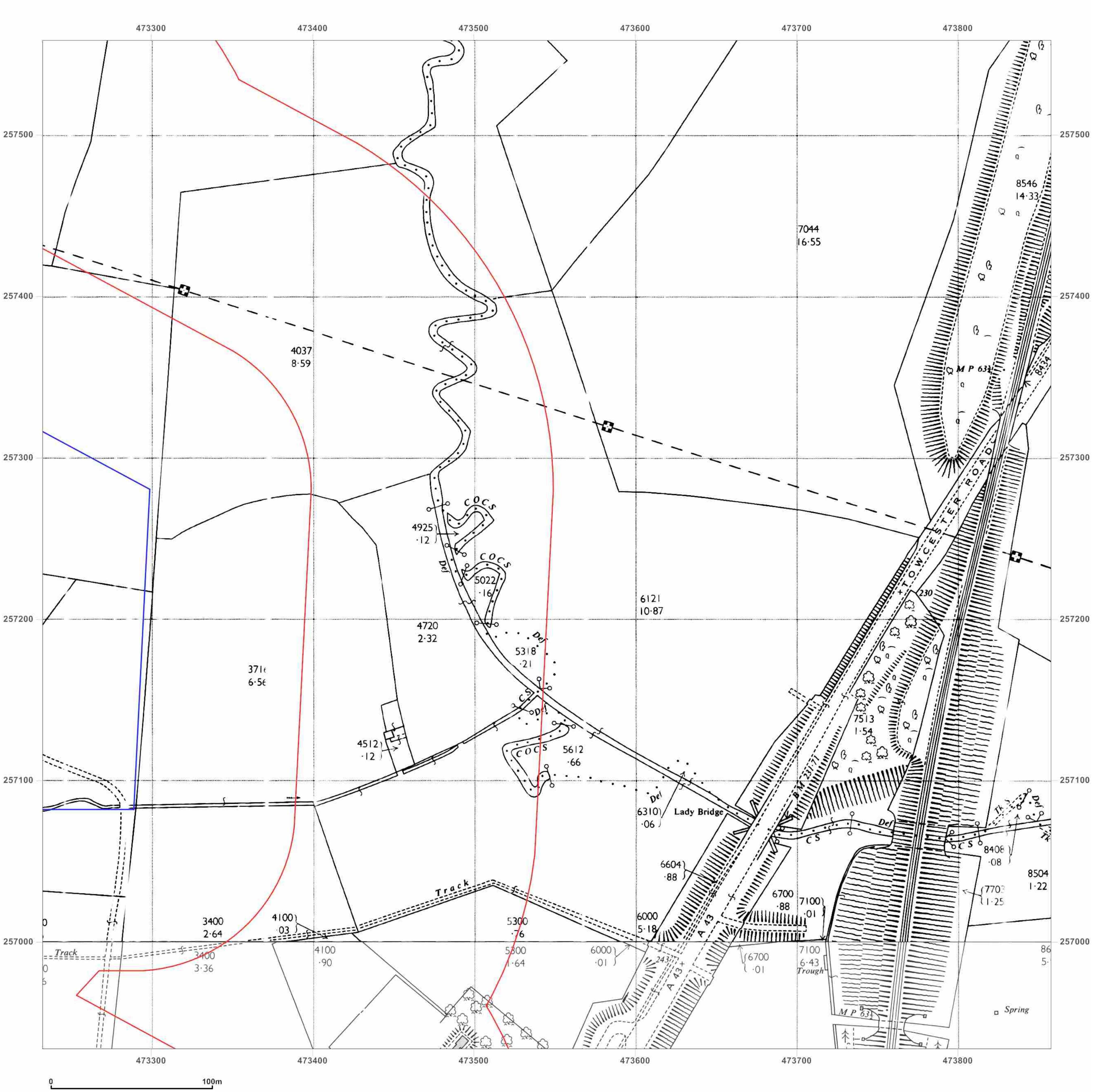

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_3
Grid Ref: 473545, 257246

Map Name: National Grid

Map date: 1964-1965

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

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

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

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W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_3
Grid Ref: 473545, 257246

Map Name: National Grid

Map date: **1964-1965**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

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

Powered by OS

Produced by
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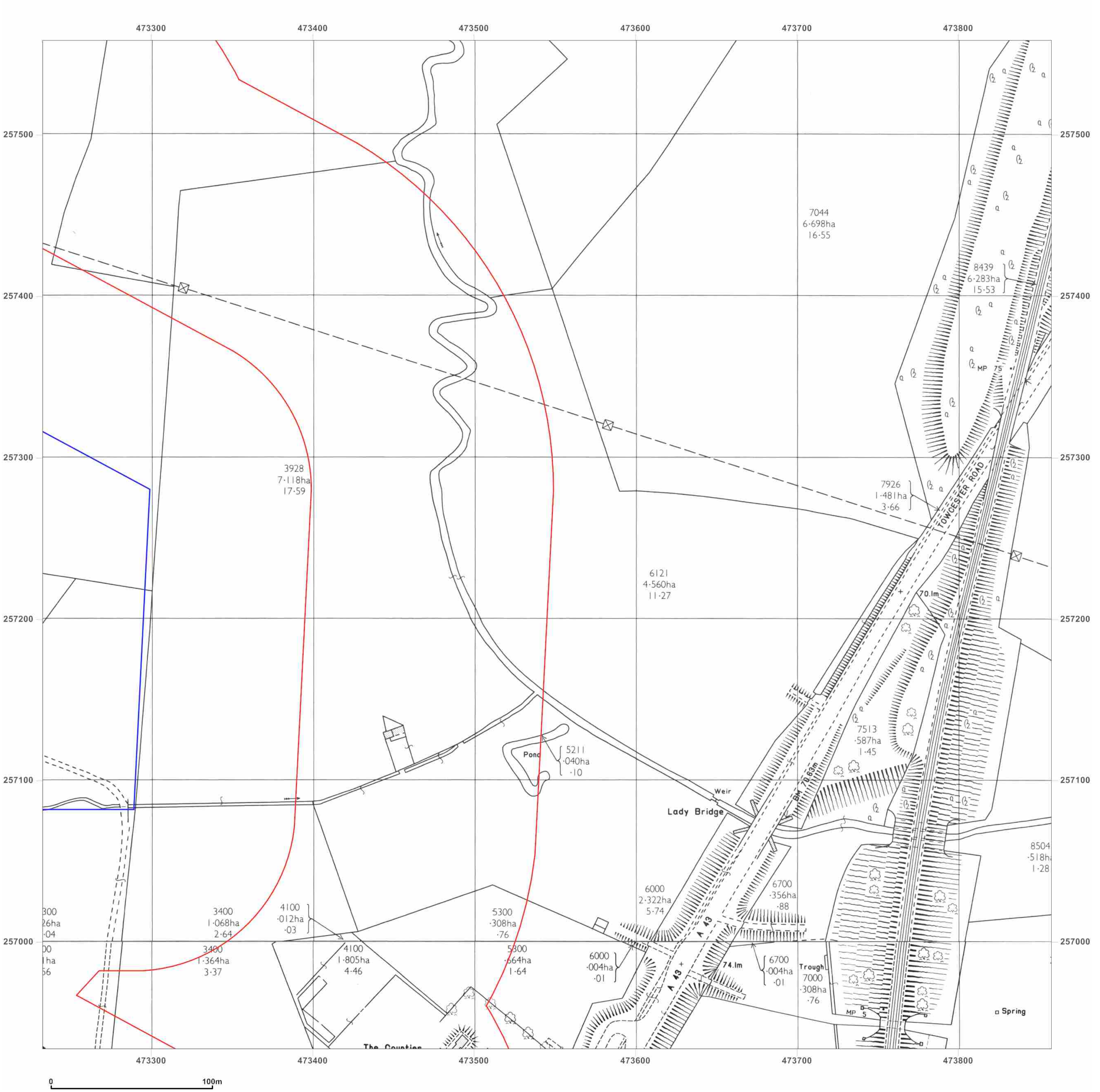
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_3
Grid Ref: 473545, 257246

Map Name: National Grid

Map date: **1977**

Scale: 1:2,500

Printed at: 1:2,500

N W E S

Surveyed 1977
Revised 1977
Edition N/A
Copyright 1978
Levelled 1961

Surveyed 1977
Revised 1977
Edition N/A
Copyright 1979
Levelled 1960

Powered by

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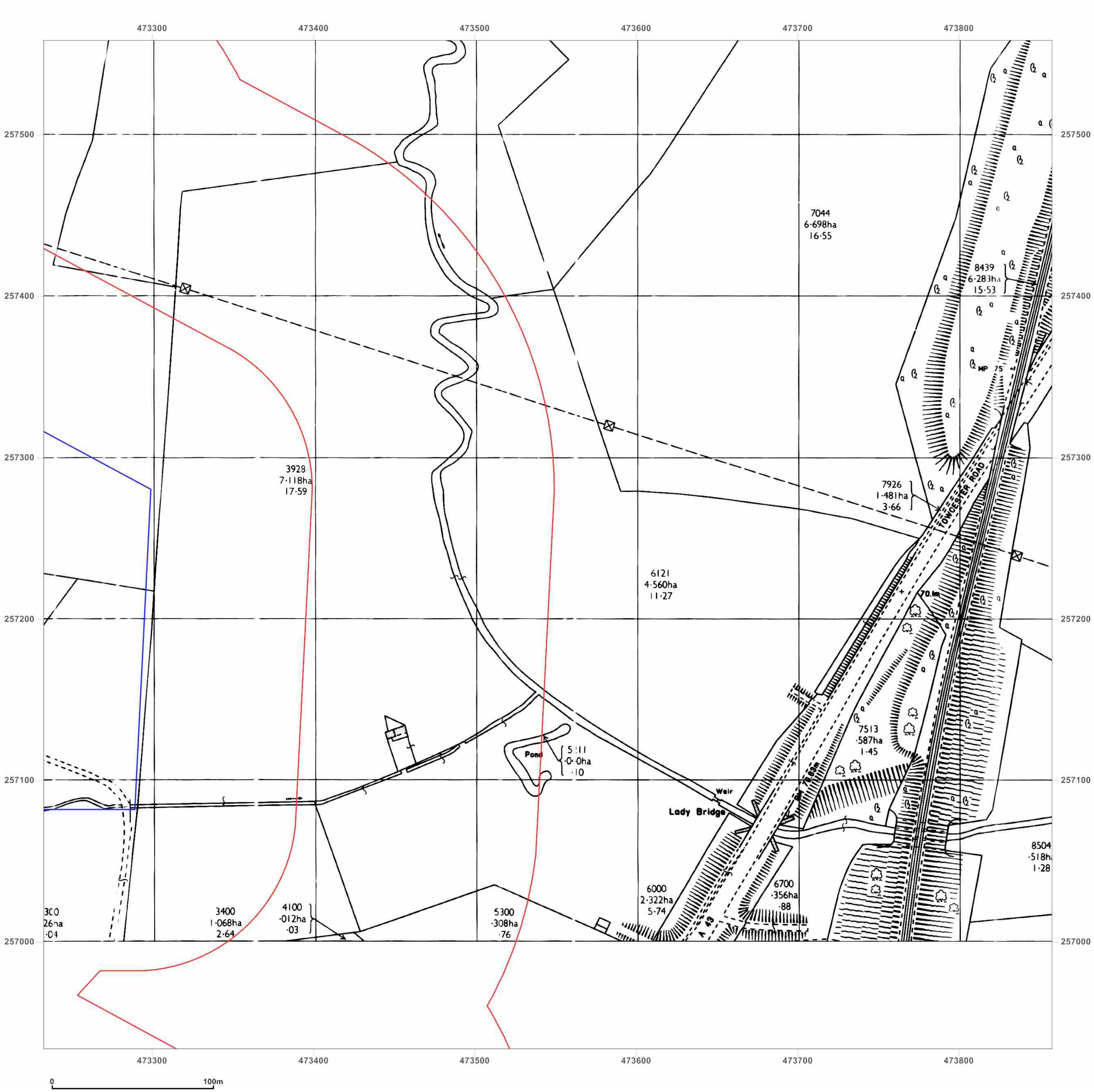
Groundsure Insights
T: 08444 159000
E: info@groundsure.com
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_3
Grid Ref: 473545, 257246

Map Name: National Grid

Map date: 1978

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

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

Powered by

Produced by
Groundsure Insights
T: 08444 159000
E: info@groundsure.com
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here Legend

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_3
Grid Ref: 473545, 257246

Map Name: National Grid

Map date: **1993**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed N/A
Revised N/A
Edition N/A
Copyright 1993
Levelled N/A

Surveyed N/A
Revised N/A
Edition N/A
Copyright 1993
Levelled N/A

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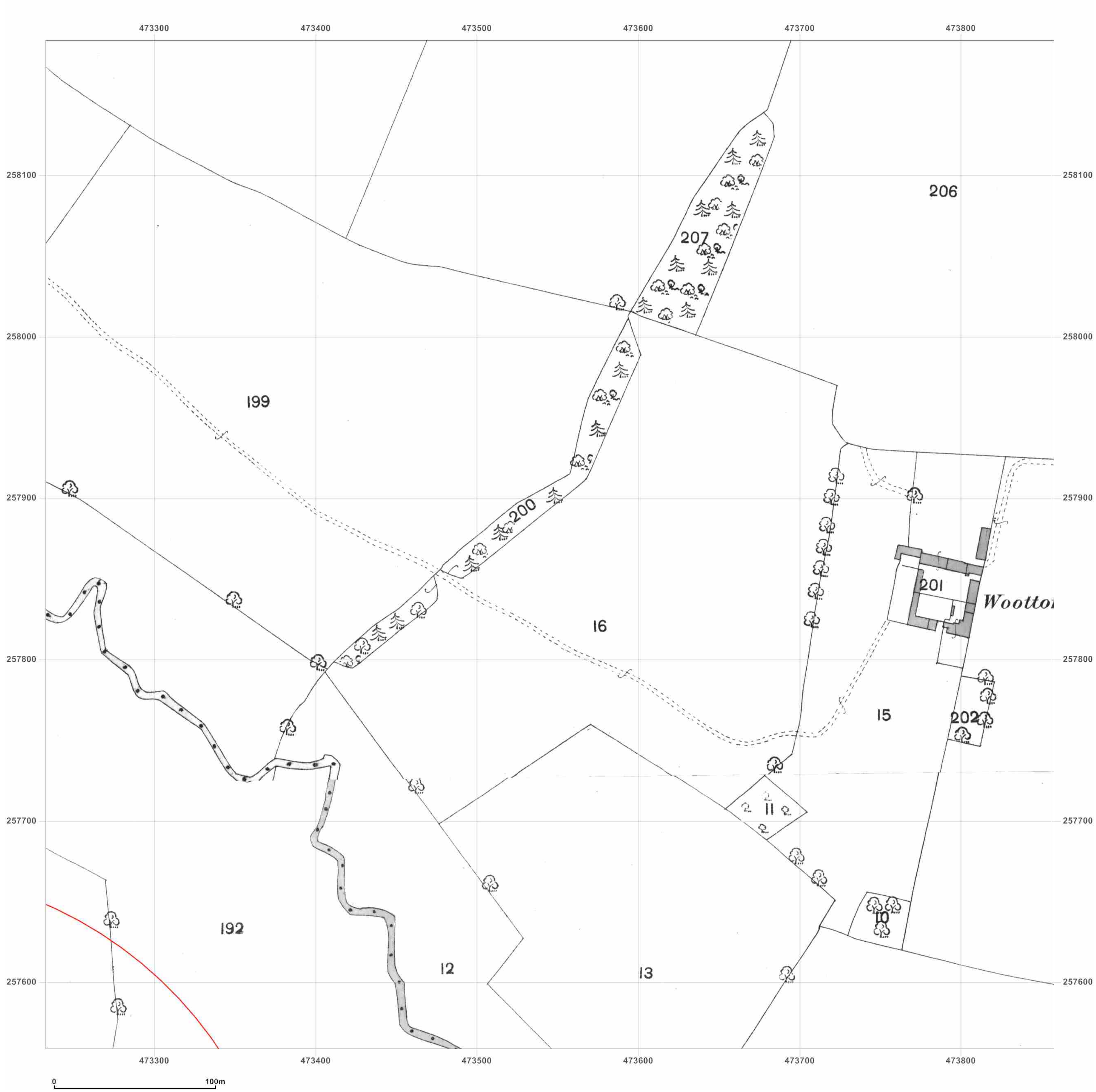
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_4
Grid Ref: 473545, 257871

Map Name: County Series

Map date: **1885-1886**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1886
Revised 1886
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1885
Revised 1885
Edition N/A
Copyright N/A
Levelled N/A

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W: www.groundsure.com

Production date: 19 June 2017

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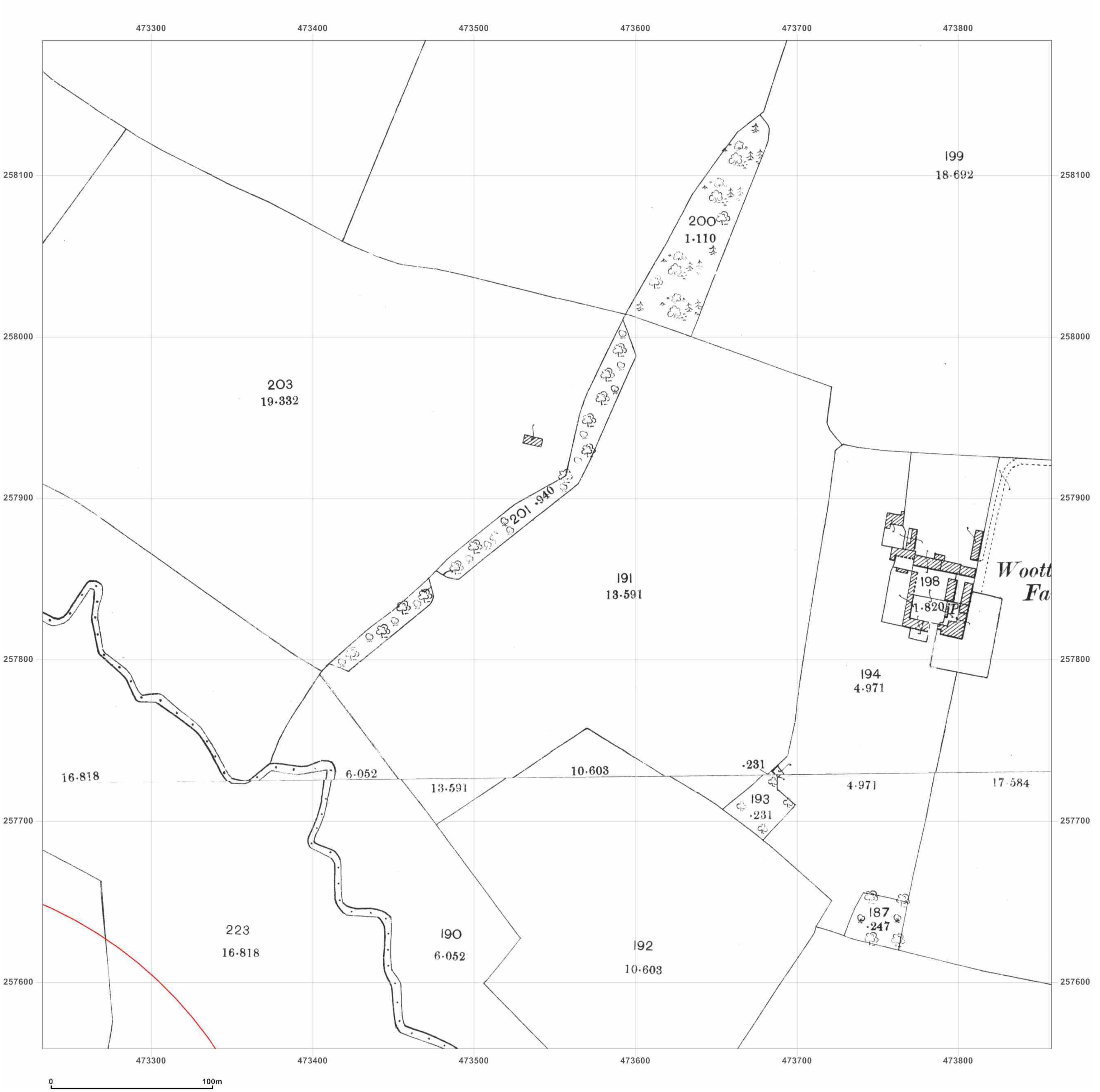

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_4
Grid Ref: 473545, 257871

Map Name: County Series

Map date: 1900

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1900
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

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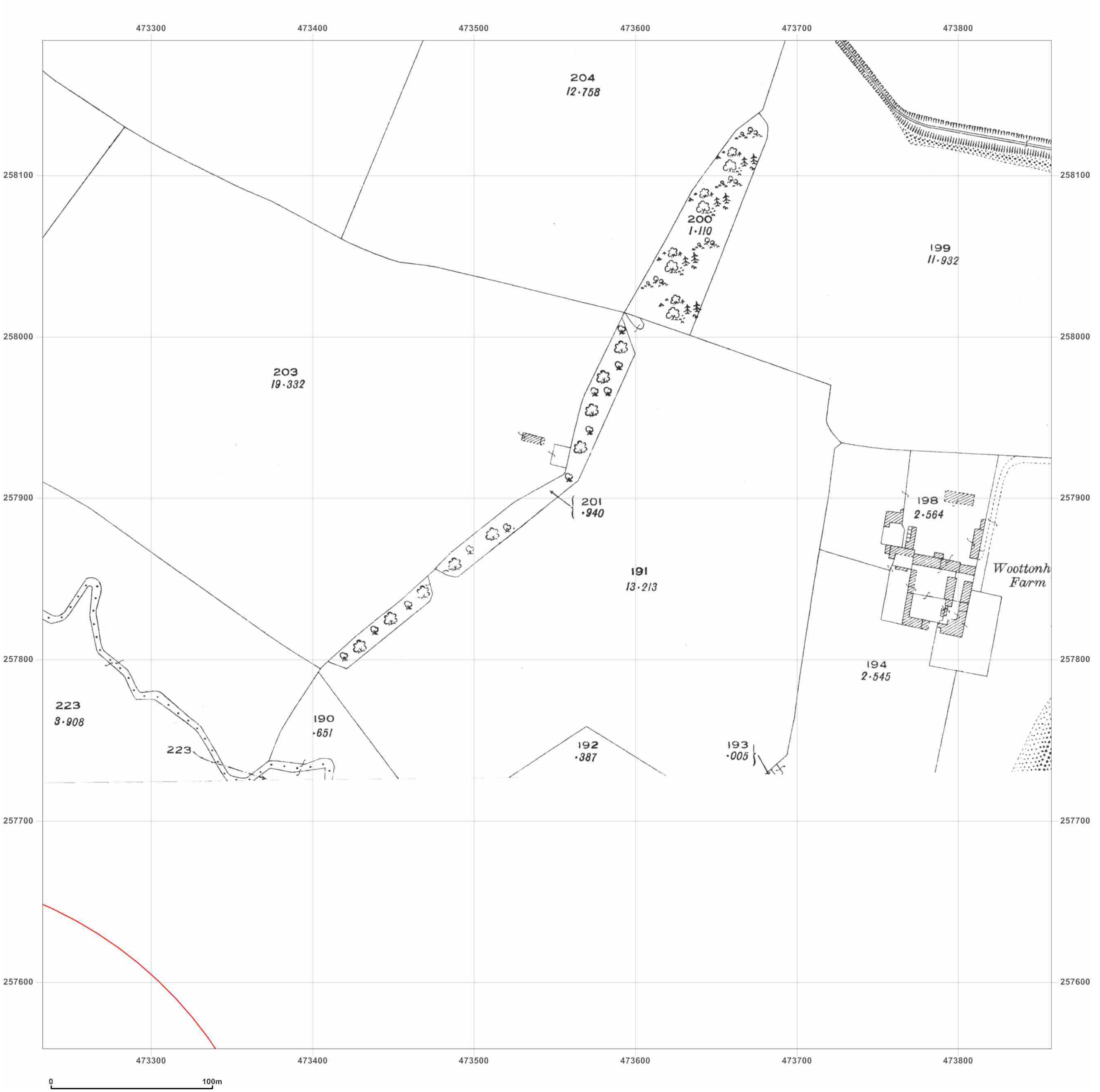
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_4
Grid Ref: 473545, 257871

Map Name: County Series

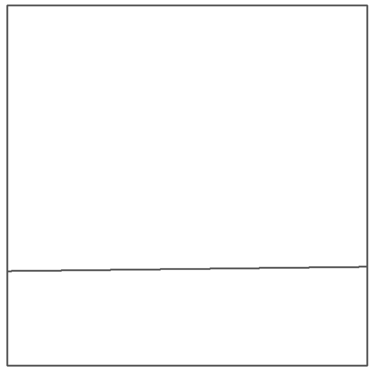
Map date: **1925**

Scale: 1:2,500

Printed at: 1:2,500

N
W
E
S

Surveyed 1925
Revised 1925
Edition N/A
Copyright N/A
Levelled N/A



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W: www.groundsure.com

Production date: 19 June 2017

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Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_4
Grid Ref: 473545, 257871

Map Name: National Grid

Map date: **1964**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

Surveyed 1964
Revised 1964
Edition N/A
Copyright 1965
Levelled 1960

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Production date: 19 June 2017

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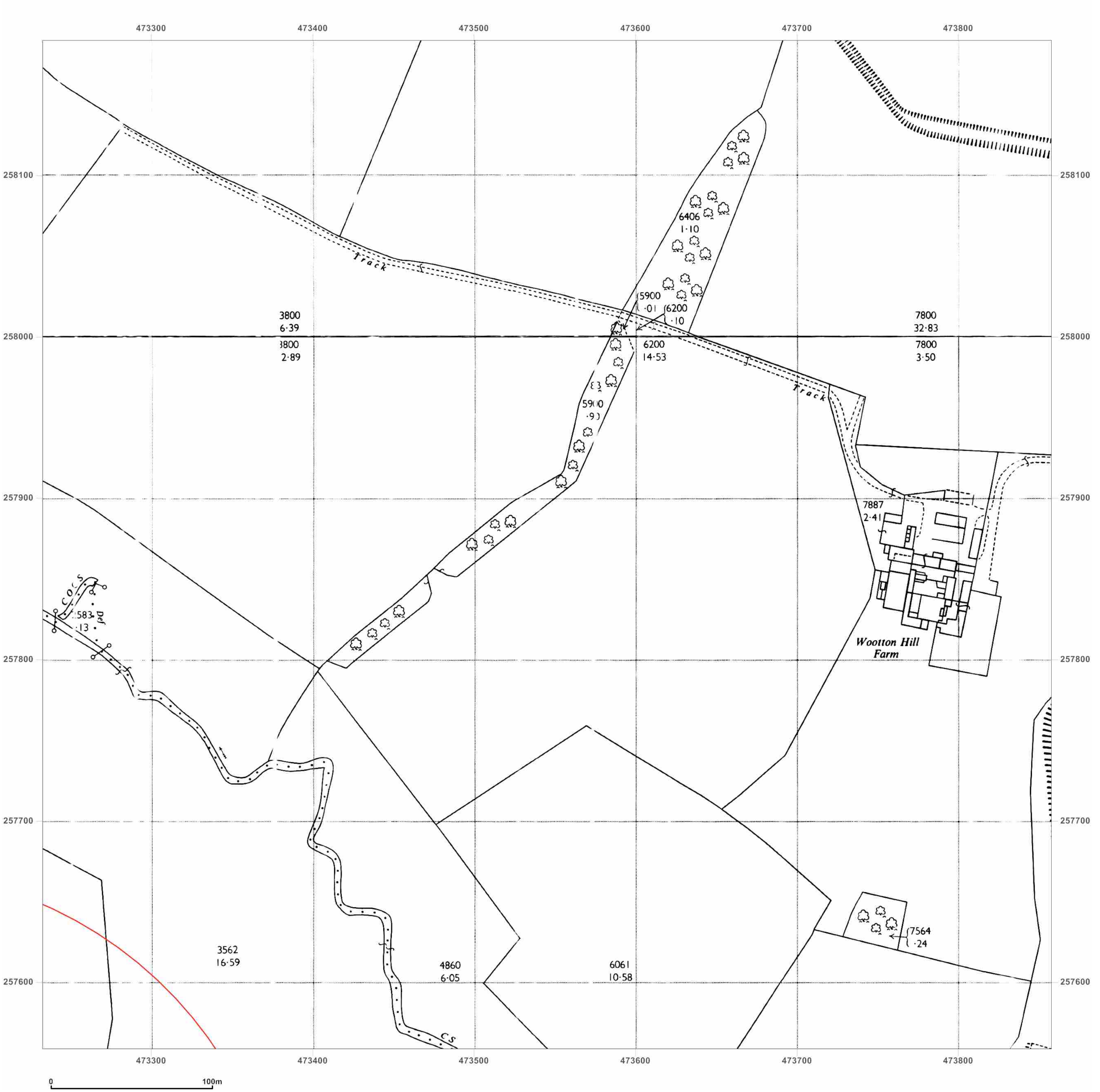

Groundsure
INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_4
Grid Ref: 473545, 257871

Map Name: National Grid

Map date: 1965

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

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

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

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Production date: 19 June 2017

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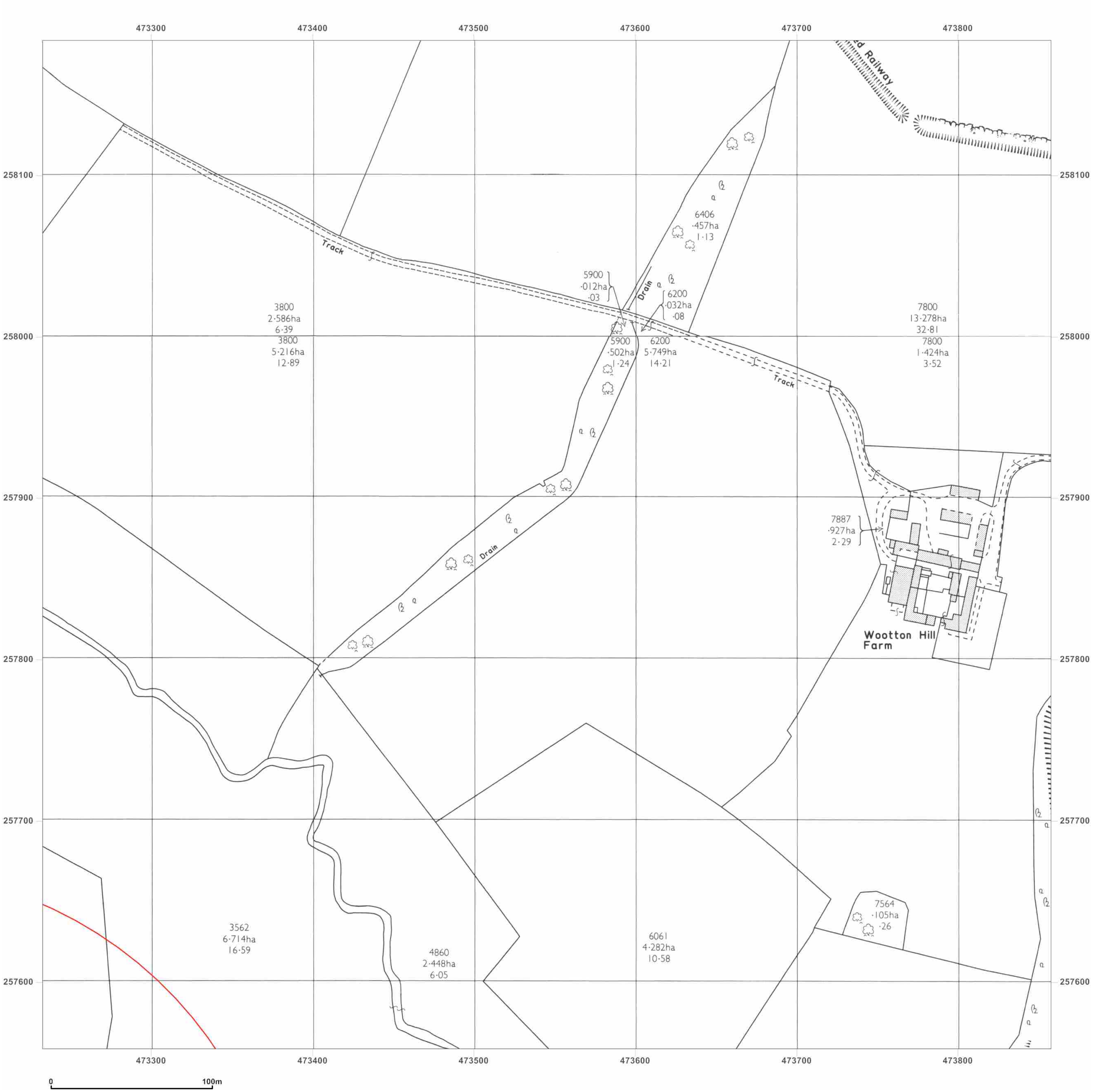

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_4
Grid Ref: 473545, 257871

Map Name: National Grid

Map date: **1977-1978**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1978
Revised 1978
Edition N/A
Copyright 1980
Levelled 1981

Surveyed 1977
Revised 1977
Edition N/A
Copyright 1978
Levelled 1961

Powered by OS

Produced by
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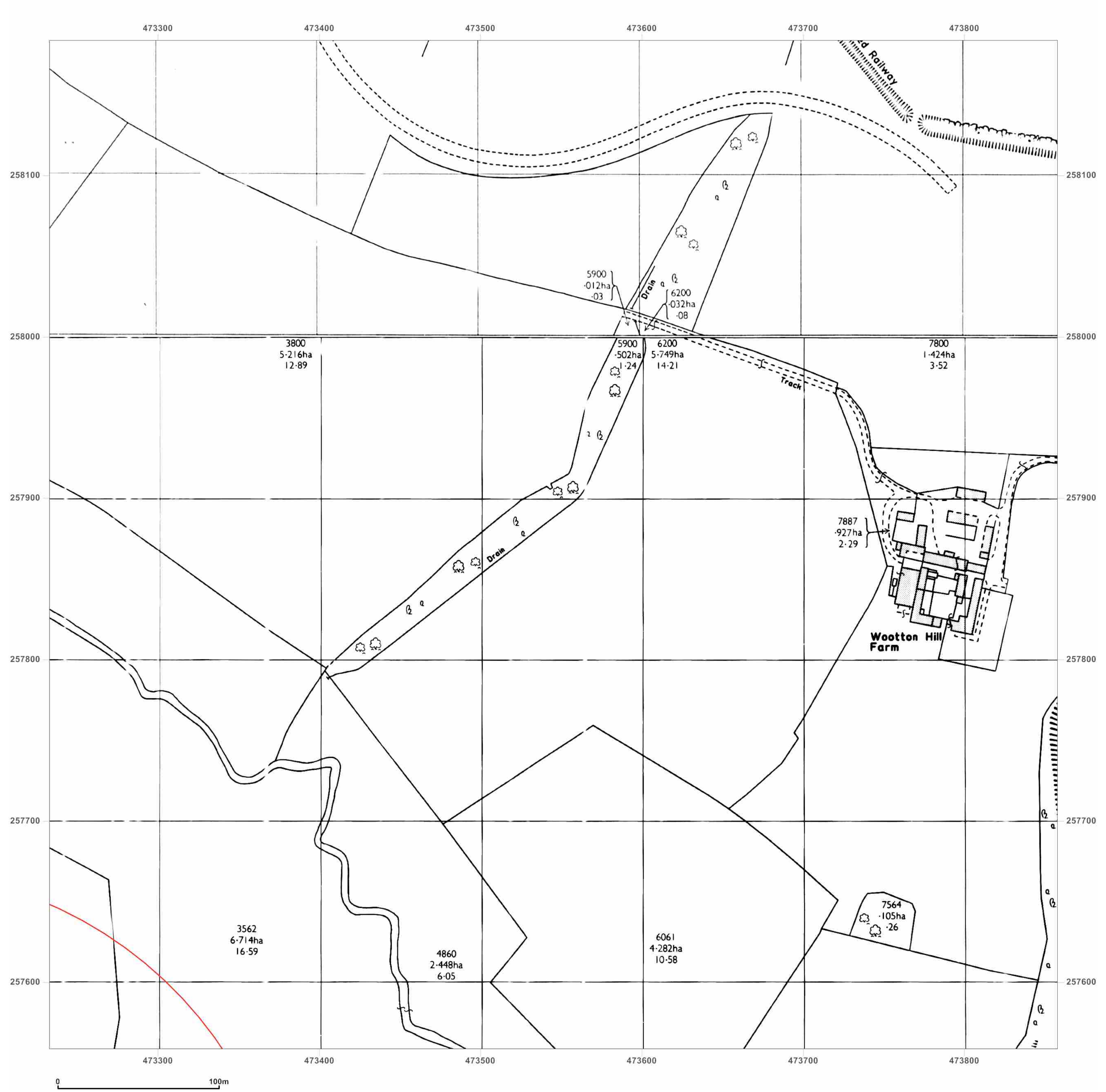
W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*



Groundsure
INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_4
Grid Ref: 473545, 257871

Map Name: National Grid

Map date: **1978-1982**

Scale: 1:2,500

Printed at: 1:2,500

N
W
E
S

Surveyed 1961
Revised 1982
Edition N/A
Copyright 1982
Levelled 1961

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

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W: www.groundsure.com

Production date: 19 June 2017

To view map legend click here *Legend*

Groundsure INSIGHTS

Site Details:

472716, 257183

Client Ref: POP009664
Report Ref: GS-4001370_LS_4_4
Grid Ref: 473545, 257871

Map Name: National Grid

Map date: 1993

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed N/A
Revised N/A
Edition N/A
Copyright 1993
Levelled N/A

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Production date: 19 June 2017

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Appendix D

Desk Study Research Information

Groundsure
LOCATION INTELLIGENCE

Hydrock Consultants Ltd

2-4 HAWTHORN PARK HYDROCK, HOLDENBY ROAD,
NORTHAMPTON/SPRATTON, NN6 8LD

Groundsure Reference:	GS-4001368
Your Reference:	POP009664
Report Date	19 Jun 2017
Report Delivery Method:	Email - pdf

Enviro Insight

Address: 472716, 257183,

Dear Sir/ Madam,

Thank you for placing your order with Groundsure. Please find enclosed the **Groundsure Enviro Insight** as requested.

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

Yours faithfully,

Managing Director
Groundsure Limited

Enc.
Groundsure Enviroinsight

Enviro Insight

Address:	**472716, 257183,**
Date:	**19 Jun 2017**
Reference:	**GS-4001368**
Client:	**Hydrock Consultants Ltd**

NW N NE

W E

SW S SE

Aerial Photograph Capture date: 16-Apr-2014
Grid Reference: 472679,256717
Site Size: 72.31ha

Report Reference: GS-4001368
Client Reference: POP009664

Contents Page

Overview of Findings

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

Section 1: Historical Industrial Sites	On-site	0-50	51-250	251-500
1.1 Potentially Contaminative Uses identified from 1:10,000 scale mapping	7	11	10	36
1.2 Additional Information – Historical Tank Database	0	0	0	6
1.3 Additional Information – Historical Energy Features Database	0	0	0	4
1.4 Additional Information – Historical Petrol and Fuel Site Database	0	0	0	0
1.5 Additional Information – Historical Garage and Motor Vehicle Repair Database	0	8	0	1
1.6 Potentially Infilled Land	15	8	8	24

Section 2: Environmental Permits, Incidents and Registers	On-site	0-50m	51-250	251-500
2.1 Industrial Sites Holding Environmental Permits and/or Authorisations				
2.1.1 Records of historic IPC Authorisations	0	0	0	0
2.1.2 Records of Part A(1) and IPPC Authorised Activities	0	0	0	0
2.1.3 Records of Red List Discharge Consents	0	0	0	0
2.1.4 Records of List 1 Dangerous Substances Inventory sites	0	0	0	0
2.1.5 Records of List 2 Dangerous Substances Inventory sites	0	0	0	0
2.1.6 Records of Part A(2) and Part B Activities and Enforcements	0	0	3	0
2.1.7 Records of Category 3 or 4 Radioactive Substances Authorisations	0	0	0	0
2.1.8 Records of Licensed Discharge Consents	1	0	3	3
2.1.9 Records of Water Industry Referrals	0	0	0	0
2.1.10 Records of Planning Hazardous Substance Consents and Enforcements within 500m of the study site	0	0	0	0
2.2 Records of COMAH and NIHHS sites	0	0	0	0
2.3 Environment Agency/Natural Resources Wales Recorded Pollution Incidents				
2.3.1 National Incidents Recording System, List 2	0	1	1	2
2.3.2 National Incidents Recording System, List 1	0	0	0	0
2.4 Sites Determined as Contaminated Land under Part 2A EPA 1990	0	0	0	0

Section 3: Landfill and Other Waste Sites

Section 3: Landfill and Other Waste Sites	On-site	0-50m	51-250	251-500	501-1000	1000-1500
3.1 Landfill Sites						
3.1.1 Environment Agency/Natural Resources Wales Registered Landfill Sites	1	0	0	0	0	Not searched
3.1.2 Environment Agency/Natural Resources Wales Historic Landfill Sites	0	0	2	2	0	2
3.1.3 BGS/DoE Landfill Site Survey	0	0	0	0	0	0
3.1.4 Records of Landfills in Local Authority and Historical Mapping Records	0	0	0	0	0	0
3.2 Landfill and Other Waste Sites Findings						
3.2.1 Operational and Non-Operational Waste Treatment, Transfer and Disposal Sites	0	0	0	0	Not searched	Not searched
3.2.2 Environment Agency/Natural Resources Wales Licensed Waste Sites	0	0	0	2	0	1

Section 4: Current Land Use

Section 4: Current Land Use	On-site	0-50m	51-250	251-500
4.1 Current Industrial Sites Data	4	3	12	Not searched
4.2 Records of Petrol and Fuel Sites	0	0	2	0
4.3 National Grid Underground Electricity Cables	0	0	0	0
4.4 National Grid Gas Transmission Pipelines	0	0	0	0

Section 5: Geology

Section 5: Geology	
5.1 Are there any records of Artificial Ground and Made Ground present beneath the study site?	No
5.2 Are there any records of Superficial Ground and Drift Geology present beneath the study site?	Yes
5.3 For records of Bedrock and Solid Geology beneath the study site see the detailed findings section.	

Section 6: Hydrogeology and Hydrology

Section 6: Hydrogeology and Hydrology	0-500m
6.1 Are there any records of Strata Classification in the Superficial Geology within 500m of the study site?	Yes
6.2 Are there any records of Strata Classification in the Bedrock Geology within 500m of the study site?	Yes

	On-site	0-50m	51-250	251-500	501-1000	1000-2000
6.3 Groundwater Abstraction Licences (within 2000m of the study site)	0	0	0	0	0	0
6.4 Surface Water Abstraction Licences (within 2000m of the study site)	0	0	0	0	2	5
6.5 Potable Water Abstraction Licences (within 2000m of the study site)	0	0	0	0	0	1
6.6 Source Protection Zones (within 500m of the study site)	0	0	0	0	Not searched	Not searched
6.7 Source Protection Zones within Confined Aquifer	0	0	0	0	Not searched	Not searched
6.8 Groundwater Vulnerability and Soil Leaching Potential (within 500m of the study site)	4	0	1	1	Not searched	Not searched

Section 6: Hydrogeology and Hydrology

	0-500m					
	On-site	0-50m	51-250	251-500	501-1000	1000-1500
6.9 Is there any Environment Agency/Natural Resources Wales information on river quality within 1500m of the study site?	No	No	No	No	Yes	Yes
6.10 Detailed River Network entries within 500m of the site	15	5	11	12	Not searched	Not searched
6.11 Surface water features within 250m of the study site	Yes	Yes	Yes	Not searched	Not searched	Not searched

Section 7: Flooding

7.1 Are there any Enviroment Agency Zone 2 floodplains within 250m of the study site?	Yes
7.2 Are there any Environment Agency/Natural Resources Wales Zone 3 floodplains within 250m of the study site	Yes
7.3 What is the Risk of flooding from Rivers and the Sea (RoFRaS) rating for the study site?	High
7.4 Are there any Flood Defences within 250m of the study site?	No
7.5 Are there any areas benefiting from Flood Defences within 250m of the study site?	Yes
7.6 Are there any areas used for Flood Storage within 250m of the study site?	No
7.7 What is the maximum BGS Groundwater Flooding susceptibility within 50m of the study site?	Potential at Surface
7.8 What is the BGS confidence rating for the Groundwater Flooding susceptibility areas?	High

Section 8: Designated Environmentally Sensitive Sites

	On-site	0-50m	51-250	251-500	501-1000	1000-2000
8.1 Records of Sites of Special Scientific Interest (SSSI)	0	0	0	0	0	0
8.2 Records of National Nature Reserves (NNR)	0	0	0	0	0	0
8.3 Records of Special Areas of Conservation (SAC)	0	0	0	0	0	0
8.4 Records of Special Protection Areas (SPA)	0	0	0	0	0	0
8.5 Records of Ramsar sites	0	0	0	0	0	0
8.6 Records of Ancient Woodlands	0	0	0	0	0	0
8.7 Records of Local Nature Reserves (LNR)	0	0	0	0	0	1
8.8 Records of World Heritage Sites	0	0	0	0	0	0
8.9 Records of Environmentally Sensitive Areas	0	0	0	0	0	0

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LOCATION INTELLIGENCE

Section 8: Designated Environmentally Sensitive Sites	On-site	0-50m	51-250	251-500	501-1000	1000-2000
8.10 Records of Areas of Outstanding Natural Beauty (AONB)	0	0	0	0	0	0
8.11 Records of National Parks	0	0	0	0	0	0
8.12 Records of Nitrate Sensitive Areas	0	0	0	0	0	0
8.13 Records of Nitrate Vulnerable Zones	1	0	0	0	0	1
8.14 Records of Green Belt land	0	0	0	0	0	0

Section 9: Natural Hazards

9.1 What is the maximum risk of natural ground subsidence?	Moderate
9.1.1 What is the maximum Shrink-Swell hazard rating identified on the study site?	Low
9.1.2 What is the maximum Landslides hazard rating identified on the study site?	Very Low
9.1.3 What is the maximum Soluble Rocks hazard rating identified on the study site?	Very Low
9.1.4 What is the maximum Compressible Ground hazard rating identified on the study site?	Moderate
9.1.5 What is the maximum Collapsible Rocks hazard rating identified on the study site?	Very Low
9.1.6 What is the maximum Running Sand hazard rating identified on the study site?	Low
9.2 Radon	
9.2.1 Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level?	The property is in a Radon Affected Area, as between 3 and 5% of properties are above the Action Level.
9.2.2 Is the property in an area where Radon Protection are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment?	Basic radon protective measures are necessary.

Section 10: Mining

10.1 Are there any coal mining areas within 75m of the study site?	No
10.2 Are there any Non-Coal Mining areas within 50m of the study site boundary?	No
10.3 Are there any brine affected areas within 75m of the study site?	No

Using this report

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

1. Historical Industrial Sites

Provides information on past land uses that may pose a risk to the study site in terms of potential contamination from activities or processes. Potentially Infilled Land features are also included. This search is conducted using radii of up to 500m.

2. Environmental Permits, Incidents and Registers

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

3. Landfills and Other Waste Sites

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

4. Current Land Uses

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

5. Geology

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

6. Hydrogeology and Hydrology

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

7. Flooding

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

8. Designated Environmentally Sensitive Sites

Provides information on the Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR), Special Areas of Conservation (SAC), Special Protection Areas (SPA), Ramsar sites, Local Nature Reserves (LNR), Areas of Outstanding Natural Beauty (AONB), National Parks (NP), Environmentally Sensitive Areas, Nitrate Sensitive Areas, Nitrate Vulnerable Zones and World Heritage Sites and Scheduled Ancient Woodland. These searches are conducted using radii of up to 2000m.

9. Natural Hazards

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

10. Mining

Provides information on areas of coal and non-coal mining and brine affected areas.

11. Contacts

This section of the report provides contact points for statutory bodies and data providers that may be able to provide further information on issues raised within this report. Alternatively, Groundsure provide a free Technical Helpline (08444 159000) for further information and guidance.

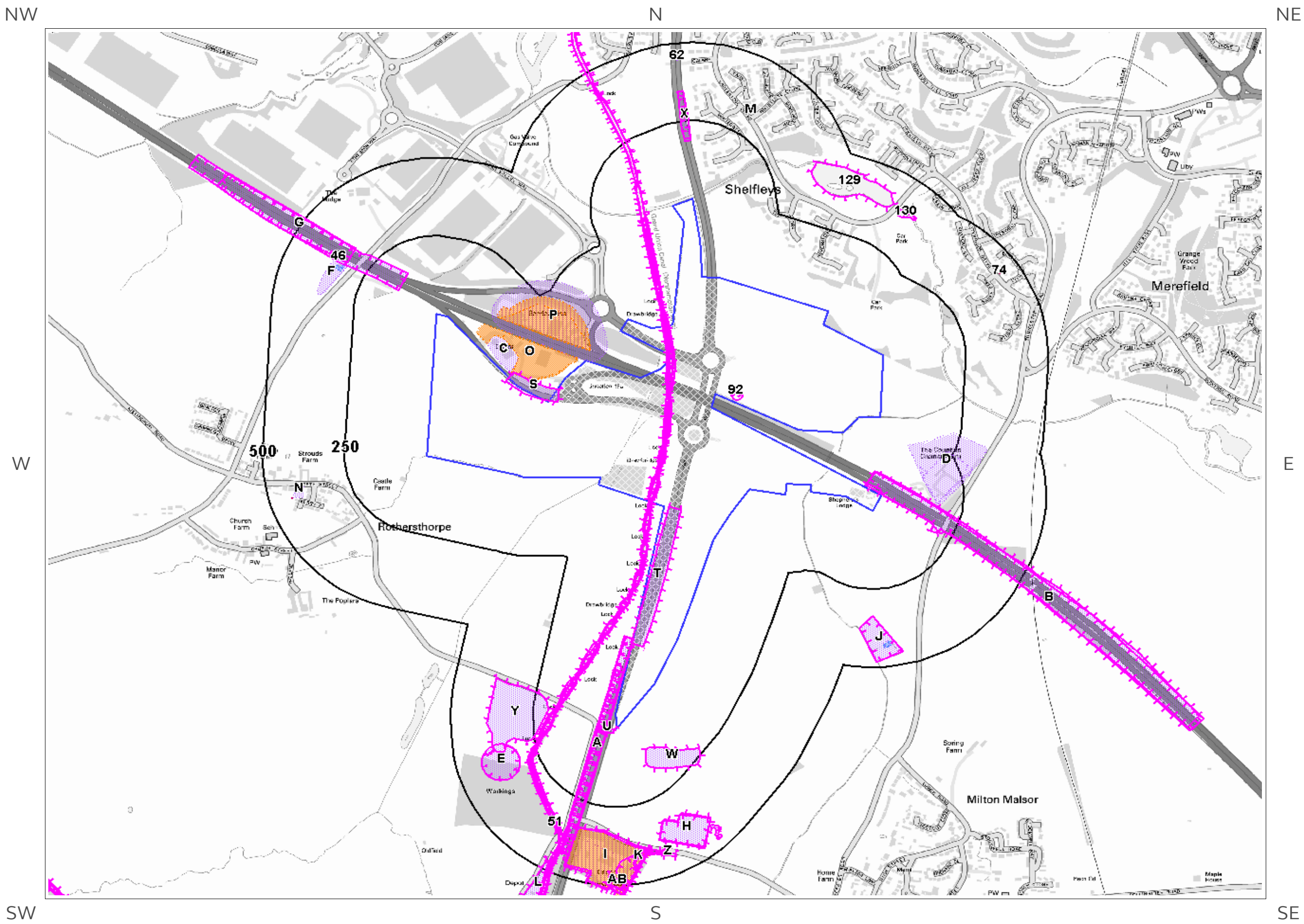
Note: Maps

Only certain features are placed on the maps within the report. All features represented on maps found within this search are given an identification number. This number identifies the feature on the mapping and correlates it to the additional information provided below. This identification number precedes all other information and takes the following format -Id: 1, Id: 2, etc. Where numerous features on the same map are in such close proximity that the numbers would obscure each other a letter identifier is used instead to represent the features. (e.g. Three features which overlap may be given the identifier “A” on the map and would be identified separately as features 1A, 3A, 10A on the data tables provided).

Where a feature is reported in the data tables to a distance greater than the map area, it is noted in the data table as “Not Shown”.

All distances given in this report are in Metres (m). Directions are given as compass headings such as N: North, E: East, NE: North East from the nearest point of the study site boundary.

1. Historical Land Use



Site Outline

250
500
Search Buffers (m)

Historical 1:10,000 and 1:10,560 scale mapping

Industrial Land Use

Potentially Infilled Land

Historical 1:2,500, 1:1,250 and 1:500 scale mapping

Energy Features

Petrol Stations

Tanks

Garages

Groundsure
LOCATION INTELLIGENCE

1. Historical Industrial Sites

1.1 Potentially Contaminative Uses identified from 1:10,000 scale Mapping

The systematic analysis of data extracted from standard 1:10,560 and 1:10,000 scale historical maps provides the following information:

Records of sites with a potentially contaminative past land use within 500m of the search boundary: 64

ID	Distance [m]	Direction	Use	Date
1T	0	On Site	Cuttings	1992
2S	0	On Site	Cuttings	1992
3A	0	On Site	Cuttings	1883
4A	0	W	Cuttings	1968
5A	0	W	Cuttings	1989
6A	0	W	Cuttings	1981
7P	0	N	Unspecified Depot	1964
8B	5	NE	Cuttings	1968
9B	5	NE	Cuttings	1992
10B	5	NE	Cuttings	1989
11B	5	NE	Cuttings	1981
12B	6	NE	Cuttings	1964
13A	6	W	Cuttings	1950
14A	6	W	Cuttings	1964
15U	7	SW	Cuttings	1992
16C	12	NE	Unspecified Depot	1981
17C	12	NE	Unspecified Depot	1989
18C	12	NE	Unspecified Depot	1992
19W	112	SE	Gravel Pit	1968
20D	123	SE	Crematorium	1950
21D	135	NE	Crematorium	1968
22D	135	NE	Crematorium	1989
23D	135	NE	Crematorium	1981
24D	135	NE	Crematorium	1992
25G	137	NW	Cuttings	1964
26D	142	E	Crematorium	1964
27X	184	N	Cuttings	1884
28Y	205	W	Sand Pit	1989
29E	308	W	Unspecified Workings	1989
30E	308	W	Unspecified Workings	1992
31F	309	NW	Unspecified Depot	1992
32F	309	NW	Oil Depot	1968
33F	309	NW	Unspecified Depot	1989
34F	309	NW	Unspecified Depot	1981

35G	316	NW	Cuttings	1968
36G	316	NW	Cuttings	1981
37G	316	NW	Cuttings	1989
38G	316	NW	Cuttings	1992
39H	324	SE	Sand Pit	1964
40H	327	SE	Sand Pit	1950
41I	328	S	Disused Gravel Pit	1964
42I	333	S	Disused Gravel Pit	1950
43I	335	S	Roads Depot	1968
44I	335	S	Unspecified Depot	1989
45I	335	S	Unspecified Depot	1981
46	337	NW	Unspecified Tanks	1968
47J	337	S	Sewage Works	1989
48J	337	S	Sewage Works	1981
49J	337	S	Sewage Works	1992
50J	337	S	Sewage Works	1968
51	355	SW	Boat House	1900
52I	371	S	Unspecified Depot	1992
53N	388	W	Smithy	1900
54K	396	S	Unspecified Ground Workings	1883
55K	396	S	Gravel Pit	1900
56J	416	S	Unspecified Tanks	1989
57J	416	S	Unspecified Tanks	1968
58J	416	S	Unspecified Tanks	1992
59J	416	S	Unspecified Tanks	1981
60Z	416	S	Unspecified Pit	1883
61AA	419	SE	Unspecified Ground Workings	1968
62	447	N	Railway Building	1964
63L	469	SW	Brick Works	1900
64L	469	SW	Brick Works	1900

1.2 Additional Information – Historical Tank Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Records of historical tanks within 500m of the search boundary: 6

ID	Distance (m)	Direction	Use	Date
65F	318	NW	Tanks	1964
66F	318	NW	Tanks	1976
67F	320	NW	Tanks	1993

68J	420	S	Tanks	1964
69J	420	S	Tanks	1977
70J	421	S	Tanks	1993

1.3 Additional Information – Historical Energy Features Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Records of historical energy features within 500m of the search boundary: 4

ID	Distance (m)	Direction	Use	Date
71M	325	NE	Electricity Substation	1989
72M	326	NE	Electricity Substation	1989
73N	428	W	Electricity Substation	1993
74	436	NE	Electricity Substation	1989

1.4 Additional Information – Historical Petrol and Fuel Site Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Records of historical petrol stations and fuel sites within 500m of the search boundary: 0

Database searched and no data found.

1.5 Additional Information – Historical Garage and Motor Vehicle Repair Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Records of historical garage and motor vehicle repair sites within 500m of the search boundary: 9

ID	Distance (m)	Direction	Use	Date
75O	15	NE	Service Area	1992
76O	15	NE	Service Area	1988
77O	16	NE	Service Area	1996
78O	16	NE	Service Area	1999
79P	33	N	Service Area	1992
80P	33	N	Service Area	1988
81P	36	N	Service Area	1996
82P	36	N	Service Area	1999

83I	334	S	Road Maintenance Depot	1964

1.6 Potentially Infilled Land

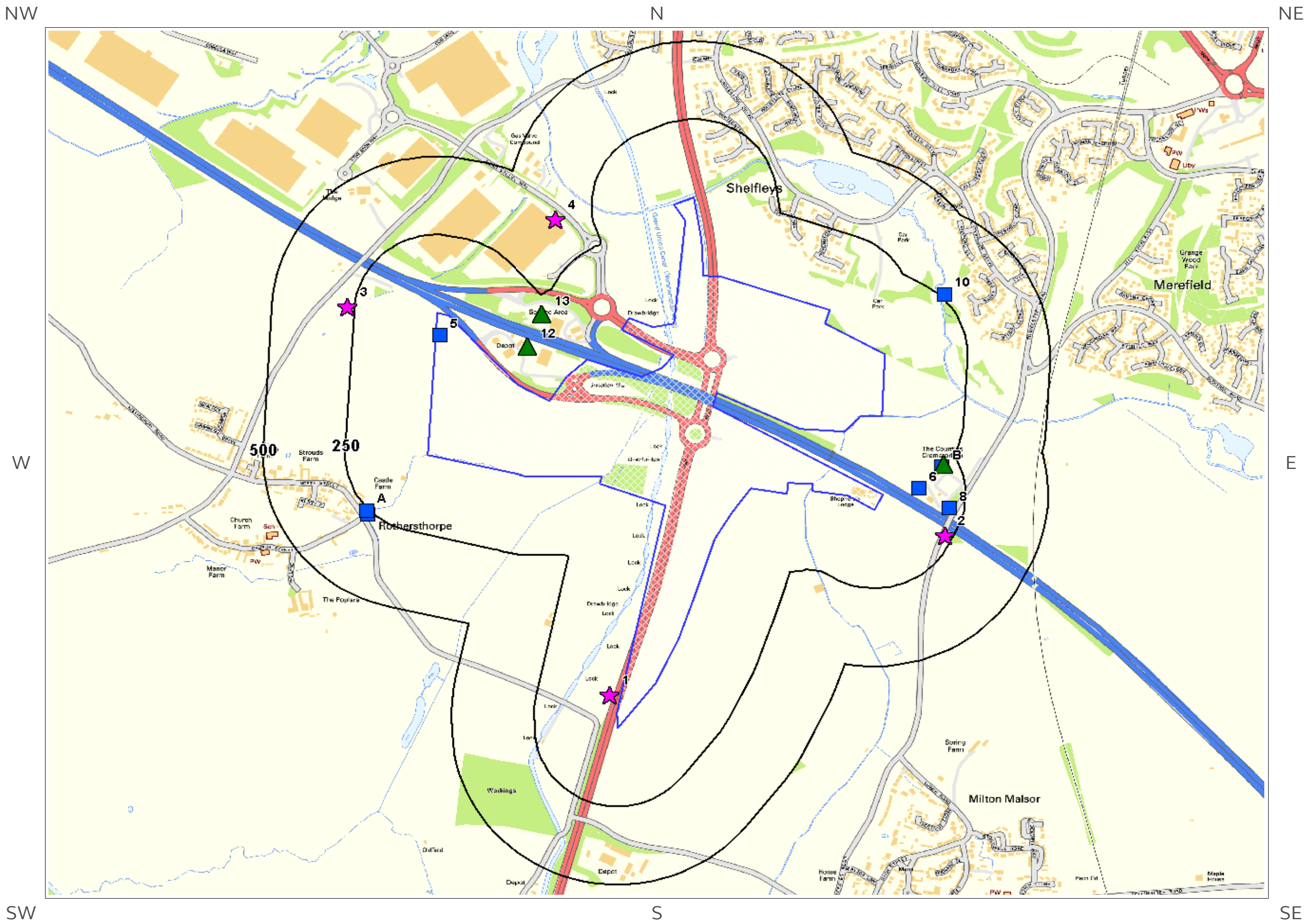
Records of Potentially Infilled Features from 1:10,000 scale mapping within 500m of the study site: 55

The following Historical Potentially Infilled Features derived from the Historical Mapping information is provided by Groundsure:

ID	Distance(m)	Direction	Use	Date
84Q	0	On Site	Canal	1883
85Q	0	On Site	Canal	1950
86R	0	On Site	Canal	1981
87R	0	On Site	Canal	1989
88R	0	On Site	Canal	1992
89R	0	On Site	Canal	1968
90S	0	On Site	Cuttings	1992
91T	0	On Site	Cuttings	1992
92	0	On Site	Pond	1883
93R	0	On Site	Canal	1964
94Q	0	On Site	Canal	1900
95A	0	On Site	Cuttings	1883
96A	0	W	Cuttings	1968
97A	0	W	Cuttings	1981
98A	0	W	Cuttings	1989
99B	5	NE	Cuttings	1981
100B	5	NE	Cuttings	1968
101B	5	NE	Cuttings	1989
102B	5	NE	Cuttings	1992
103B	6	NE	Cuttings	1964
104A	6	W	Cuttings	1950
105A	6	W	Cuttings	1964
106U	7	SW	Cuttings	1992
107V	89	W	Canal	1899
108V	89	W	Canal	1950
109V	89	W	Canal	1884
110V	89	W	Canal	1923
111W	112	SE	Gravel Pit	1968
112G	137	NW	Cuttings	1964
113X	184	N	Cuttings	1884
114Y	205	W	Sand Pit	1989
115E	308	W	Unspecified Workings	1989
116E	308	W	Unspecified Workings	1992
117G	316	NW	Cuttings	1989
118G	316	NW	Cuttings	1992
119G	316	NW	Cuttings	1981
120G	316	NW	Cuttings	1968

121H	324	SE	Sand Pit	1964
122H	327	SE	Sand Pit	1950
123I	328	S	Disused Gravel Pit	1964
124I	333	S	Disused Gravel Pit	1950
125J	337	S	Sewage Works	1989
126J	337	S	Sewage Works	1968
127J	337	S	Sewage Works	1981
128J	337	S	Sewage Works	1992
129	358	N	Ponds	1981
130	373	NE	Pond	1981
131K	396	S	Unspecified Ground Workings	1883
132K	396	S	Gravel Pit	1900
133Z	416	S	Unspecified Pit	1883
134AA	419	SE	Unspecified Ground Workings	1968
135AB	468	S	Pond	1964
136L	469	SW	Brick Works	1900
137L	469	SW	Brick Works	1900
138AB	472	S	Pond	1950

2. Environmental Permits, Incidents and Registers Map



- Site Outline
- Search Buffers (m) — 250, 500
- Recorded Pollution Incident
- Dangerous Substances (List 1)
- Dangerous Substances (List 2)
- Water Industry Referrals
- Licenced Discharge Consents
- Red List Discharge Consents
- RAS 3 & 4 Authorisations
- Part A(1) Authorised Processes and Historic IPC Authorisations
- Part A(2) and Part B Authorised Processes
- COMAH / NIHHS Sites
- Sites Determined as Contaminated Land
- Hazardous Substance Consents and Enforcements

2. Environmental Permits, Incidents and Registers

2.1 Industrial Sites Holding Licences and/or Authorisations

Searches of information provided by the Environment Agency/Natural Resources Wales and Local Authorities reveal the following information:

2.1.1 Records of historic IPC Authorisations within 500m of the study site:

0

Database searched and no data found.

2.1.2 Records of Part A(1) and IPPC Authorised Activities within 500m of the study site:

0

Database searched and no data found.

2.1.3 Records of Red List Discharge Consents (potentially harmful discharges to controlled waters) within 500m of the study site:

0

Database searched and no data found.

2.1.4 Records of List 1 Dangerous Substances Inventory Sites within 500m of the study site:

0

Database searched and no data found.

2.1.5 Records of List 2 Dangerous Substance Inventory Sites within 500m of the study site:

0

Database searched and no data found.

2.1.6 Records of Part A(2) and Part B Activities and Enforcements within 500m of the study site:

3

The following Part A(2) and Part B Activities are represented as points on the Environmental Permits, Incidents and Registers Map:

ID	Distance (m)	Direction	NGR	Details	
12	100	NE	472215 257299	Address: Rothersthorpe North Connect, Northampton Motorway, Service Area, M1 (Northbound), Northampton, NN4 9QS Process: Unloading of Petrol into Storage at Service Stations Status: Current Permit Permit Type: Part B	Enforcement: No Enforcement Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified
13	197	NW	472260 257403	Address: BP Connect/Wildbean Café (Formerly Roadchef), Rothersthorpe Service Area, Northampton, NN5 9QY Process: Unloading of Petrol into Storage at Service Stations Status: Current Permit Permit Type: Part B	Enforcement: No Enforcements Notified Date of Enforcement: No Enforcements Notified Comment: No Enforcements Notified
14B	203	NE	473475 256921	Address: Dignity Funerals, Counties Crematorium, Towcester Road, Northampton, NN4 9RN Process: Crematoria Processes Status: Current Permit Permit Type: Part B	Enforcement: No Enforcements Notified Date of Enforcement: No Enforcements Notified Comment: No Enforcements Notified

2.1.7 Records of Category 3 or 4 Radioactive Substances Authorisations:

0

Database searched and no data found.

2.1.8 Records of Licensed Discharge Consents within 500m of the study site:

7

The following Licensed Discharge Consents records are represented as points on the Environmental Permits, Incidents and Registers Map:

ID	Distance (m)	Direction	NGR	Details	
5	0	On Site	471950 257340	Address: ROTHERSTHORPE SERVICE AREA M1 MOTO, M1, NORTHAMPTON, NN4 9QS Effluent Type: SEWAGE DISCHARGES - FINAL/TREATED EFFLUENT - NOT WATER COMPANY Permit Number: PR5NF641 Permit Version: 1	Receiving Water: Trib Wootton Brook Status: PRE NRA LEGISLATION WHERE ISSUE DATE < 01-SEP-89 (HISTORIC ONLY) Issue date: 29/11/1974 Effective Date: 29-Nov-1974 Revocation Date: 25/02/1992

ID	Distance (m)	Direction	NGR	Details	
6	108	E	473400 256850	Address: TOWCESTER ROAD, MILTON MALSOR, NORTHAMPTON, NN4 9RN Effluent Type: UNSPECIFIED Permit Number: PR5LF3668 Permit Version: 1	Receiving Water: Land Status: PRE NRA LEGISLATION WHERE ISSUE DATE < 01-SEP-89 (HISTORIC ONLY) Issue date: 07/01/1980 Effective Date: 07-Jan-1980 Revocation Date: 01/10/1996
7B	198	NE	473470 256920	Address: THE COUNTIES CREMATORIUM, TOWESTER RD, MILTON MALSOR, NORTHAMPTON, . Effluent Type: SEWAGE DISCHARGES - FINAL/TREATED EFFLUENT - NOT WATER COMPANY Permit Number: PRNNF18259 Permit Version: 1	Receiving Water: UNNAMED TRIB OF WOOTEN BROOK Status: NEW CONSENT (WRA 91, S88 & SCHED 10 AS AMENDED BY ENV ACT 1995) Issue date: 14/10/2004 Effective Date: 01-Oct-2004 Revocation Date: -
8	206	E	473494 256787	Address: MILTON EDGE & MILTON VIEW, TOWCESTER ROAD, MILTON MALSOR, NORTHAMPTON, NORTHANTS, NN4 9RN Effluent Type: SEWAGE DISCHARGES - FINAL/TREATED EFFLUENT - NOT WATER COMPANY Permit Number: PRNNF18363 Permit Version: 1	Receiving Water: UNNAMED TRIB OF WOOTON BROOK Status: NEW CONSENT (WRA 91, S88 & SCHED 10 AS AMENDED BY ENV ACT 1995) Issue date: 16/05/2005 Effective Date: 03-May-2005 Revocation Date: -
9A	258	SW	471730 256780	Address: ROTHERSTHORPE PS, BERRY CLOSE, ROTHERSTHORPE, NORTHAMPTON, NORTHANTS, NN7 3JQ Effluent Type: SEWAGE DISCHARGES - PUMPING STATION - WATER COMPANY Permit Number: NPSWQD009761 Permit Version: 1	Receiving Water: TRIB OF THE WOOTTON BROOK Status: NEW CONSENT (WRA 91, S88 & SCHED 10 AS AMENDED BY ENV ACT 1995) Issue date: 08/03/2010 Effective Date: 08-Mar-2010 Revocation Date: -
10	262	NE	473480 257470	Address: PARKSIDE 'C', LADYBRIDGE ROAD, NORTHAMPTON Effluent Type: MISCELLANEOUS DISCHARGES - SURFACE WATER Permit Number: PR5NF5031 Permit Version: 1	Receiving Water: Wootton Brook Status: PRE NRA LEGISLATION WHERE ISSUE DATE < 01-SEP-89 (HISTORIC ONLY) Issue date: 21/03/1985 Effective Date: 21-Mar-1985 Revocation Date: 27/02/1992
11A	264	SW	471733 256768	Address: ROTHERSTHORPE PS, BERRY CLOSE, ROTHERSTHORPE, NORTHAMPTON, NORTHANTS, NN7 3JQ Effluent Type: SEWAGE DISCHARGES - STW STORM OVERFLOW/STORM TANK - WATER COMPANY Permit Number: AW5NF113 Permit Version: 1	Receiving Water: Unknown Trib Status: PRE NRA LEGISLATION WHERE ISSUE DATE < 01-SEP-89 (HISTORIC ONLY) Issue date: 06/11/1958 Effective Date: 06-Nov-1958 Revocation Date: -

2.1.9 Records of Water Industry Referrals (potentially harmful discharges to the public sewer) within 500m of the study site:

0

Database searched and no data found.

2.1.10 Records of Planning Hazardous Substance Consents and Enforcements within 500m of the study site:

0

Database searched and no data found.

2.2 Dangerous or Hazardous Sites

Records of COMAH & NIHHS sites within 500m of the study site: 0

Database searched and no data found.

2.3 Environment Agency/Natural Resources Wales Recorded Pollution Incidents

2.3.1 Records of National Incidents Recording System, List 2 within 500m of the study site:

4

The following NIRS List 2 records are represented as points on the Environmental Permits, Incidents and Registers Map:

ID	Distance (m)	Direction	NGR	Details	
1	35	W	472464 256191	Incident Date: 08-Aug-2003 Incident Identification: 180439 Pollutant: Pollutant Not Identified Pollutant Description: Not Identified	Water Impact: Category 4 (No Impact) Land Impact: Category 3 (Minor) Air Impact: Category 4 (No Impact)
2	227	SE	473480 256700	Incident Date: 11-Oct-2003 Incident Identification: 195585 Pollutant: Inert Materials and Wastes Pollutant Description: Construction and Demolition Materials and Wastes	Water Impact: Category 4 (No Impact) Land Impact: Category 3 (Minor) Air Impact: Category 4 (No Impact)
3	274	W	471670 257430	Incident Date: 08-Jan-2003 Incident Identification: 129935 Pollutant: Inert Materials and Wastes Pollutant Description: Other Inert Material or Waste	Water Impact: Category 4 (No Impact) Land Impact: Category 3 (Minor) Air Impact: Category 4 (No Impact)
4	365	W	472300 257710	Incident Date: 11-Mar-2002 Incident Identification: 63297 Pollutant: Organic Chemicals/Products Pollutant Description: Hydrocarbons	Water Impact: Category 4 (No Impact) Land Impact: Category 3 (Minor) Air Impact: Category 4 (No Impact)

2.3.2 Records of National Incidents Recording System, List 1 within 500m of the study site:

0

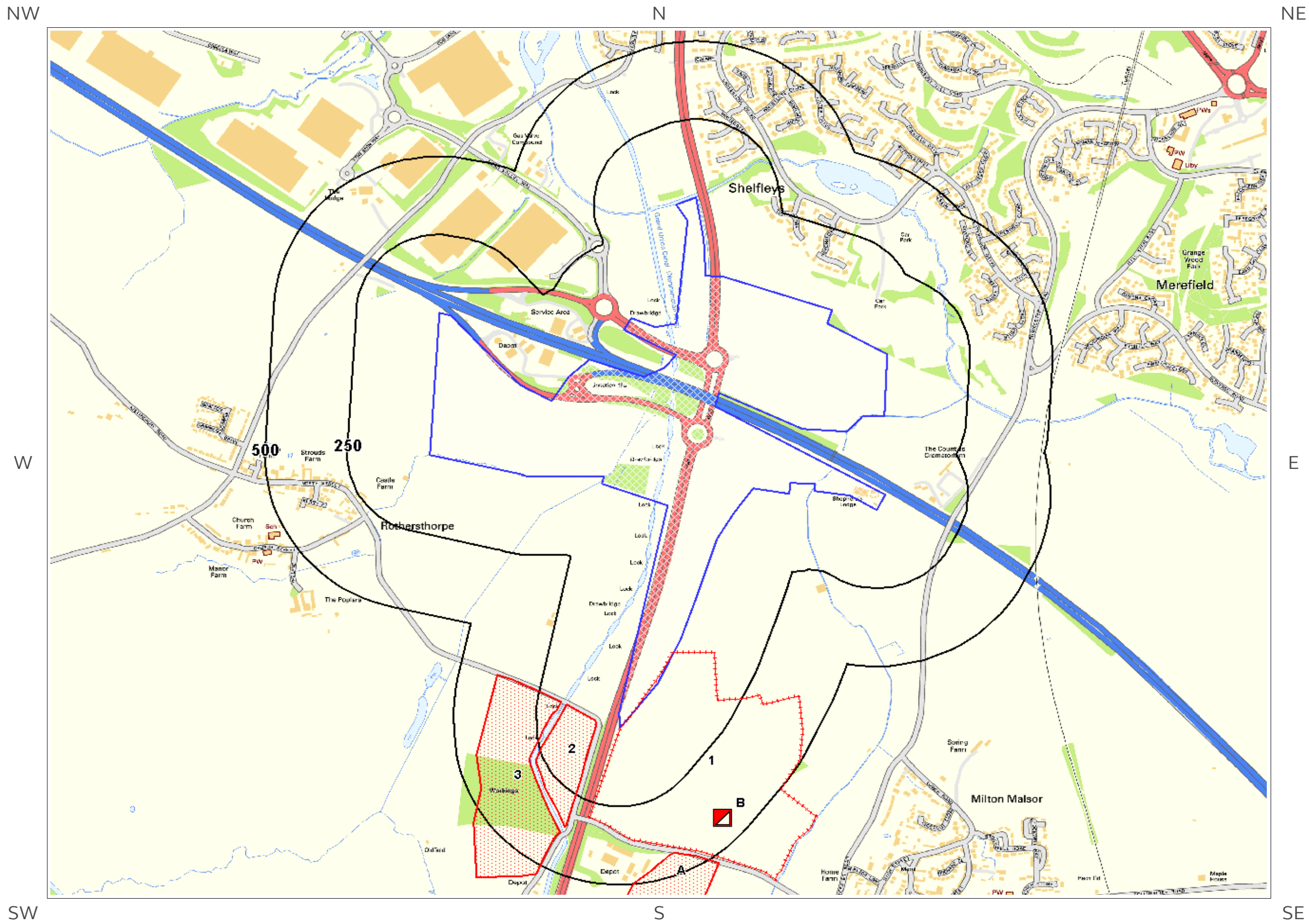
Database searched and no data found.

2.4 Sites Determined as Contaminated Land under Part 2A EPA 1990

How many records of sites determined as contaminated land under Section 78R of the Environmental Protection Act 1990 are there within 500m of the study site? 0

Database searched and no data found.

3. Landfill and Other Waste Sites Map



Site Outline

— 250 —
— 500 — Search Buffers (m)

EA/NRW Active Landfill

EA/NRW Historic Landfill

BGS / DoE Survey Landfill

Historic and Planned Waste Sites

EA/NRW Licensed Waste Site

Local Authority/Historical Mapping Landfill Records

3. Landfill and Other Waste Sites

3.1 Landfill Sites

3.1.1 Records from Environment Agency/Natural Resources Wales landfill data within 1000m of the study site:

1

The following Environment Agency/Natural Resources Wales landfill records are represented as polygons on the Landfill and Other Waste Sites map:

ID	Distance (m)	Direction	NGR	Details	
1	0	On Site	472800 255800	Address: Weldon Plant Ltd, Milton Malsor, Northants, NN7 3AA Landfill Reference: 70648.0 Environmental Permitting Regulations (Waste) Reference: WEL001 Landfill Type: A05: Landfill taking Non-Biodegradeable Wastes	Operator: Weldon Plant Ltd Status: Closure IPPC Reference: EPR Reference:

3.1.2 Records of Environment Agency/Natural Resources Wales historic landfill sites within 1500m of the study site:

6

The following landfill records are represented as either points or polygons on the Landfill and Other Waste Sites map:

ID	Distance (m)	Direction	NGR	Details	
2	69	W	472300 255900	Site Address: Rothersthorpe, Milton Malsor, Northamptonshire Waste Licence: Yes Site Reference: S/022 Waste Type: Inert Environmental Permitting Regulations (Waste) Reference: -	Licence Issue: 06-Aug-1980 Licence Surrendered: Licence Holder Address: Little Billing, Northampton Operator: - Licence Holder: Mixconcrete Aggregates Limited First Recorded: 01-Aug-1980 Last Recorded: 30-Jul-1986
3	178	W	472100 255900	Site Address: Milton Sand Pit, Milton Malsor and Gayton Waste Licence: Yes Site Reference: S/015 Waste Type: Inert, Liquid, sludge Environmental Permitting Regulations (Waste) Reference: -	Licence Issue: 02-Nov-1979 Licence Surrendered: Licence Holder Address: Little Billing, Northampton, Northamptonshire Operator: Mixconcrete Aggregates Limited Licence Holder: Mixconcrete Holdings First Recorded: 01-Dec-1979 Last Recorded: 28-Feb-1984

ID	Distance (m)	Direction	NGR	Details	
4A	433	S	472600 255500	Site Address: Gayton Road, Milton Malsor Waste Licence: Yes Site Reference: S/107 Waste Type: Inert Environmental Permitting Regulations (Waste) Reference: -	Licence Issue: 24-Aug-1993 Licence Surrendered: 12-Aug-1997 Licence Holder Address: PO Box 33, Gayton Road, Milton Malsor, Northampton Operator: Galliford Roadstone Licence Holder: Galliford Roadstone First Recorded: 28-Feb-1993 Last Recorded: -
5A	433	S	725 557	Site Address: Gayton Road, Milton Malsor, Waste Licence: Yes Site Reference: 2800/0170 Waste Type: Inert Environmental Permitting Regulations (Waste) Reference: -	Licence Issue: 24-Aug-1993 Licence Surrendered: Licence Holder Address: - Operator: GALLYFORD ROADSTONE Licence Holder: GALLYFORD ROADSTONE First Recorded: - Last Recorded: -
Not shown	1072	SW	471400 255200	Site Address: Gayton Landfill Site, Milton Malsor Road, Gayton Waste Licence: - Site Reference: S/A, R4701 Waste Type: Inert, Industrial, Commercial, Household, Liquid, sludge Environmental Permitting Regulations (Waste) Reference: -	Licence Issue: Licence Surrendered: Licence Holder Address: - Operator: Northamptonshire County Council Licence Holder: - First Recorded: 31-Dec-1938 Last Recorded: 30-Oct-1986
Not shown	1274	NW	471400 259000	Site Address: Land Off Camp Lane, Upton, Northampton Waste Licence: Yes Site Reference: N/015 Waste Type: Inert Environmental Permitting Regulations (Waste) Reference: -	Licence Issue: 01-Aug-1980 Licence Surrendered: 12-Mar-1993 Licence Holder Address: Little Billing, Northampton Operator: Mixconcrete Aggregates Limited Licence Holder: Mixconcrete Aggregares Limited First Recorded: 31-Dec-1986 Last Recorded: 31-Jan-1993

3.1.3 Records of BGS/DoE non-operational landfill sites within 1500m of the study site:

0

Database searched and no data found.

3.1.4 Records of Landfills from Local Authority and Historical Mapping Records within 1500m of the study site:

0

Database searched and no data found.

3.2 Other Waste Sites

3.2.1 Records of waste treatment, transfer or disposal sites within 500m of the study site:

0

Database searched and no data found.

3.2.2 Records of Environment Agency/Natural Resources Wales licensed waste sites within 1500m of the study site:

3

The following waste treatment, transfer or disposal sites records are represented as points on the Landfill and Other Waste Sites map:

ID	Distance (m)	Direction	NGR	Details	
8B	422	SE	472800 255800	Site Address: Weldon Plant Ltd, Milton Malsor, Northants, NN7 3AA Type: Landfill taking Non-Biodegradeable Wastes Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: WEL001 EPR reference: EA/EPR/XP3395NA/A001 Operator: Weldon Plant Ltd Waste Management licence No: 70648 Annual Tonnage: 422955.0	Issue Date: 01/05/1990 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Closure Site Name: Milton Malsor Landfill Correspondence Address: -
9B	422	SE	472800 255800	Site Address: Weldon Plant Ltd, Milton Malsor, Northants, NN7 3AA Type: Landfill taking Non-Biodegradeable Wastes Size: >= 75000 tonnes Environmental Permitting Regulations (Waste) Licence Number: WEL001 EPR reference: - Operator: Weldon Plant Ltd Waste Management licence No: 70648 Annual Tonnage: 0.0	Issue Date: 01/05/1990 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: Milton Malsor Landfill Correspondence Address: Weldon Plant Ltd, Lammas Road, Weldon Industrial Estate, Corby, Northants, NN17 1JF
Not shown	1137	SW	471707 255261	Site Address: X1 Type: Physical Treatment Facility Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: IPC037 EPR reference: EA/EPR/ZP3692ND/A001 Operator: Northamptonshire County Council Waste Management licence No: 73237 Annual Tonnage: 50000.0	Issue Date: 01/11/2004 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: Gayton Landfill (post Op) Treatment Plant Correspondence Address: -

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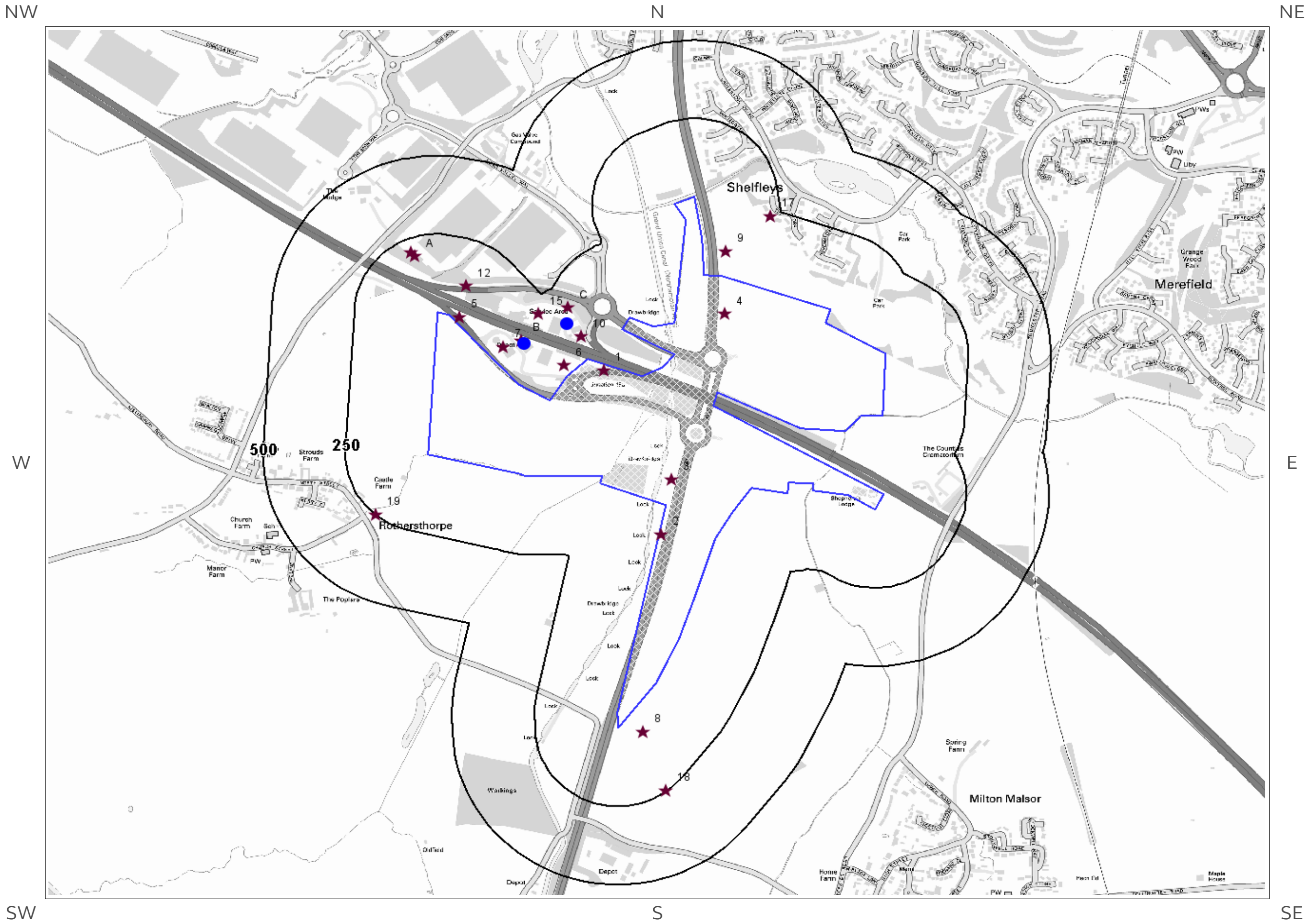
4. Current Land Use Map



Site Outline

Current Industrial Sites

Electricity Transmission Cables

250
500
Search Buffers (m)

Petrol & Fuel Sites

Gas Transmission Pipelines

4. Current Land Uses

4.1 Current Industrial Data

Records of potentially contaminative industrial sites within 250m of the study site: 19

The following records are represented as points on the Current Land Uses map.

ID	Distance (m)	Direction	Company	NGR	Address	Activity	Category
1	0	On Site	Gantry	472445 257229	Gantry, NN4	Travelling Cranes and Gantries	Industrial Features
2	0	On Site	Gantry	472619 256705	Gantry, NN7	Travelling Cranes and Gantries	Industrial Features
3	0	On Site	Gantry	472649 256881	Gantry, NN7	Travelling Cranes and Gantries	Industrial Features
4	0	On Site	Gantry	472812 257408	Gantry, NN4	Travelling Cranes and Gantries	Industrial Features
5	20	NE	Electricity Sub Station	472009 257399	Electricity Sub Station, NN4	Electrical Features	Infrastructure and Facilities
6	37	NW	Northampton Northbound Motorway Service Area	472324 257245	Northampton Northbound Motorway Service Area, NN4	Motorway Service Stations	Road and Rail
7	50	NE	Depot	472142 257303	Depot, NN4	Container and Storage	Transport, Storage and Delivery
8	64	SE	Landfill Site	472563 256075	Landfill Site, NN7	Refuse Disposal Facilities	Infrastructure and Facilities
9	67	E	Gantry	472813 257608	Gantry, NN4	Travelling Cranes and Gantries	Industrial Features
10	78	N	M1 Rothersthorpe Connect Motorway Service Area Southbound	472376 257337	M1 Rothersthorpe Connect Motorway Service Area Southbound, M1 J15a, A43, Rothersthorpe, Northampton, Northamptonshire, NN4 9QS	Petrol and Fuel Stations	Road and Rail
11B	103	NE	M1 Rothersthorpe Connect Motorway Service Area Northbound	472195 257324	M1 Rothersthorpe Connect Motorway Service Area Northbound, M1 J15a, A43, Rothersthorpe, Northampton, Northamptonshire, NN4 9QS	Petrol and Fuel Stations	Road and Rail
12	106	NE	Gantry	472029 257497	Gantry, NN4	Travelling Cranes and Gantries	Industrial Features
13C	177	N	Electricity Sub Station	472338 257429	Electricity Sub Station, NN4	Electrical Features	Infrastructure and Facilities
14A	194	N	Tank	471874 257592	Tank, NN4	Tanks (Generic)	Industrial Features

ID	Distance (m)	Direction	Company	NGR	Address	Activity	Category
15	200	NE	Northampton Southbound Motorway Service Area	472248 257409	Northampton Southbound Motorway Service Area, NN4	Motorway Service Stations	Road and Rail
16A	211	NW	Tank	471861 257605	Tank, NN4	Tanks (Generic)	Industrial Features
17	214	E	Fred Dickens Ltd	472948 257721	Fred Dickens Ltd, 12, Teal Close, Northampton, NN4 9XF	Leather Products	Consumer Products
18	245	SE	Landfill Site	472633 255888	Landfill Site, NN7	Refuse Disposal Facilities	Infrastructure and Facilities
19	247	SW	Pumping House	471757 256769	Pumping House, NN7	Water Pumping Stations	Industrial Features

4.2 Petrol and Fuel Sites

Records of petrol or fuel sites within 500m of the study site: 2

The following petrol or fuel site records provided by Catalist are represented as points on the Current Land Use map:

ID	Distance (m)	Direction	NGR	Company	Address	LPG	Status
20B	101	NE	472205 257311	BP	M1 Northampton Connect Motorway Service Area Northbound, M1 J15a, M1 J15a, A43, Rothersthorpe, Northampton, Northamptonshire, NN4 9QS	Yes	Open
21C	128	NW	472335 257374	BP	M1 Northampton Connect Motorway Service Area Southbound, M1 J15a, M1 J15a, A43, Rothersthorpe, Northampton, Northamptonshire, NN4 9QS	Yes	Open

4.3 National Grid High Voltage Underground Electricity Transmission Cables

This dataset identifies the high voltage electricity transmission lines running between generating power plants and electricity substations. The dataset does not include the electricity distribution network (smaller, lower voltage cables distributing power from substations to the local user network). This information has been extracted from databases held by National Grid and is provided for information only with no guarantee as to its completeness or accuracy. National Grid do not offer any warranty as to the accuracy of the available data and are excluded from any liability for any such inaccuracies or errors.

Records of National Grid high voltage underground electricity transmission cables within 500m of the study site: 0

Database searched and no data found.

4.4 National Grid High Pressure Gas Transmission Pipelines

This dataset identifies high-pressure, large diameter pipelines which carry gas between gas terminals, power stations, compressors and storage facilities. The dataset does not include the Local Transmission System (LTS) which supplies gas directly into homes and businesses. This information has been extracted from databases held by National Grid and is provided for information only with no guarantee as to its completeness or accuracy. National Grid do not offer any warranty as to the accuracy of the available data and are excluded from any liability for any such inaccuracies or errors.

Records of National Grid high pressure gas transmission pipelines within 500m of the study site: 0

Database searched and no data found.

Groundsure
LOCATION INTELLIGENCE

5. Geology

5.1 Artificial Ground and Made Ground

Database searched and no data found.

The database has been searched on site, including a 50m buffer.

5.2 Superficial Ground and Drift Geology

The database has been searched on site, including a 50m buffer.

Lex Code	Description	Rock Type
ALV-XCZSV	ALLUVIUM	CLAY, SILT, SAND AND GRAVEL
GFDMP-XSV	GLACIOFLUVIAL DEPOSITS, MID PLEISTOCENE	SAND AND GRAVEL
ODT-DMTN	OADBY MEMBER	DIAMICTON
ODT-DMTN	OADBY MEMBER	DIAMICTON
ODT-DMTN	OADBY MEMBER	DIAMICTON

5.3 Bedrock and Solid Geology

The database has been searched on site, including a 50m buffer.

Lex Code	Description	Rock Type
WHM-MDST	WHITBY MUDSTONE FORMATION	MUDSTONE
MRB-FLMST	MARLSTONE ROCK FORMATION	LIMESTONE, FERRUGINOUS
DYS-SIMD	DYRHAM FORMATION	SILTSTONE AND MUDSTONE, INTERBEDDED
DYS-SIMD	DYRHAM FORMATION	SILTSTONE AND MUDSTONE, INTERBEDDED
MRB-FLMST	MARLSTONE ROCK FORMATION	LIMESTONE, FERRUGINOUS

(Derived from the BGS 1:50,000 Digital Geological Map of Great Britain)

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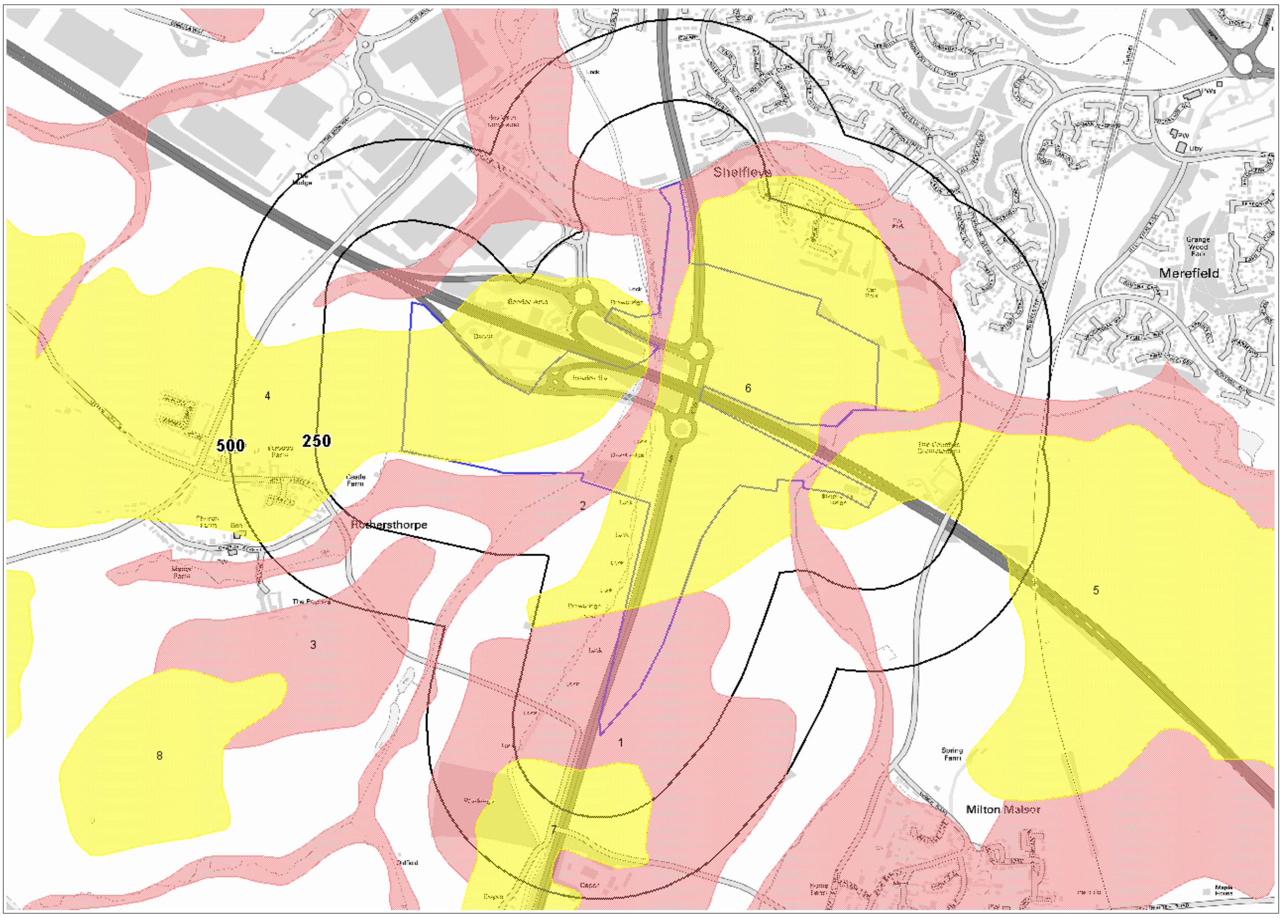
6 Hydrogeology and Hydrology

6a. Aquifer Within Superficial Geology

NW N NE

W E

SW S SE



Site Outline

250 — 500 — Search Buffers (m)

Principal Aquifer

Secondary (A) Aquifer - Permeable Layers

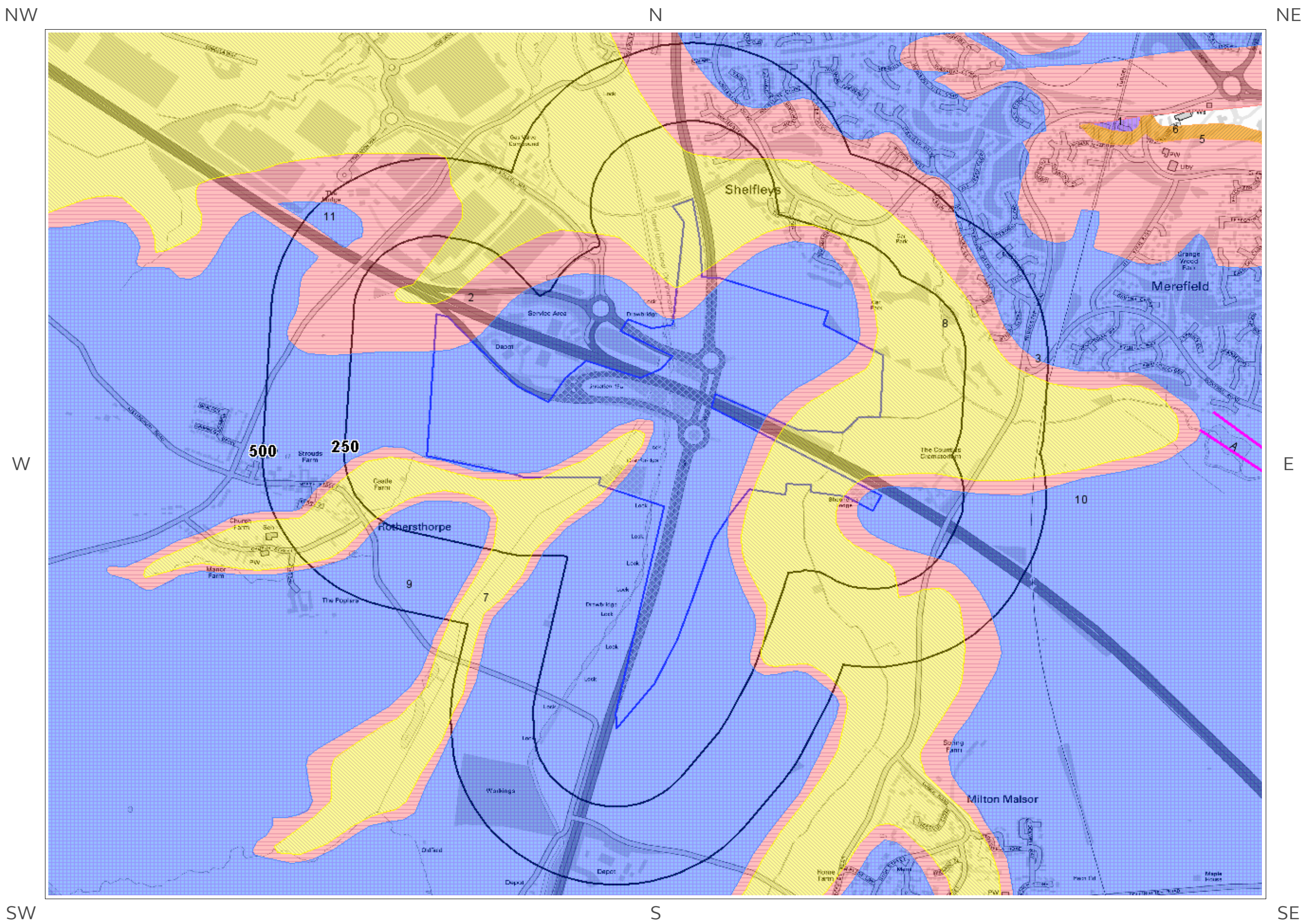
Secondary (B) Aquifer - Lower Permeability Layers

Secondary Aquifer - Undifferentiated Layers

Unproductive

Unknown (lakes and landslip)

6b. Aquifer Within Bedrock Geology and Abstraction Licenses



Site Outline

250
500
Search Buffers (m)

Principal Aquifer

Secondary (A) Aquifer - Permeable Layers

Secondary (B) Aquifer - Lower Permeability Layers

Groundwater Abstraction Licence

Secondary Aquifer - Undifferentiated Layers

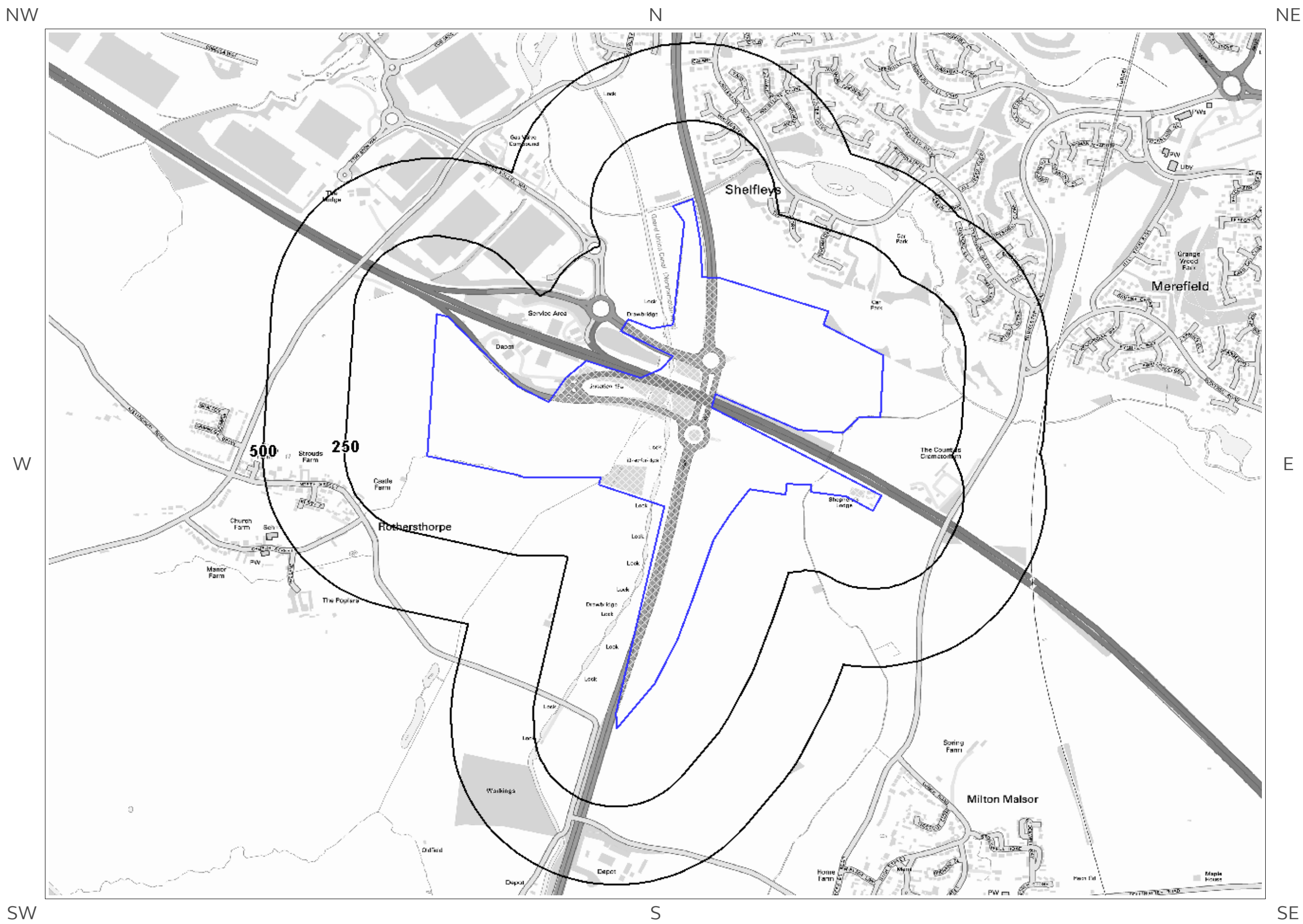
Unproductive

Unknown (lakes and landslip)

Surface Water Abstraction Licence

Groundsure
LOCATION INTELLIGENCE

6c. Hydrogeology – Source Protection Zones and Potable Water Abstraction Licenses



Site Outline

250
500
Search Buffers (m)

Source Protection Zone 1 - Inner Catchment

Source Protection Zone 2 - Outer Catchment

Source Protection Zone 3 - Total Catchment

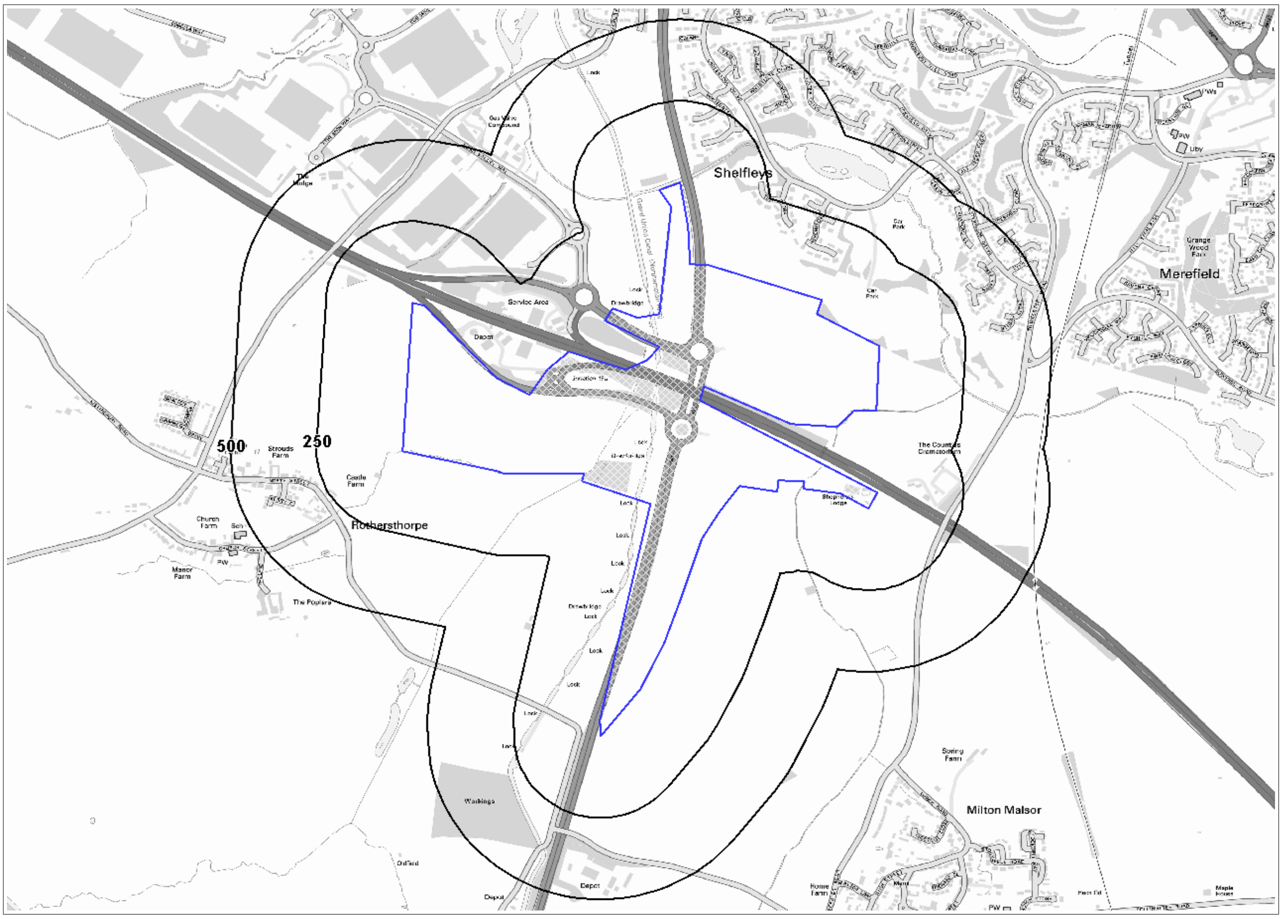
Source Protection Zone 4 - Zone of Special Interest

Potable Water Abstraction Licence

Groundsure
LOCATION INTELLIGENCE

6d. Hydrogeology – Source Protection Zones within confined aquifer

NW N NE

W 

E

SW S SE

Site Outline

250
500
Search Buffers (m)

Source Protection Zone 1 - Inner Catchment

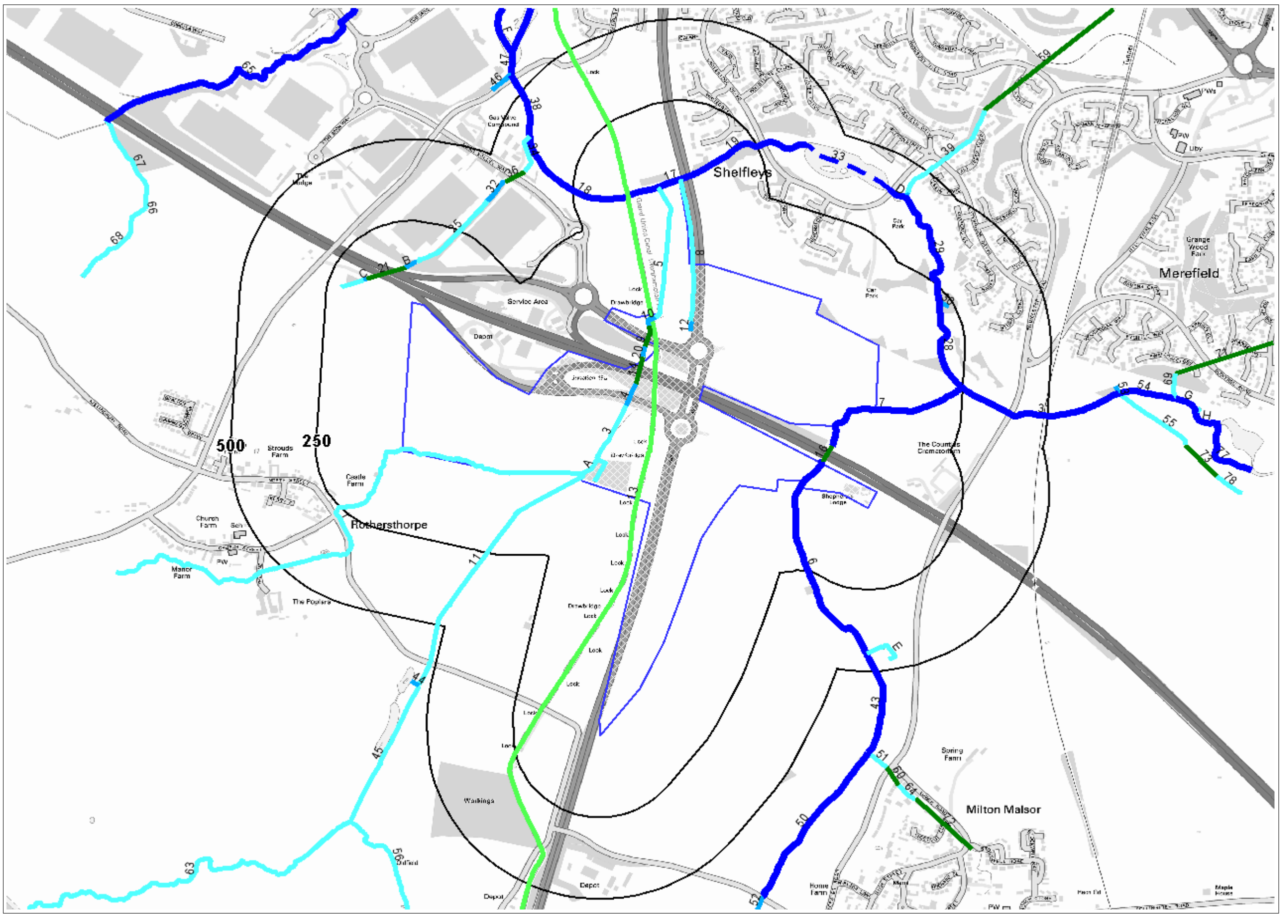
Source Protection Zone 2C - Outer Catchment within Confined Aquifer

Source Protection Zone 3C - Total Catchment within Confined Aquifer

Potable Water Abstraction Licence

6e. Hydrology – Detailed River Network and River Quality

NW N NE

W  E

SW S SE

- Site Outline
- 250 / 500 — Search Buffers (m)
- Primary River
- Secondary River
- Tertiary River
- Lake/Reservoir
- Underground River (inferred)
- General Quality Assessment: Biology
- General Quality Assessment: Chemistry
- Canal
- Canal Tunnel
- Culvert
- Multiple Channel Culvert
- Underground River (Potential Sewer)
- Underground River (local knowledge)

Groundsure
LOCATION INTELLIGENCE

6.Hydrogeology and Hydrology

6.1 Aquifer within Superficial Deposits

Are there records of strata classification within the superficial geology at or in proximity to the property? Yes

From 1 April 2010, the Environment Agency/Natural Resources Wales's Groundwater Protection Policy has been using aquifer designations consistent with the Water Framework Directive. For further details on the designation and interpretation of this information, please refer to the Groundsure Enviro Insight User Guide.

The following aquifer records are shown on the Aquifer within Superficial Geology Map (6a):

ID	Distance (m)	Direction	Designation	Description
1	0	On Site	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers
2	0	On Site	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers
4	0	On Site	Secondary (undifferentiated)	Assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type
5	0	On Site	Secondary (undifferentiated)	Assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type
6	0	On Site	Secondary (undifferentiated)	Assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type
7	92	S	Secondary (undifferentiated)	Assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type
3	255	S	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers

6.2 Aquifer within Bedrock Deposits

Are there records of strata classification within the bedrock geology at or in proximity to the property? Yes

From 1 April 2010, the Environment Agency/Natural Resources Wales's Groundwater Protection Policy has been using aquifer designations consistent with the Water Framework Directive. For further details on the designation and interpretation of this information, please refer to the Groundsure Enviro Insight User Guide.

The following aquifer records are shown on the Aquifer within Bedrock Geology Map (6b):

ID	Distance (m)	Direction	Designation	Description
2	0	On Site	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers

ID	Distance (m)	Direction	Designation	Description
3	0	On Site	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers
4	0	On Site	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers
7	0	On Site	Secondary (undifferentiated)	Assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type
8	0	On Site	Secondary (undifferentiated)	Assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type
9	0	On Site	Unproductive	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow
10	0	On Site	Unproductive	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow
11	336	NW	Unproductive	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow

6.3 Groundwater Abstraction Licences

Are there any Groundwater Abstraction Licences within 2000m of the study site? No

Database searched and no data found.

6.4 Surface Water Abstraction Licences

Are there any Surface Water Abstraction Licences within 2000m of the study site? Yes

The following Surface Water Abstraction Licences records are represented as points, lines and regions on the Aquifer within Bedrock Geology Map (6b):

ID	Distance (m)	Direction	NGR	Details	
12A	972	E	474260 257040	Status: Active Licence No: 5/32/04/*S/0055 Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: Wootton Brook At Collingtree Data Type: Line Name: COLLINGTREE PARK GOLF COURSE LTD	Annual Volume (m³): 27000 Max Daily Volume (m³): 570 Application No: NA319 Original Start Date: 18/6/2002 Expiry Date: - Issue No: 1 Version Start Date: 18/6/2002 Version End Date:
13A	972	E	474260 257040	Status: Active Licence No: 5/32/04/*S/0056 Details: Spray Irrigation - Storage Direct Source: Surface Water Source Of Supply Point: Wootton Brook At Collingtree Data Type: Line Name: COLLINGTREE PARK GOLF COURSE LTD	Annual Volume (m³): 12000 Max Daily Volume (m³): 570 Application No: NA320 Original Start Date: 18/6/2002 Expiry Date: - Issue No: 1 Version Start Date: 18/6/2002 Version End Date:

ID	Distance (m)	Direction	NGR	Details	
14A	1009	E	474300 257100	Status: Historical Licence No: 5/32/04/*S/0052B Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: Wootton Brook Data Type: Line Name: COLLINGTREE PARK GOLF COURSE	Annual Volume (m^3): - Max Daily Volume (m^3): - Application No: - Original Start Date: 1/2/1988 Expiry Date: - Issue No: 100 Version Start Date: 1/3/1993 Version End Date:
15A	1009	E	474300 257100	Status: Historical Licence No: 5/32/04/*S/0052B Details: Spray Irrigation - Storage Direct Source: Surface Water Source Of Supply Point: Wootton Brook Data Type: Line Name: COLLINGTREE PARK GOLF COURSE	Annual Volume (m^3): - Max Daily Volume (m^3): - Application No: - Original Start Date: 1/2/1988 Expiry Date: - Issue No: 100 Version Start Date: 1/3/1993 Version End Date:
16A	1009	E	474300 257100	Status: Historical Licence No: 5/32/04/*S/0052A Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: Wootton Brook Data Type: Line Name: COLLINGTREE PARK GOLF COURSE	Annual Volume (m^3): - Max Daily Volume (m^3): - Application No: - Original Start Date: 1/2/1988 Expiry Date: - Issue No: 100 Version Start Date: 1/3/1993 Version End Date:
Not shown	1497	SE	474600 256100	Status: Historical Licence No: 5/32/04/*S/0042 Details: General Farming & Domestic Direct Source: Surface Water Source Of Supply Point: Spring At Milton Data Type: Point Name: H C SARGEANT & SONS	Annual Volume (m^3): - Max Daily Volume (m^3): - Application No: - Original Start Date: 1/3/1966 Expiry Date: - Issue No: 100 Version Start Date: 1/3/1966 Version End Date:
Not shown	1821	N	472920 259590	Status: Active Licence No: 5/32/04/*S/0016 Details: Potable Water Supply - Storage Direct Source: Surface Water Source Of Supply Point: River Nene - Duston Mill Data Type: Point Name: ANGLIAN WATER SERVICES LIMITED	Annual Volume (m^3): 38500000 Max Daily Volume (m^3): 181800 Application No: - Original Start Date: 1/1/1966 Expiry Date: - Issue No: 102 Version Start Date: 6/11/2014 Version End Date:

6.5 Potable Water Abstraction Licences

Are there any Potable Water Abstraction Licences within 2000m of the study site? Yes

The following Potable Water Abstraction Licences records are represented as points, lines and regions on the SPZ and Potable Water Abstraction Licences Map (6c):

ID	Distance (m)	Direction	NGR	Details	
Not shown	1821	N	472920 259590	Status: Active Licence No: 5/32/04/*S/0016 Details: Potable Water Supply - Storage Direct Source: Surface Water Source Of Supply Point: River Nene - Duston Mill Data Type: Point Name: ANGLIAN WATER SERVICES LIMITED	Annual Volume (m^3): 38500000 Max Daily Volume (m^3): 181800 Original Application No: - Original Start Date: 1/1/1966 Expiry Date: - Issue No: 102 Version Start Date: Version End Date:

6.6 Source Protection Zones

Are there any Source Protection Zones within 500m of the study site? No

Database searched and no data found.

6.7 Source Protection Zones within Confined Aquifer

Are there any Source Protection Zones within the Confined Aquifer within 500m of the study site? No

Historically, Source Protection Zone maps have been focused on regulation of activities which occur at or near the ground surface, such as prevention of point source pollution and bacterial contamination of water supplies. Sources in confined aquifers were often considered to be protected from these surface pressures due to the presence of a low permeability confining layer (e.g. glacial till, clay). The increased interest in subsurface activities such as onshore oil and gas exploration, ground source heating and cooling requires protection zones for confined sources to be marked on SPZ maps where this has not already been done.

Database searched and no data found.

6.8 Groundwater Vulnerability and Soil Leaching Potential

Is there any Environment Agency/Natural Resources Wales information on groundwater vulnerability and soil leaching potential within 500m of the study site? Yes

Distance (m)	Direction	Classification	Soil Vulnerability Category	Description
0	On Site	Minor Aquifer/High Leaching Potential	H2	Deep, permeable, coarse textured soils which readily transmit a wide range of pollutants because of their rapid drainage and low attenuation potential.
0	On Site	Minor Aquifer/Low Leaching Potential	L	Soils in which pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or they have the ability to attenuate diffuse pollutants.
0	On Site	Minor Aquifer/Low Leaching Potential	L	Soils in which pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or they have the ability to attenuate diffuse pollutants.
0	On Site	Minor Aquifer/High Leaching Potential	H1	Soils which readily transmit liquid discharges because they are shallow or susceptible to rapid flow directly to rock, gravel or groundwater.
77	S	Minor Aquifer/Intermediate Leaching Potential	I1	Soils which can possibly transmit a wide range of pollutants.
271	S	Minor Aquifer/High Leaching Potential	H2	Deep, permeable, coarse textured soils which readily transmit a wide range of pollutants because of their rapid drainage and low attenuation potential.

6.9 River Quality

Is there any Environment Agency/Natural Resources Wales information on river quality within 1500m of the study site? Yes

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6.9.1 Biological Quality:

Biological Quality data describes water quality in terms of 83 groups of macroinvertebrates, some of which are pollution sensitive. The results are graded from A ('Very Good') to F ('Bad').

The following Biological Quality records are shown on the Hydrology Map (6e):

ID	Distance (m)	Direction	NGR	River Quality Grade	Biological Quality Grade				
					2005	2006	2007	2008	2009
Not shown	962	NW	472200 258600	River Name: Wootton Brook Reach: Quinton Brook...gayton Arm End/Start of Stretch: End of Stretch NGR	A	B	B	B	A
Not shown	962	NW	472200 258600	River Name: Wootton Brook Reach: Gayton Arm...nene End/Start of Stretch: Start of Stretch NGR	A	B	B	B	A
Not shown	1069	N	472400 258800	River Name: Nene Reach: Bugbrooke...wootton Brook End/Start of Stretch: End of Stretch NGR	B	B	B	B	B
Not shown	1069	N	472400 258800	River Name: Wootton Brook Reach: Gayton Arm...nene End/Start of Stretch: End of Stretch NGR	A	B	B	B	A

6.9.2 Chemical Quality:

Chemical quality data is based on the General Quality Assessment Headline Indicators scheme (GQAHI). In England, each chemical sample is measured for ammonia and dissolved oxygen. In Wales, the samples are measured for biological oxygen demand (BOD), ammonia and dissolved oxygen. The results are graded from A ('Very Good') to F ('Bad').

The following Chemical Quality records are shown on the Hydrology Map (6e):

ID	Distance (m)	Direction	NGR	River Quality Grade	Chemical Quality Grade				
					2005	2006	2007	2008	2009
Not shown	1069	N	472400 258800	River Name: Nene Reach: Wootton Brook Duston Mill End/Start of Stretch: Start of Stretch NGR	B	B	B	B	B

6.10 Detailed River Network

Are there any Detailed River Network entries within 500m of the study site? Yes

The following Detailed River Network records are represented on the Hydrology Map (6e):

ID	Distance (m)	Direction	Details	
1	0	On Site	River Name: - Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined

ID	Distance (m)	Direction	Details	
2A	0	On Site	River Name: - Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
3	0	On Site	River Name: - Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
4	0	On Site	River Name: - Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
5	0	On Site	River Name: - Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
6	0	On Site	River Name: - Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
7	0	On Site	River Name: - Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
8	0	On Site	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
9	0	On Site	River Name: - Welsh River Name: - Alternative Name: -	River Type: Culvert Main River Status: Currently Undefined
10	0	On Site	River Name: - Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
11	0	On Site	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
12	0	On Site	River Name: - Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
13	0	On Site	River Name: Grand Union Canal (Northampton Arm) Welsh River Name: - Alternative Name: -	River Type: Canal Main River Status: Currently Undefined
14	0	On Site	River Name: - Welsh River Name: - Alternative Name: -	River Type: Culvert Main River Status: Currently Undefined
15A	0	On Site	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
16	3	NE	River Name: - Welsh River Name: - Alternative Name: -	River Type: Culvert Main River Status: Currently Undefined
17	9	N	River Name: - Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
18	9	NW	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
19	10	N	River Name: - Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
20	14	NW	River Name: - Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined

ID	Distance (m)	Direction	Details	
21	109	N	River Name: - Welsh River Name: - Alternative Name: -	River Type: Culvert Main River Status: Currently Undefined
22B	110	N	River Name: - Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
23B	126	N	River Name: - Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
24B	135	N	River Name: - Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
25	138	N	River Name: - Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
26C	150	NW	River Name: - Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
27C	156	NW	River Name: - Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
28	178	E	River Name: - Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
29	219	NE	River Name: - Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
30	219	NE	River Name: - Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
31	245	E	River Name: - Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
32	370	NE	River Name: - Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
33	380	E	River Name: - Welsh River Name: - Alternative Name: -	River Type: Lake/Reservoir Main River Status: Currently Undefined
34	381	W	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
35D	387	NE	River Name: - Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
36	394	W	River Name: - Welsh River Name: - Alternative Name: -	River Type: Culvert Main River Status: Currently Undefined
37D	396	NE	River Name: - Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
38	411	NW	River Name: - Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined
39	412	NE	River Name: - Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined

ID	Distance (m)	Direction	Details	
40E	422	S	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
41E	427	S	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
42E	427	S	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
43	447	S	River Name: - Welsh River Name: - Alternative Name: -	River Type: Primary River Main River Status: Currently Undefined

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6.11 Surface Water Features

Are there any surface water features within 250m of the study site? Yes

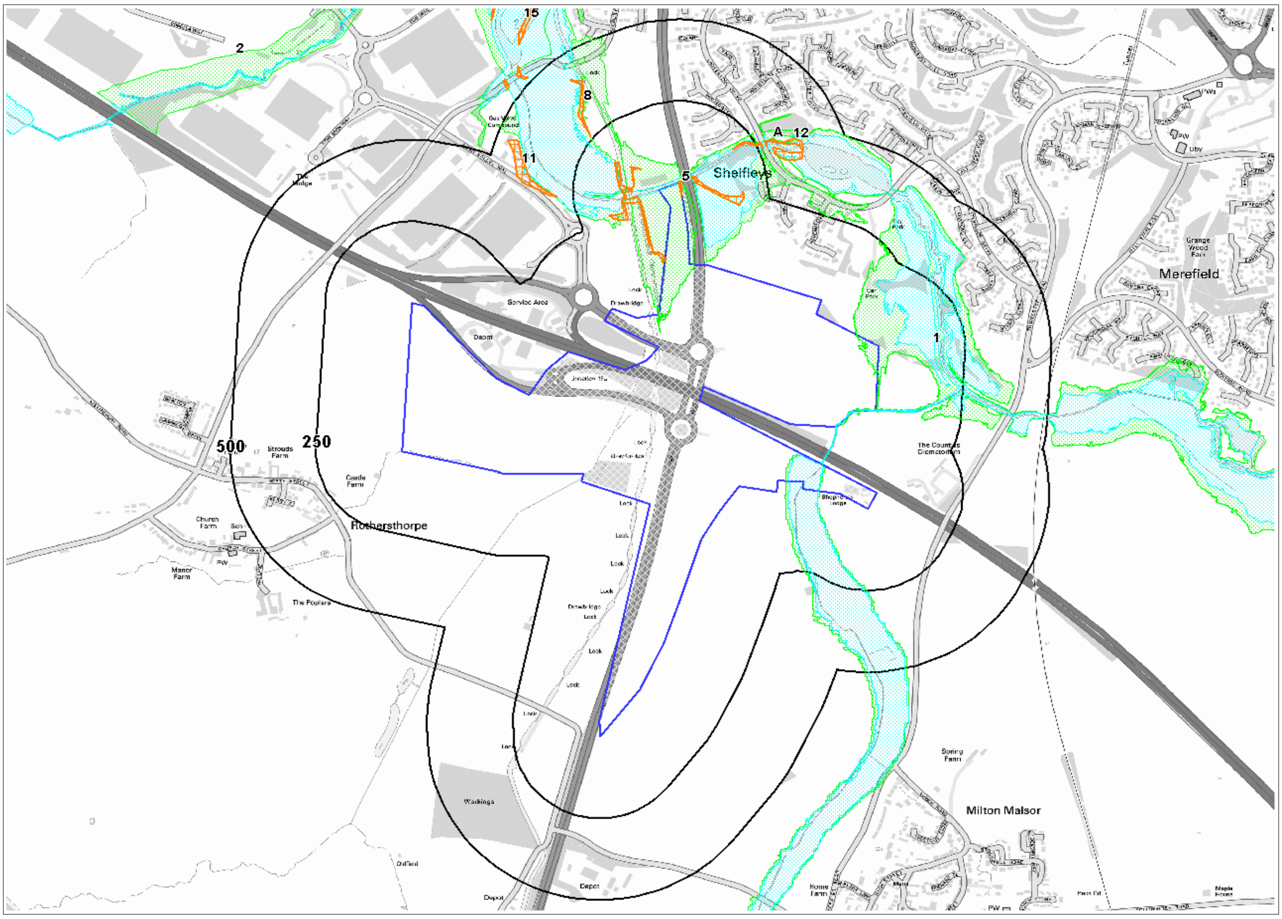
The following surface water records are not represented on mapping:

Distance (m)	Direction
0	On Site
0	On Site
0	On Site
0	On Site
0	On Site
0	On Site
0	On Site
0	On Site
0	On Site
0	On Site
0	On Site
0	On Site
0	On Site
0	On Site
0	On Site
0	On Site
0	On Site
0	W
4	W
35	NE
44	W
52	W
103	S
104	W
126	N
130	S
135	N
138	N
156	NW
161	NW
167	W
173	E
175	SW

7a. Environment Agency/Natural Resources Wales Flood Map for Planning (from rivers and the sea)

NW N NE

W E



SW S SE

Zone 2 Floodplain

Area used for Flood Storage

Site Outline

Zone 3 Floodplain

Area Benefiting from Flood Defences

100
250
Search Buffers (m)

Flood Defences

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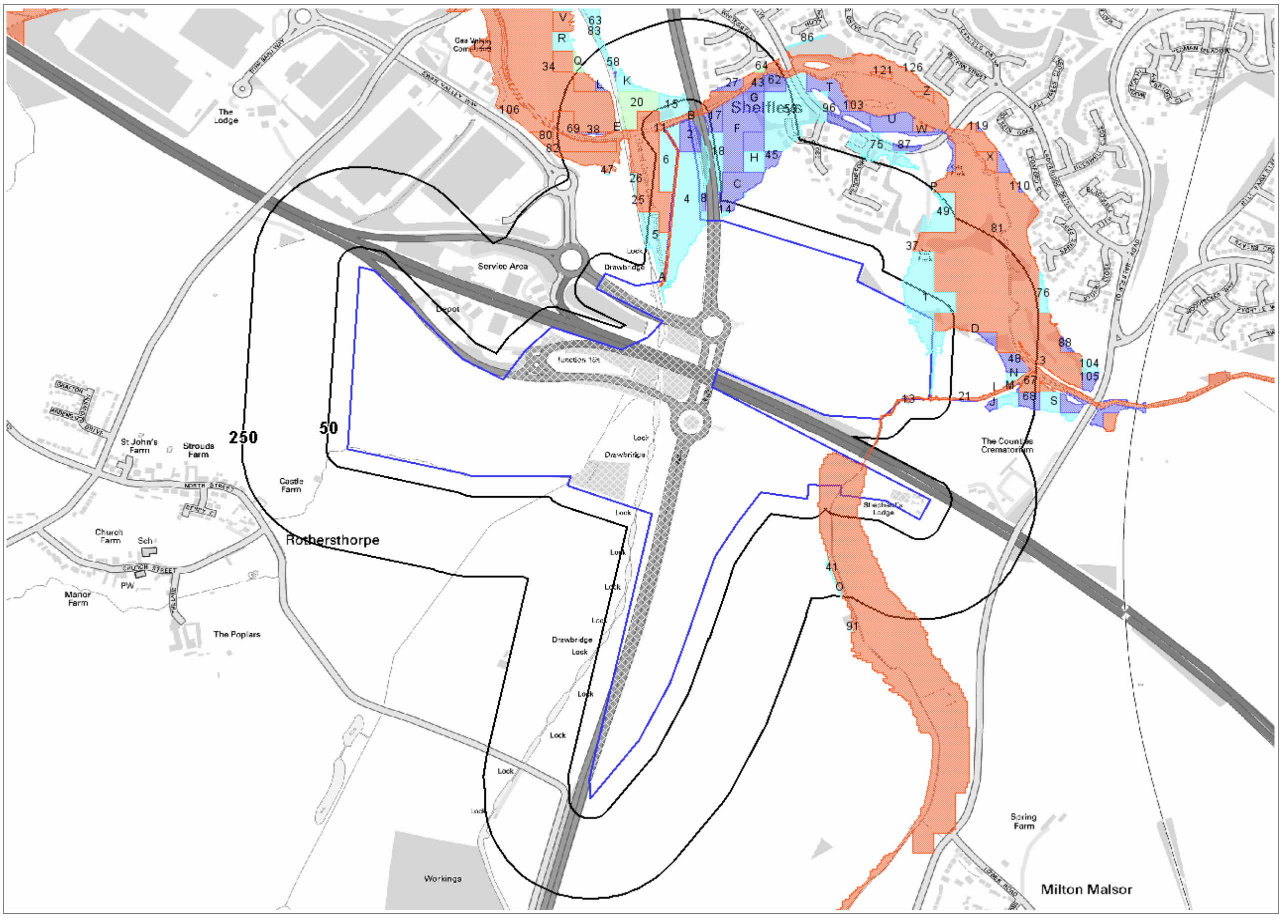
7b. Environment Agency/Natural Resources Wales Risk of Flooding from Rivers and the Sea (RoFRaS) Map

NW N NE

W E



SW S SE

Site Outline

100
250
Search Buffers (m)

RoFRaS Rating

Very Low

Low

Medium

High

7 Flooding

7.1 River and Coastal Zone 2 Flooding

Is the site within 250m of an Environment Agency/Natural Resources Wales Zone 2 floodplain? Yes

Environment Agency/Natural Resources Wales Zone 2 floodplains estimate the annual probability of flooding as between 1 in 1000 (0.1%) and 1 in 100 (1%) from rivers and between 1 in 1000 (0.1%) and 1 in 200 (0.5%) from the sea. Any relevant data is represented on Map 7a – Flood Map for Planning:

ID	Distance (m)	Direction	Update	Type
1	0	On Site	12-May-2017	Zone 2 - (Fluvial /Tidal Models)

7.2 River and Coastal Zone 3 Flooding

Is the site within 250m of an Environment Agency/Natural Resources Wales Zone 3 floodplain? Yes

Zone 3 shows the extent of a river flood with a 1 in 100 (1%) or greater chance of occurring in any year or a sea flood with a 1 in 200 (0.5%) or greater chance of occurring in any year. Any relevant data is represented on Map 7a – Flood Map for Planning.

ID	Distance (m)	Direction	Update	Type
1	0	On Site	15-May-2017	Zone 3 - (Fluvial Models)

7.3 Risk of Flooding from Rivers and the Sea (RoFRaS) Flood Rating

What is the highest risk of flooding onsite? High

The Environment Agency/Natural Resources Wales RoFRaS database provides an indication of river and coastal flood risk at a national level on a 50m grid with the flood rating at the centre of the grid calculated and given above. The data considers the probability that the flood defences will overtop or breach by considering their location, type, condition and standard of protection.

RoFRaS data for the study site indicates the property is in an area with a High (1 in 30 or greater) chance of flooding in any given year.

Any relevant data within 250m is represented on the RoFRaS Flood map. Data to 50m is reported in the table below.

ID	Distance (m)	Direction	RoFRas flood Risk
1	0.0	On Site	Low
2	0.0	On Site	Medium

3	0.0	On Site	High
4	0.0	On Site	Low
5	0.0	W	Low
6	1.0	SW	Low
7A	1.0	N	Low
8	2.0	E	Medium
9A	2.0	W	Low
10A	2.0	W	Low
11	2.0	SW	High
12B	3.0	E	Medium
13	7.0	S	Low
14	10.0	N	Low
15	15.0	N	Low
16C	23.0	N	Medium
17	33.0	E	Medium
18	39.0	E	Low
19B	39.0	NE	Low
20	45.0	N	Very Low
21	47.0	E	Medium

7.4 Flood Defences

Are there any Flood Defences within 250m of the study site? No

Database searched and no data found.

7.5 Areas benefiting from Flood Defences

Are there any areas benefiting from Flood Defences within 250m of the study site? Yes

7.6 Areas benefiting from Flood Storage

Are there any areas used for Flood Storage within 250m of the study site? No

7.7 Groundwater Flooding Susceptibility Areas

7.7.1 Are there any British Geological Survey groundwater flooding susceptibility areas within 50m of the boundary of the study site? Yes

Does this relate to Clearwater Flooding or Superficial Deposits Flooding? Superficial Deposits Flooding

Notes: Groundwater flooding may either be associated with shallow unconsolidated sedimentary aquifers which overlie unproductive aquifers (Superficial Deposits Flooding), or with unconfined aquifers (Clearwater Flooding).

7.7.2 What is the highest susceptibility to groundwater flooding in the search area based on the underlying geological conditions?

Potential at Surface

Where potential for groundwater flooding to occur at surface is indicated, this means that given the geological conditions in the area groundwater flooding hazard should be considered in all land-use planning decisions. It is recommended that other relevant information e.g. records of previous incidence of groundwater flooding, rainfall, property type, and land drainage information be investigated in order to establish relative, but not absolute, risk of groundwater flooding.

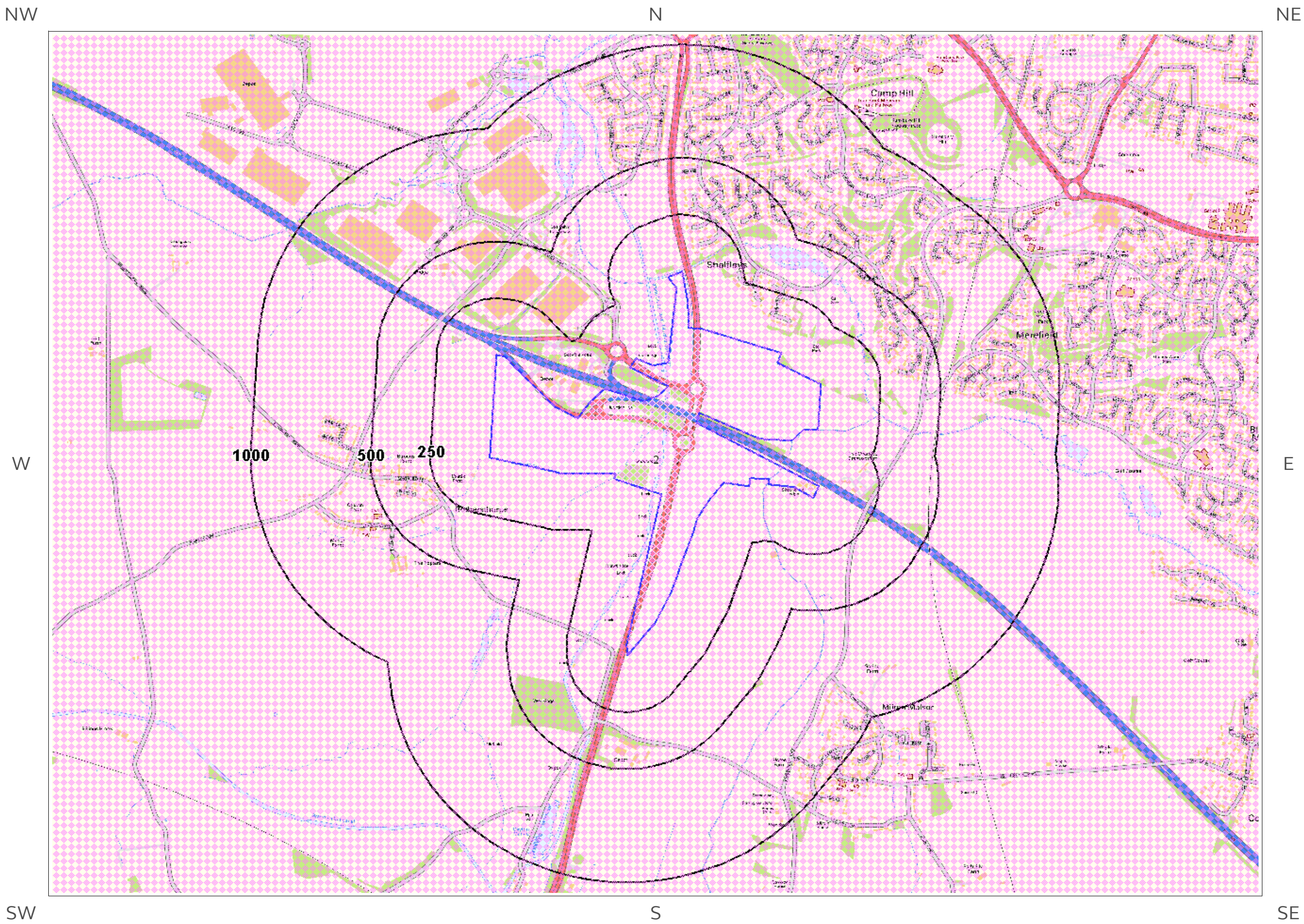
7.8 Groundwater Flooding Confidence Areas

What is the British Geological Survey confidence rating in this result? High

Notes: Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

The confidence rating is on a threefold scale - Low, Moderate and High. This provides a relative indication of the BGS confidence in the accuracy of the susceptibility result for groundwater flooding. This is based on the amount and precision of the information used in the assessment. In areas with a relatively lower level of confidence the susceptibility result should be treated with more caution. In other areas with higher levels of confidence the susceptibility result can be used with more confidence.

8. Designated Environmentally Sensitive Sites Map



Site Outline
100
250
Search Buffers (m)

AONB
National Park
SSSI
Special Protection Areas
Nitrate Vulnerable Zones
Green Belt
Environmentally Sensitive Areas
Special Areas of Conservation
World Heritage Sites
Nitrate Sensitive Areas
Ancient Woodland
National Nature Reserve
Local Nature Reserves
Ramsar Sites

8. Designated Environmentally Sensitive Sites

Presence of Designated Environmentally Sensitive Sites within 2000m of the study site? Yes

8.1 Records of Sites of Special Scientific Interest (SSSI) within 2000m of the study site:

0

Database searched and no data found.

8.2 Records of National Nature Reserves (NNR) within 2000m of the study site:

0

Database searched and no data found.

8.3 Records of Special Areas of Conservation (SAC) within 2000m of the study site:

0

Database searched and no data found.

8.4 Records of Special Protection Areas (SPA) within 2000m of the study site:

0

Database searched and no data found.

8.5 Records of Ramsar sites within 2000m of the study site:

0

Database searched and no data found.

8.6 Records of Ancient Woodland within 2000m of the study site:

0

Database searched and no data found.

8.7 Records of Local Nature Reserves (LNR) within 2000m of the study site:

1

The following Local Nature Reserve (LNR) records provided by Natural England/Natural Resources Wales are represented as polygons on the Designated Environmentally Sensitive Sites Map:

ID	Distance (m)	Direction	LNR Name	Data Source
Not shown	1975	N	Storton's Pits	Natural England

8.8 Records of World Heritage Sites within 2000m of the study site:

0

Database searched and no data found.

8.9 Records of Environmentally Sensitive Areas within 2000m of the study site:

0

Database searched and no data found.

8.10 Records of Areas of Outstanding Natural Beauty (AONB) within 2000m of the study site:

0

Database searched and no data found.

8.11 Records of National Parks (NP) within 2000m of the study site:

0

Database searched and no data found.

8.12 Records of Nitrate Sensitive Areas within 2000m of the study site:

0

Database searched and no data found.

8.13 Records of Nitrate Vulnerable Zones within 2000m of the study site:

2

The following Nitrate Vulnerable Zone records produced by DEFRA are represented as polygons on the Designated Environmentally Sensitive Sites Map:

ID	Distance (m)	Direction	NVZ Name	Data Source
2	0	On Site	Existing	DEFRA
Not shown	1915	W	Existing	DEFRA

8.14 Records of Green Belt land within 2000m of the study site:

0

Database searched and no data found.

9. Natural Hazards Findings

9.1 Detailed BGS GeoSure Data

BGS GeoSure Data has been searched to 50m. The data is included in tabular format. If you require further information on geology and ground stability, please obtain a Groundsure Geo Insight, available from our website. The following information has been found:

9.1.1 Shrink Swell

What is the maximum Shrink-Swell** hazard rating identified on the study site? Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
Ground conditions predominantly medium plasticity. Do not plant trees with high soil moisture demands near to buildings. For new build, consideration should be given to advice published by the National House Building Council (NHBC) and the Building Research Establishment (BRE). There is a possible increase in construction cost to reduce potential shrink-swell problems. For existing property, there is a possible increase in insurance risk, especially during droughts or where vegetation with high moisture demands is present.

9.1.2 Landslides

What is the maximum Landslide* hazard rating identified on the study site? Very Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
Slope instability problems are unlikely to be present. No special actions required to avoid problems due to landslides. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with landslides.

9.1.3 Soluble Rocks

What is the maximum Soluble Rocks* hazard rating identified on the study site? Very Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
Significant soluble rocks are present. Problems unlikely except with considerable surface or subsurface water flow. No special actions required to avoid problems due to soluble rocks. No special ground investigation required or increased construction costs are likely. An increase in financial risk due to potential problems with soluble rocks is unlikely.

* This indicates an automatically generated 50m buffer and site.

9.1.4 Compressible Ground

What is the maximum Compressible Ground* hazard rating identified on the study site? Moderate

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
Significant potential for compressibility problems. Avoid large differential loadings of ground. Do not drain or de-water ground near the property without technical advice. For new build consider possibility of compressible ground in ground investigation, construction and building design. Consider effects of groundwater changes. Extra construction costs are likely. For existing property possible increase in insurance risk from compressibility, especially if water conditions or loading of the ground change significantly.

9.1.5 Collapsible Rocks

What is the maximum Collapsible Rocks* hazard rating identified on the study site? Very Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.

9.1.6 Running Sand

What is the maximum Running Sand** hazard rating identified on the study site? Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
Possibility of running sand problems after major changes in ground conditions. Normal maintenance to avoid leakage of water-bearing services or water bodies (ponds, swimming pools) should reduce likelihood of problems due to running sand. For new build consider possibility of running sand into trenches or excavations if water table is high or sandy strata are exposed to water. Avoid concentrated water inputs to site. Unlikely to be an increase in construction costs due to potential for running sand. For existing property no significant increase in insurance risk due to running sand problems is likely.

9.2 Radon

9.2.1 Radon Affected Areas

Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level? The property is in a Radon Affected Area, as between 3 and 5% of properties are above the Action Level.

* This indicates an automatically generated 50m buffer and site.

9.2.2 Radon Protection

Is the property in an area where Radon Protection are required for new properties or extensions to existing
ones as described in publication BR211 by the Building Research Establishment? Basic radon protective measures are necessary.

10. Mining

10.1 Coal Mining

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

Database searched and no data found.

10.2 Non-Coal Mining

Are there any Non-Coal Mining areas within 50m of the study site boundary?	No

Database searched and no data found.

10.3 Brine Affected Areas

Are there any brine affected areas within 75m of the study site? Guidance: No Guidance Required.	No

Contact Details

Groundsure Helpline
Telephone: 08444 159 000
info@groundsure.com

British Geological Survey Enquiries
Kingsley Dunham Centre
Keyworth, Nottingham NG12 5GG
Tel: 0115 936 3143.
Fax: 0115 936 3276.
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BGS Geological Hazards Reports and general geological enquiries:
enquiries@bgs.ac.uk

Environment Agency
National Customer Contact Centre, PO Box 544
Rotherham, S60 1BY
Tel: 03708 506 506
Web: **www.environment-agency.gov.uk**
Email: enquiries@environment-agency.gov.uk

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Public information access office
Public Health England, Wellington House
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www.gov.uk/phe
Email:**enquiries@phe.gov.uk**
Main switchboard**: 020 7654 8000**

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DX 716176 Mansfield 5
www.coal.gov.uk

Ordnance Survey
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SO16 0AS
Tel: 08456 050505

Local Authority
Authority: South Northamptonshire Council
Phone: 0845 230 0226
Web: http://www.southnorthants.gov.uk/
Address: Springfields, Towcester, Northants, NN12 6AE

Gemapping PLC
Virginia Villas, High Street, Hartley Witney,
Hampshire RG27 8NW
Tel: 01252 845444

Acknowledgements: Site of Special Scientific Interest, National Nature Reserve, Ramsar Site, Special Protection Area, Special Area of Conservation data is provided by, and used with the permission of, Natural England who retain the Copyright and Intellectual Property Rights for the data.

Standard Terms and Conditions

Groundsure's Terms and Conditions can be viewed online at this link:
https://www.groundsure.com/terms-and-conditions-sept-2016

Groundsure
LOCATION INTELLIGENCE

Hydrock Consultants Ltd

2-4 HAWTHORN PARK HYDROCK, HOLDENBY ROAD,
NORTHAMPTON/SPRATTON, NN6 8LD

Groundsure Reference:	GS-4001369
Your Reference:	POP009664
Report Date	19 Jun 2017
Report Delivery Method:	Email - pdf

Geo Insight

Address: 472716, 257183,

Dear Sir/ Madam,

Thank you for placing your order with Groundsure. Please find enclosed the **Groundsure Geo Insight** as requested.

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

Yours faithfully,

Managing Director
Groundsure Limited

Enc.
Groundsure Geo Insight

Geo Insight

Groundsure
LOCATION INTELLIGENCE

Address: 472716, 257183,

Date: 19 Jun 2017

Reference: GS-4001369

Client: Hydrock Consultants Ltd

Aerial Photograph Capture date: 16-Apr-2014
Grid Reference: 472679,256717
Site Size: 72.31ha

Contents Page

Overview of Findings

The Groundsure Geo Insight provides high quality geo-environmental information that allows geo-environmental professionals and their clients to make informed decisions and be forewarned of potential ground instability problems that may affect the ground investigation, foundation design and possibly remediation options that could lead to possible additional costs.

The report is based on the BGS 1:50,000 and 1:10,000 Digital Geological Map of Great Britain, BGS Geosure data; BRITPITS database; Non-coal mining data and Borehole Records, Coal Authority data including brine extraction areas, PBA non-coal mining and natural cavities database, Johnson Poole and Bloomer mining data and Groundsure's unique database including historical surface ground and underground workings.

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

Section 1: Geology 1:10,000 Scale

1.1 Artificial Ground	1.1 Is there any Artificial Ground/ Made Ground present beneath the study site at 1:10,000 scale?	No
1.2 Superficial Geology and Landslips	1.2.1 Is there any Superficial Ground/Drift Geology present beneath the study site at 1:10,000 scale?*	Yes
	1.2.2 Are there any records of landslip within 500m of the study site boundary at 1:10,000 scale?	No
1.3 Bedrock, Solid Geology and Faults	1.3.1 For records of Bedrock and Solid Geology beneath the study site* see the detailed findings section.	
	1.3.2 Are there any records of faults within 500m of the study site boundary at 1:10,000 scale?	No

Section 2: Geology 1:50,000 Scale

2.1 Artificial Ground	2.1.1 Is there any Artificial Ground/ Made Ground present beneath the study site?	No
	2.1.2 Are there any records relating to permeability of artificial ground within the study site*boundary?	No
2.2 Superficial Geology and Landslips	2.2.1 Is there any Superficial Ground/Drift Geology present beneath the study site?*	Yes
	2.2.2 Are there any records of permeability of superficial ground within 500m of the study site?	Yes
	2.2.3 Are there any records of landslip within 500m of the study site boundary?	No
	2.2.4 Are there any records relating to permeability of landslips within the study site* boundary?	No

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Section 2: Geology 1:50,000 Scale

2.3 Bedrock, Solid Geology and Faults	2.3.1 For records of Bedrock and Solid Geology beneath the study site* see the detailed findings section.	
	2.3.2 Are there any records relating to permeability of bedrock ground within the study site boundary?	Yes
	2.3.3 Are there any records of faults within 500m of the study site boundary?	No

Section 3: Radon

3. Radon	3.1Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level?	The property is in a Radon Affected Area, as between 3 and 5% of properties are above the Action Level.
	3.2Radon Protection	Basic radon protective measures are necessary.

Section 4: Ground Workings	On-site	0-50m	51-250	251-500	501-1000
4.1 Historical Surface Ground Working Features from Small Scale Mapping	14	8	8	Not Searched	Not Searched
4.2 Historical Underground Workings from Small Scale Mapping	0	0	0	0	13
4.3 Current Ground Workings	0	0	0	2	4

Section 5: Mining, Extraction & Natural Cavities	On-site	0-50m	51-250	251-500	501-1000
5.1 Historical Mining	0	0	0	0	4
5.2 Coal Mining	0	0	0	0	0
5.3 Johnson Poole and Bloomer Mining Area	0	0	0	0	0
5.4 Non-Coal Mining*	0	0	0	0	0
5.5 Non-Coal Mining Cavities	0	0	0	0	0
5.5 Natural Cavities	0	0	0	0	2

Section 5: Mining, Extraction & Natural Cavities	On-site	0-50m	51-250	251-500	501-1000
5.6 Brine Extraction	0	0	0	0	0
5.7 Gypsum Extraction	0	0	0	0	0
5.8 Tin Mining	0	0	0	0	0
5.9 Clay Mining	0	0	0	0	0

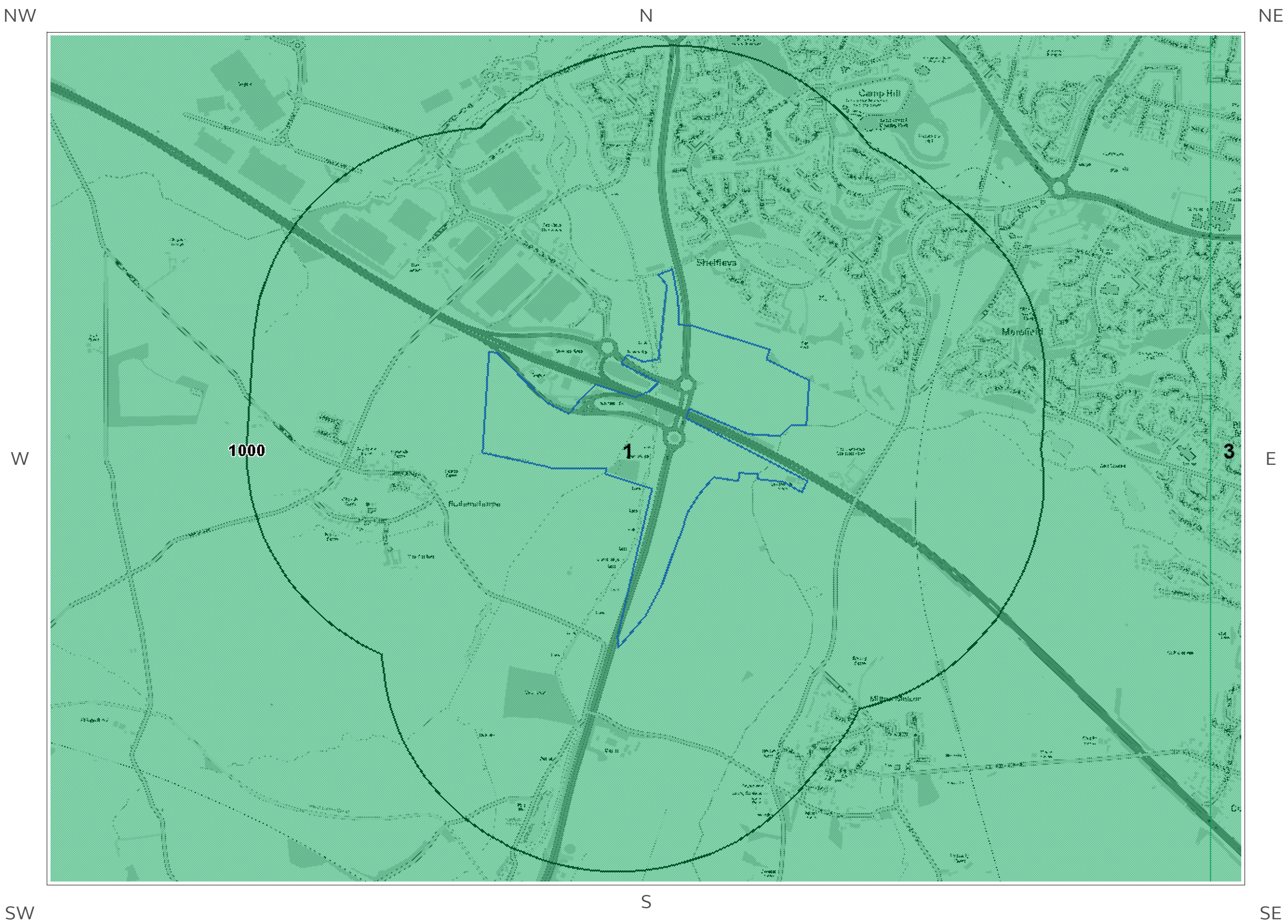
Section 6: Natural Ground Subsidence	On-site
6.1 Shrink-Swell Clay	Low
6.2 Landslides	Very Low
6.3 Ground Dissolution of Soluble Rocks	Very Low
6.4 Compressible Deposits	Moderate
6.5 Collapsible Deposits	Very Low
6.5 Running Sand	Low

Section 7: Borehole Records	On-site	0-50m	51-250
7 BGS Recorded Boreholes	71	32	49

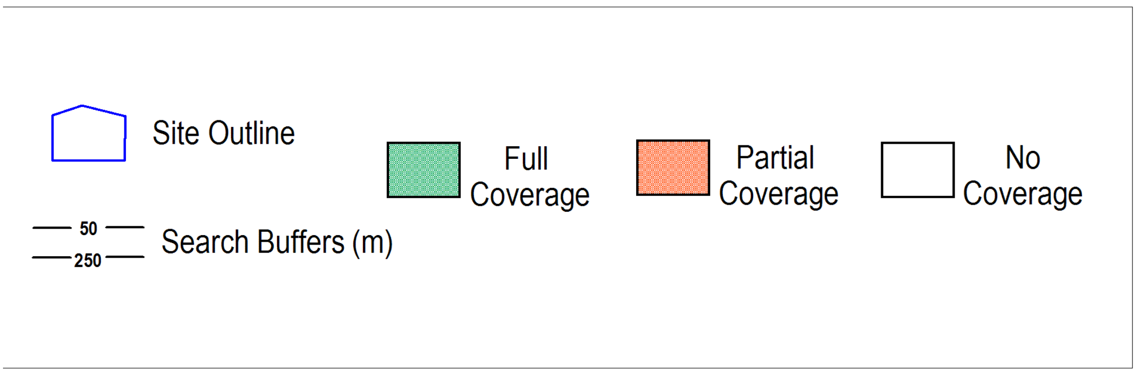
Section 8: Estimated Background Soil Chemistry	On-site	0-50m	51-250
8 Records of Background Soil Chemistry	77	23	0

Section 9: Railways and Tunnels	On-site	0-50m	51-250	250-500
9.1 Tunnels	0	0	0	Not Searched
9.2 Historical Railway and Tunnel Features	0	0	0	Not Searched
9.3 Historical Railways	3	0	0	Not Searched
9.4 Active Railways	0	0	0	Not Searched
9.5 Railway Projects	0	0	0	0

1:10,000 Scale Availability



1_10,000 Availability Legend



Groundsure
LOCATION INTELLIGENCE

Availability of 1:10,000 Scale Geology Mapping

The following information represents the availability of the key components of the 1:10,000 scale geological data.

ID	Distance	Artificial Coverage	Superficial Coverage	Bedrock Coverage	Mass Movement Coverage
1	0.0	Some deposits are mapped	Full	Full	No coverage
N2	1086.0	No deposits are mapped	No coverage	No coverage	No coverage
3	1701.0	Some deposits are mapped	Full	Full	No coverage
N4	1915.0	Some deposits are mapped	Full	Full	No coverage

Guidance: The 1:10,000 scale geological interpretation is the most detailed generally available from BGS and is the scale at which most geological surveying is carried out in the field. The database is presented as four types of geology (artificial, mass movement, superficial and bedrock), although not all themes are mapped or available on every map sheet. Therefore a coverage layer showing the availability of the four themes is presented above.

The definitions of coverage are as follows:

Geology	Full Coverage	Partial Coverage	No Coverage
Bedrock	The whole tile has been mapped	Some but not all the tile has been mapped	No coverage
Superficial	The whole tile has been mapped	Some but not all of the tile has been mapped	No coverage
Artificial	Some deposits are mapped on this tile	-	No deposits are mapped
Mass Movement	Some deposits are mapped on this tile	-	No coverage

1 Geology (1:10,000 scale).

1.1 Artificial Ground Map (1:10,000 scale)

Artificial Ground Legend

Site Outline

Search Buffers (m) — 500, 1000

Made Ground (undivided)

Disturbed Ground (undivided)

Worked Ground (undivided)

Landscaped Ground (undivided)

Infilled Ground

Reclaimed Ground

1. Geology 1:10,000 scale

1.1 Artificial Ground

The following geological information represented on the mapping is derived from 1:10,000 scale BGS Geological mapping.

Are there any records of Artificial/ Made Ground within 500m of the study site boundary at 1:10,000 scale? No

Database searched and no data found.

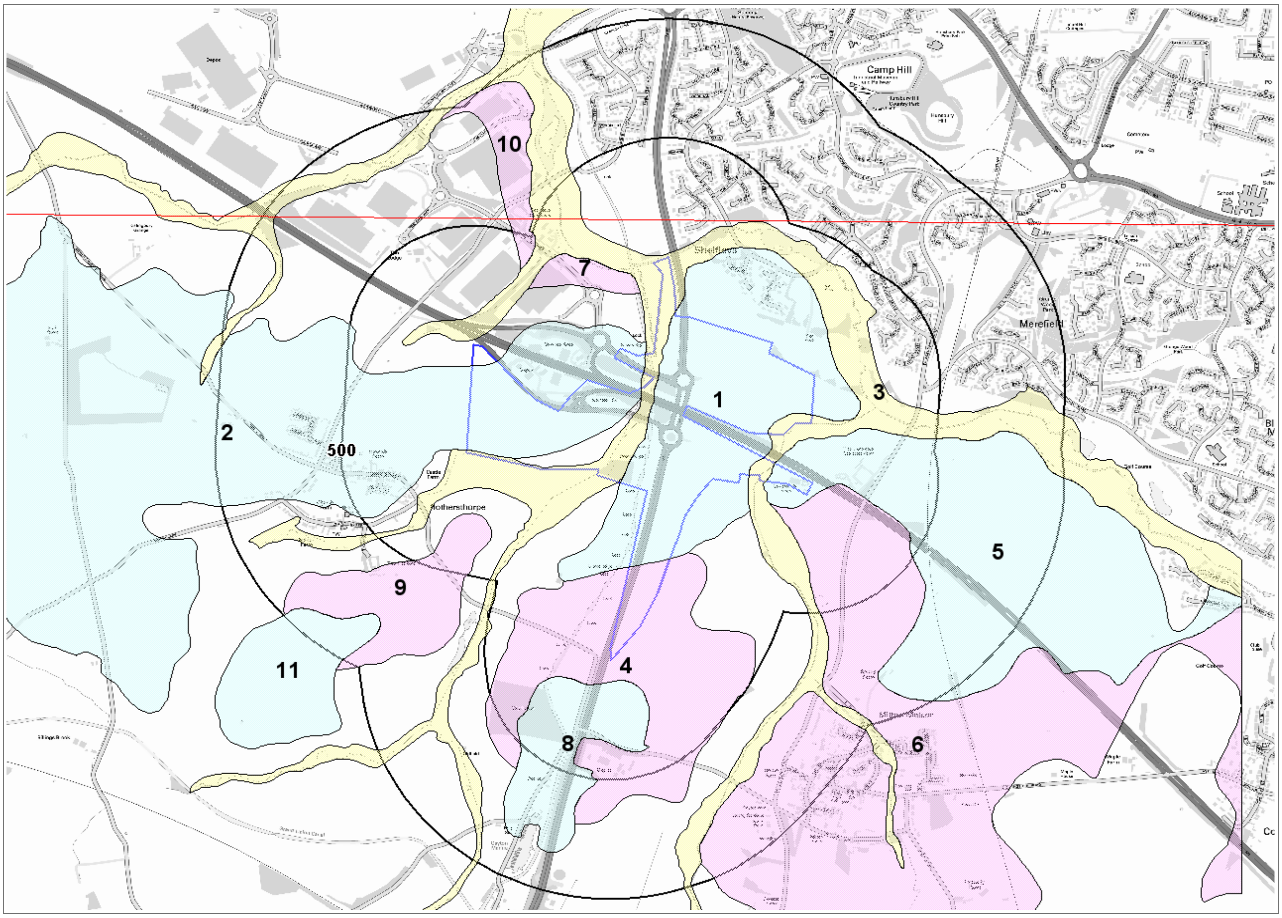
Groundsure
LOCATION INTELLIGENCE

1.2 Superficial Deposits and Landslips Map (1:10,000 scale)

NW N NE

W E

SW S SE



Artificial Ground Legend

Site Outline

500
1000
Search Buffers (m)

1.2 Superficial Deposits and Landslips

The following geological information represented on the mapping is derived from 1:10,000 scale BGS Geological mapping

1.2.1 Superficial Deposits/ Drift Geology

Are there any records of Superficial Deposits/ Drift Geology within 500m of the study site boundary at 1:10,000 scale? Yes

ID	Distance (m)	Direction	LEX Code	Description	Rock Description
1	0.0	On Site	TILMP-DMTN	Till, Mid Pleistocene - Diamicton	Diamicton
2	0.0	On Site	TILMP-DMTN	Till, Mid Pleistocene - Diamicton	Diamicton
3	0.0	On Site	ALV-XCZSV	Alluvium - Clay, Silt, Sand And Gravel	Clay, Silt, Sand And Gravel
4	0.0	On Site	GFSMP-XSV	Glaciofluvial Sheet Deposits, Mid Pleistocene - Sand And Gravel	Sand And Gravel
5	0.0	On Site	TILMP-DMTN	Till, Mid Pleistocene - Diamicton	Diamicton
6	20.0	SE	GFSMP-XSV	Glaciofluvial Sheet Deposits, Mid Pleistocene - Sand And Gravel	Sand And Gravel
7	84.0	W	GFDMP-XSV	Glaciofluvial Deposits, Mid Pleistocene - Sand And Gravel	Sand And Gravel
8	87.0	S	TILMP-DMTN	Till, Mid Pleistocene - Diamicton	Diamicton
9	242.0	S	GFSMP-XSV	Glaciofluvial Sheet Deposits, Mid Pleistocene - Sand And Gravel	Sand And Gravel
10	355.0	NE	GFDMP-XSV	Glaciofluvial Deposits, Mid Pleistocene - Sand And Gravel	Sand And Gravel

1.2.2 Landslip

Are there any records of Landslip within 500m of the study site boundary at 1:10,000 scale?

No

Database searched and no data found.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of Great Britain at 1:10,000 scale

This Geology shows the main components as discrete layers, these are: Artificial / Made Ground, Superficial / Drift Geology and Landslips. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

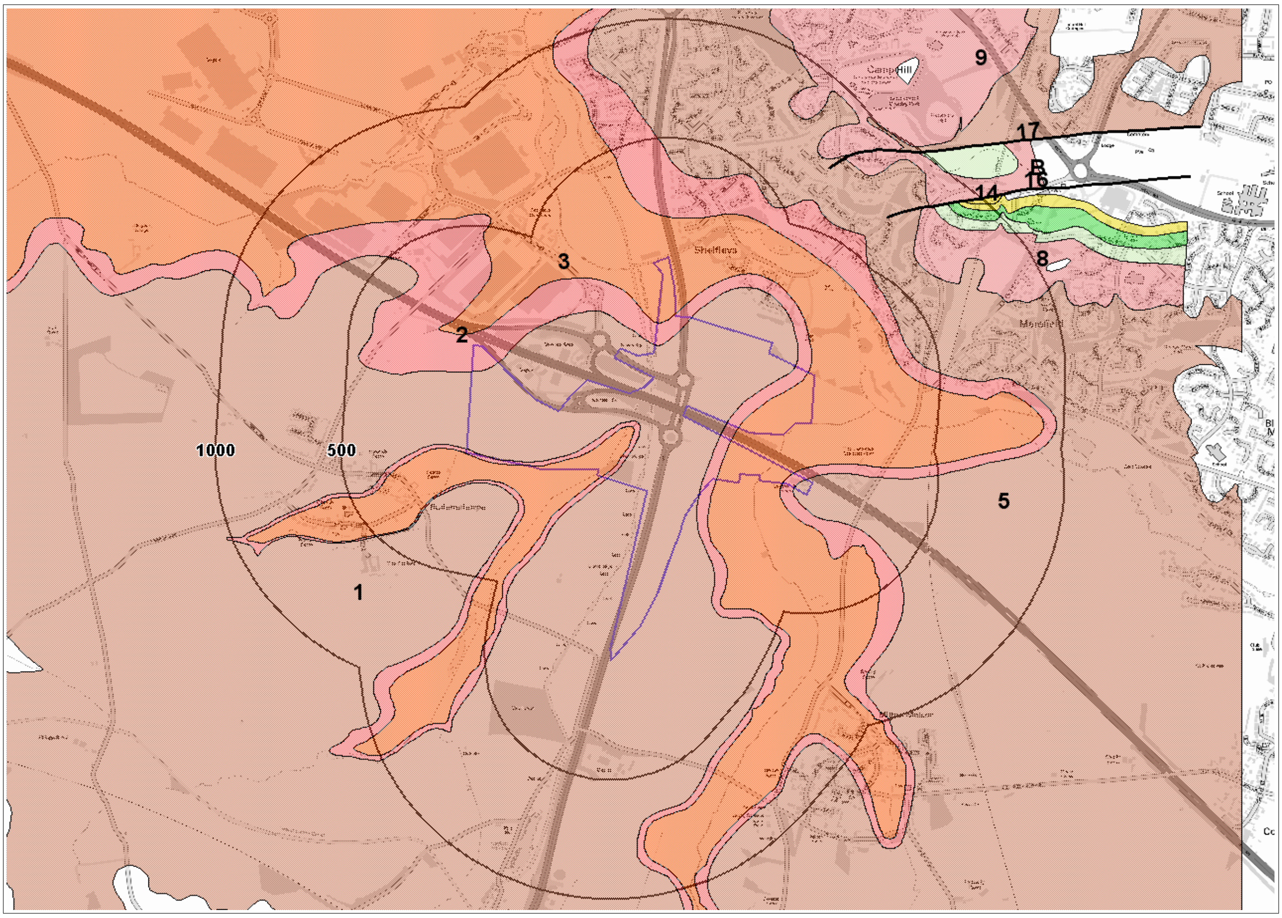
Groundsure
LOCATION INTELLIGENCE

1.3 Bedrock and Faults Map (1:10,000 scale)

NW N NE

W E

SW S SE



Bedrock and Faults Legend

Site Outline

500
1000
Search Buffers (m)

1.3 Bedrock and Faults

The following geological information represented on the mapping is derived from 1:10,000 scale BGS Geological mapping.

1.3.1 Bedrock/ Solid Geology

Records of Bedrock/Solid Geology within 500m of the study site boundary at 1:10,000 scale.

ID	Distance (m)	Direction	LEX Code	Description	Rock Age
1	0.0	On Site	WHM-MDST	Whitby Mudstone Formation - Mudstone	Toarcian Age
2	0.0	On Site	MRB-FLMST	Marlstone Rock Formation - Ferruginous Limestone	Toarcian Age - Pliensbachian Age
3	0.0	On Site	DYS-SIMD	Dyrham Formation - Siltstone And Mudstone, Interbedded	Pliensbachian Age
4	0.0	On Site	MRB-FLMST	Marlstone Rock Formation - Ferruginous Limestone	Toarcian Age - Pliensbachian Age
5	0.0	On Site	WHM-MDST	Whitby Mudstone Formation - Mudstone	Toarcian Age
6	0.0	On Site	MRB-FLMST	Marlstone Rock Formation - Ferruginous Limestone	Toarcian Age - Pliensbachian Age
7	0.0	On Site	DYS-SIMD	Dyrham Formation - Siltstone And Mudstone, Interbedded	Pliensbachian Age

1.3.2 Faults

Are there any records of Faults within 500m of the study site boundary at 1:10,000 scale? No

Database searched and no data found at this scale.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of great Britain at 1:10,000 scale.

This Geology shows the main components as discrete layers, these are: Bedrock/ Solid Geology and linear features such as Faults. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

2 Geology 1:50,000 Scale

2.1 Artificial Ground Map

NW N NE

W E

SW S SE

Ground Workings Legend

Site Outline

500
1000
Search Buffers (m)

Made Ground (undivided)

Disturbed Ground (undivided)

Worked Ground (undivided)

Landscaped Ground (undivided)

Infilled Ground

Reclaimed Ground

2. Geology 1:50,000 scale

2.1 Artificial Ground

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No: 202

2.1.1 Artificial/ Made Ground

Are there any records of Artificial/ Made Ground within 500m of the study site boundary? No

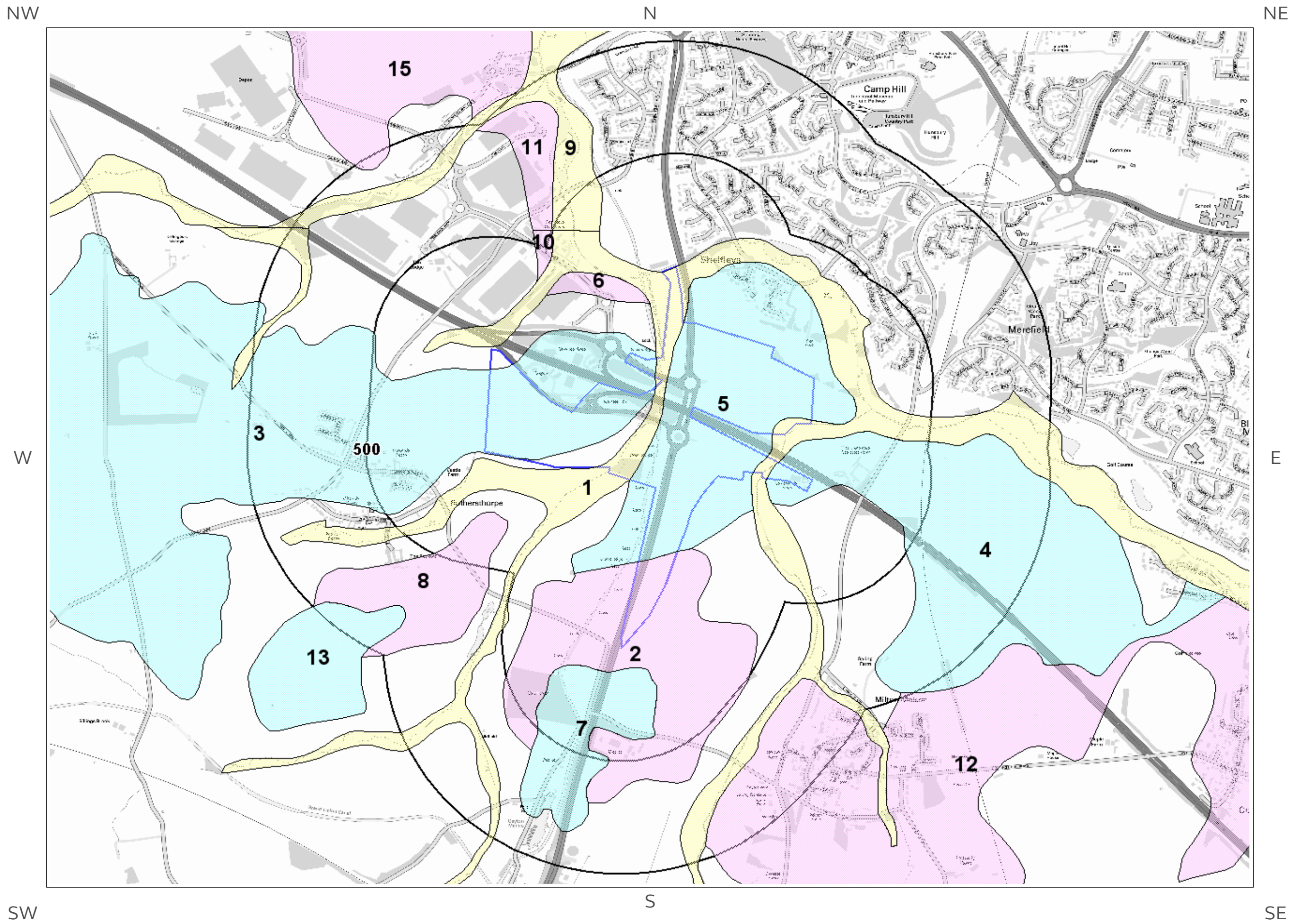
Database searched and no data found.

2.1.2 Permeability of Artificial Ground

Are there any records relating to permeability of artificial ground within the study site boundary? No

Database searched and no data found.

2.2 Superficial Deposits and Landslips Map (1:50,000 scale)



Ground Workings Legend

Site Outline

500
1000
Search Buffers (m)

2.2 Superficial Deposits and Landslips

2.2.1 Superficial Deposits/ Drift Geology

Are there any records of Superficial Deposits/ Drift Geology within 500m of the study site boundary? Yes

ID	Distance	Direction	LEX Code	Description	Rock Description
1	0.0	On Site	ALV-XCZSV	ALLUVIUM	CLAY, SILT, SAND AND GRAVEL
2	0.0	On Site	GFDMP-XSV	GLACIOFLUVIAL DEPOSITS, MID PLEISTOCENE	SAND AND GRAVEL
3	0.0	On Site	ODT-DMTN	OADBY MEMBER	DIAMICTON
4	0.0	On Site	ODT-DMTN	OADBY MEMBER	DIAMICTON
5	0.0	On Site	ODT-DMTN	OADBY MEMBER	DIAMICTON
6	75.0	W	GFDMP-XSV	GLACIOFLUVIAL DEPOSITS, MID PLEISTOCENE	SAND AND GRAVEL
7	92.0	S	ODT-DMTN	OADBY MEMBER	DIAMICTON
8	255.0	S	GFDMP-XSV	GLACIOFLUVIAL DEPOSITS, MID PLEISTOCENE	SAND AND GRAVEL
9	321.0	NW	ALV-XCZSV	ALLUVIUM	CLAY, SILT, SAND AND GRAVEL
10	345.0	NE	GFDMP-XSV	GLACIOFLUVIAL DEPOSITS, MID PLEISTOCENE	SAND AND GRAVEL
11	499.0	W	GFDMP-XSV	GLACIOFLUVIAL DEPOSITS, MID PLEISTOCENE	SAND AND GRAVEL

2.2.2 Permeability of Superficial Ground

Are there any records relating to permeability of superficial ground within the study site boundary? Yes

Distance (m)	Direction	Flow Type	Maximum Permeability	Minimum Permeability
0.0	On Site	Mixed	Moderate	Low
0.0	On Site	Mixed	Moderate	Low
0.0	On Site	Mixed	Moderate	Low
0.0	On Site	Intergranular	Very High	High
0.0	On Site	Intergranular	High	Very Low

2.2.3 Landslip

Are there any records of Landslip within 500m of the study site boundary? No

Database searched and no data found.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of Great Britain at 1:50,000 scale.

This Geology shows the main components as discrete layers, there are: Artificial/ Made Ground, Superficial/ Drift Geology and Landslips. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

2.2.4 Landslip Permeability

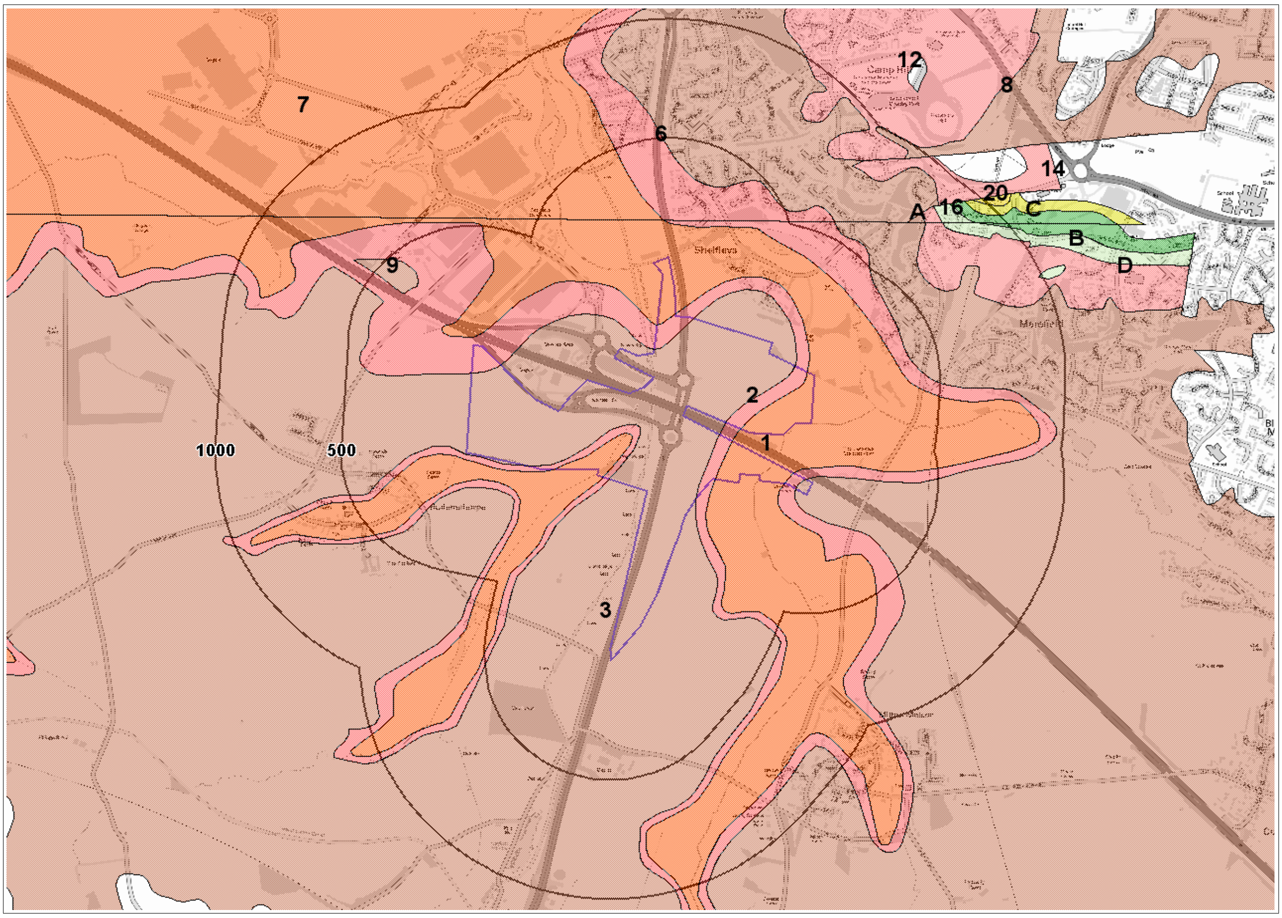
Are there any records relating to permeability of landslips within the study site boundary? No

Database searched and no data found.

2.3 Bedrock and Faults Map (1:50,000 scale)

NW N NE

W E



SW S SE

Ground Workings Legend

Site Outline

500
1000
Search Buffers (m)

2.3 Bedrock, Solid Geology & Faults

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No: 202

2.3.1 Bedrock/Solid Geology

Records of Bedrock/Solid Geology within 500m of the study site boundary:

ID	Distance	Direction	LEX Code	Rock Description	Rock Age
1	0.0	On Site	DYS-SIMD	DYRHAM FORMATION - SILTSTONE AND MUDSTONE, INTERBEDDED	PLIENSBACHIAN
2	0.0	On Site	MRB-FLMST	MARLSTONE ROCK FORMATION - LIMESTONE, FERRUGINOUS	PLIENSBACHIAN
3	0.0	On Site	WHM-MDST	WHITBY MUDSTONE FORMATION - MUDSTONE	TOARCIAN
4	0.0	On Site	MRB-FLMST	MARLSTONE ROCK FORMATION - LIMESTONE, FERRUGINOUS	PLIENSBACHIAN
5	0.0	On Site	DYS-SIMD	DYRHAM FORMATION - SILTSTONE AND MUDSTONE, INTERBEDDED	PLIENSBACHIAN
6	156.0	N	MRB-FLMST	MARLSTONE ROCK FORMATION - LIMESTONE, FERRUGINOUS	PLIENSBACHIAN
7	158.0	N	DYS-SIMD	DYRHAM FORMATION - SILTSTONE AND MUDSTONE, INTERBEDDED	PLIENSBACHIAN
8	335.0	NE	WHM-MDST	WHITBY MUDSTONE FORMATION - MUDSTONE	TOARCIAN
9	336.0	NW	WHM-MDST	WHITBY MUDSTONE FORMATION - MUDSTONE	TOARCIAN

2.3.2 Permeability of Bedrock Ground

Are there any records relating to permeability of bedrock ground within the study site boundary? Yes

Distance	Direction	Flow Type	Maximum Permeability	Minimum Permeability
0.0	On Site	Fracture	Very High	High
0.0	On Site	Fracture	Low	Low
0.0	On Site	Mixed	Moderate	Low
0.0	On Site	Fracture	Very High	High
0.0	On Site	Mixed	Moderate	Low
0.0	On Site	Fracture	Low	Low
0.0	On Site	Fracture	Very High	High

2.3.3 Faults

Are there any records of Faults within 500m of the study site boundary? No

Database searched and no data found.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of Great Britain at 1:50,000 scale.

This Geology shows the main components as discrete layers, these are: Bedrock/Solid Geology and linear features such as Faults. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nation wide coverage.

3 Radon Data

3.1 Radon Affected Areas

Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level? The property is in a Radon Affected Area, as between 3 and 5% of properties are above the Action Level.

3.2 Radon Protection

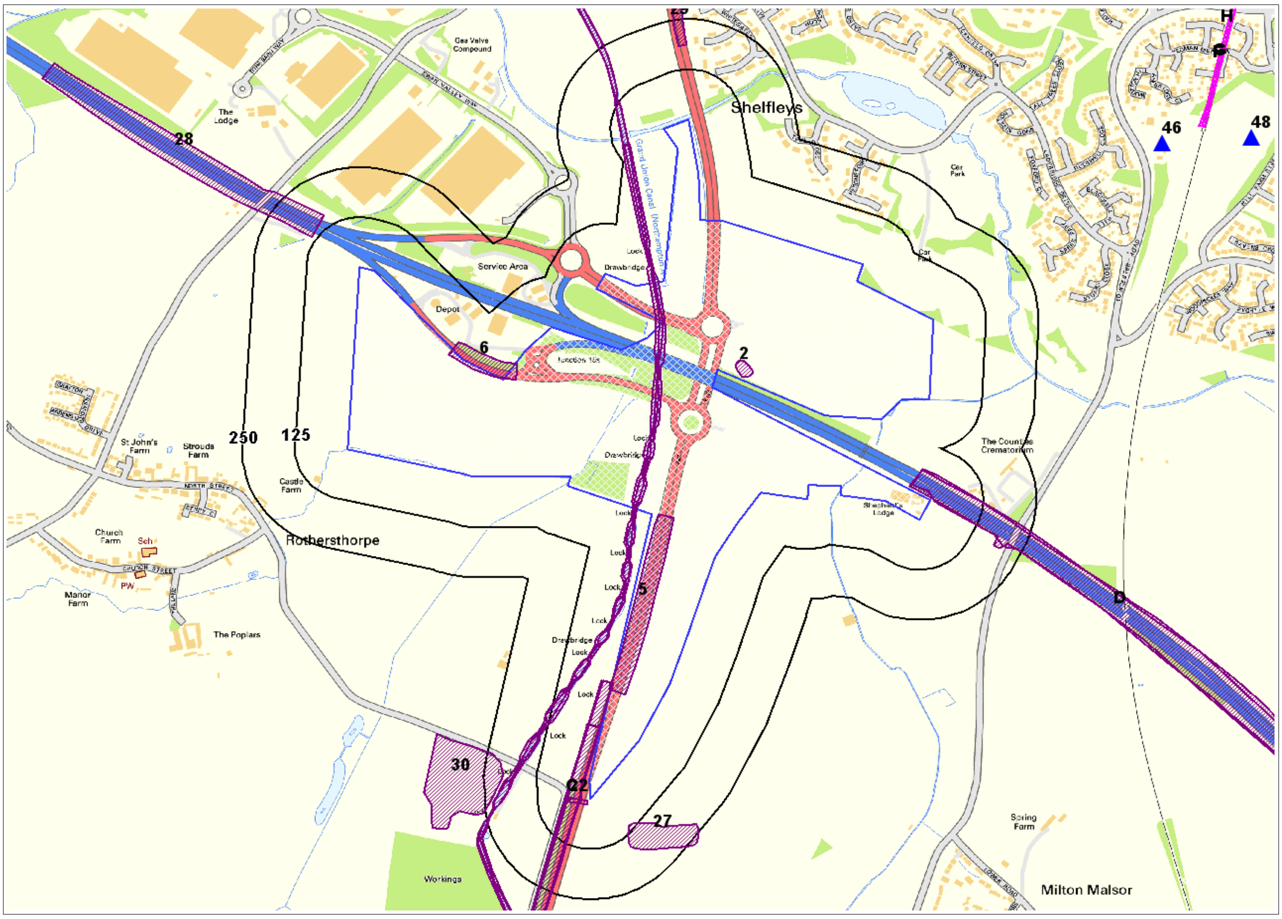
Is the property in an area where Radon Protection are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment? Basic radon protective measures are necessary.

Groundsure
LOCATION INTELLIGENCE

4 Ground Workings Map

NW N NE

W E



SW S SE

Ground Workings Legend

Site Outline

Historic Surface Ground Workings

Historic Underground Workings

125 250 Search Buffers (m)

Current Ground Workings

Groundsure LOCATION INTELLIGENCE

4 Ground Workings

4.1 Historical Surface Ground Working Features derived from Historical Mapping

This dataset is based on Groundsure's unique Historical Land Use Database derived from 1:10,560 and 1:10,000 scale historical mapping

Are there any Historical Surface Ground Working Features within 250m of the study site boundary? Yes

ID	Distance (m)	Direction	NGR	Use	Date
1C	0.0	On Site	472434 256032	Cuttings	1883
2	0.0	On Site	472853 257159	Pond	1883
3A	0.0	On Site	472286 256107	Canal	1950
4A	0.0	On Site	472286 256107	Canal	1883
5	0.0	On Site	472610 256572	Cuttings	1992
6	0.0	On Site	472235 257178	Cuttings	1992
7B	0.0	On Site	472640 257349	Canal	1950
8B	0.0	On Site	472640 257349	Canal	1981
9B	0.0	On Site	472640 257349	Canal	1989
10B	0.0	On Site	472640 257349	Canal	1992
11B	0.0	On Site	472640 257349	Canal	1968
12C	0.0	W	472432 256034	Cuttings	1989
13C	0.0	W	472432 256034	Cuttings	1981
14C	0.0	W	472432 256034	Cuttings	1968
15D	5.0	NE	473829 256497	Cuttings	1968
16D	5.0	NE	473829 256497	Cuttings	1989
17D	5.0	NE	473829 256497	Cuttings	1992
18D	5.0	NE	473829 256497	Cuttings	1981
19D	6.0	NE	473823 256495	Cuttings	1950
20C	6.0	W	472422 255996	Cuttings	1950
21C	6.0	W	472423 255998	Cuttings	1950

ID	Distance (m)	Direction	NGR	Use	Date
22	7.0	SW	472459 256080	Cuttings	1992
23E	89.0	W	472252 258703	Canal	1884
24E	89.0	W	472252 258703	Canal	1923
25E	89.0	W	472252 258703	Canal	1899
26E	89.0	W	472252 258703	Canal	1950
27	112.0	SE	472662 255993	Gravel Pit	1968
28	137.0	NW	471526 257704	Cuttings	1950
29	184.0	N	472695 258044	Cuttings	1884
30	205.0	W	472189 256129	Sand Pit	1989

4.2 Historical Underground Working Features derived from Historical Mapping

This data is derived from the Groundsure unique Historical Land Use Database. It contains data derived from 1:10,000 and 1:10,560 historical Ordnance Survey Mapping and includes some natural topographical features (Shake Holes for example) as well as manmade features that may have implications for ground stability. Underground and mining features have been identified from surface features such as shafts. The distance that these extend underground is not shown.

Are there any Historical Underground Working Features within 1000m of the study site boundary? Yes

The following Historical Underground Working Features are provided by Groundsure:

ID	Distance (m)	Direction	NGR	Use	Date
31F	793.0	NE	474055 258247	Tunnel	1950
32F	793.0	NE	474055 258247	Tunnel	1968
33F	793.0	NE	474055 258247	Tunnel	1992
34F	793.0	NE	474055 258247	Tunnel	1981
35F	793.0	NE	474055 258247	Tunnel	1989
36G	798.0	NE	474033 258177	Tunnel	1899
37G	798.0	NE	474033 258177	Tunnel	1950
38G	798.0	NE	474033 258177	Tunnel	1923
39G	798.0	NE	474033 258177	Tunnel	1884
40H	998.0	NE	473994 258001	Air Shaft	1899
41H	998.0	NE	473994 258001	Air Shaft	1923

ID	Distance (m)	Direction	NGR	Use	Date
42H	998.0	NE	473994 258001	Air Shaft	1884
43H	998.0	NE	473994 258001	Air Shaft	1950

4.3 Current Ground Workings

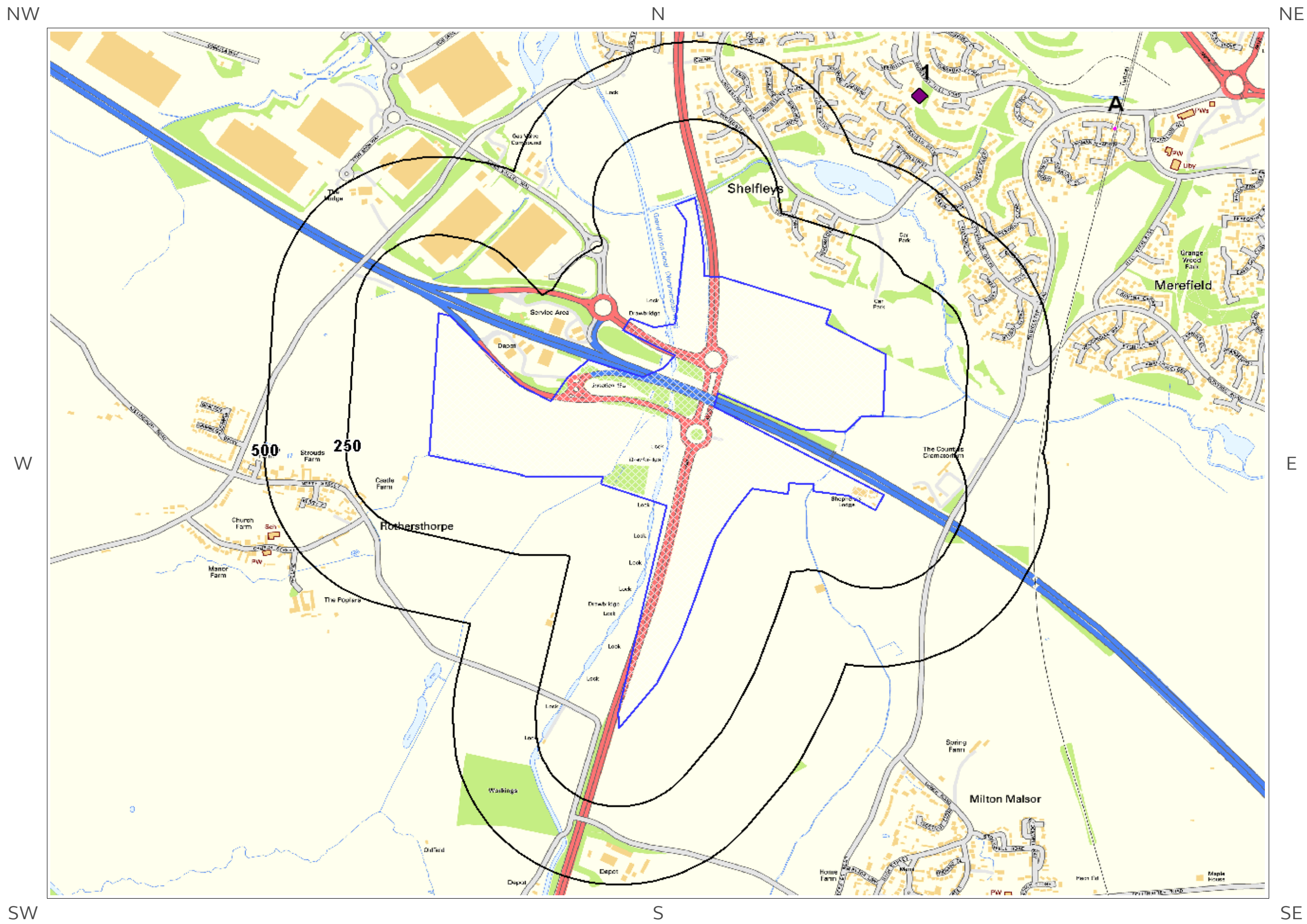
This dataset is derived from the BGS BRITPITS database covering active; inactive mines; quarries; oil wells; gas wells and mineral wharves; and rail deposits throughout the British Isles.

Are there any BGS Current Ground Workings within 1000m of the study site boundary? Yes

The following Current Ground Workings information is provided by British Geological Survey:

ID	Distance (m)	Direction	NGR	Commodity Produced	Pit Name	Type of working	Status
Not shown	498.0	S	472600 255600	Sand & Gravel	Milton Malsor	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Ceased
Not shown	498.0	S	472600 255600	Clay & Shale	Milton Malsor	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Ceased
46	697.0	NE	473840 257720	Ironstone	Wootton Hill Pit	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Ceased
Not shown	868.0	SW	472120 255300	Clay & Shale	Blisworth Brickworks	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Ceased
48	878.0	NE	474050 257735	Ironstone	Wootton Hill Pit	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Ceased
Not shown	950.0	NE	473780 258115	Ironstone	Wootton Pit	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Ceased

5 Mining, Extraction & Natural Cavities Map



Mining, Extraction and Natural Cavities Legend

Site Outline

250
500
Search Buffers (m)

Historical Mining

Non-Coal Mining Cavities

Natural Cavities

Non-Coal Mining

Highly likely

Likely

Unlikely

Highly unlikely

Rare

5 Mining, Extraction & Natural Cavities

5.1 Historical Mining

This dataset is derived from Groundsure unique Historical Land-use Database that are indicative of mining or extraction activities.

Are there any Historical Mining areas within 1000m of the study site boundary? Yes

The following Historical Mining information is provided by Groundsure:

ID	Distance (m)	Direction	NGR	Details	Date
3A	998.0	NE	473994 258001	Air Shaft	1884
4A	998.0	NE	473994 258001	Air Shaft	1899
5A	998.0	NE	473994 258001	Air Shaft	1923
6A	998.0	NE	473994 258001	Air Shaft	1950

5.2 Coal Mining

This dataset provides information as to whether the study site lies within a known coal mining affected area as defined by the coal authority.

Are there any Coal Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

5.3 Johnson Poole and Bloomer

This dataset provides information as to whether the study site lies within an area where JPB hold information relating to mining.

Are there any JPB Mining areas within 1000m of the study site boundary? No

The following information provided by JPB is not represented on mapping: Database searched and no data found.

5.4 Non-Coal Mining

This dataset provides information as to whether the study site lies within an area which may have been subject to non-coal historic mining.

Are there any Non-Coal Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

5.5 Non-Coal Mining Cavities

This dataset provides information from the Peter Brett Associates (PBA) mining cavities database (compiled for the national study entitled "Review of mining instability in Great Britain, 1990" PBA has also continued adding to this database) on mineral extraction by mining.

Are there any Non-Coal Mining cavities within 1000m of the study site boundary? No

Database searched and no data found.

5.6 Natural Cavities

This dataset provides information based on Peter Brett Associates natural cavities database.

Are there any Natural Cavities within 1000m of the study site boundary? Yes

The following Natural Cavities information provided by Peter Brett Associates:

ID	Distance (m)	Direction	NGR	Superficial Deposits	Bedrock Deposits	Cavity Type and Number
1	731.0	N	473400 258100	Worked Ground	Lower Estuarine Series, Northampton Sand Formation, Upper Lias	Gulls/Fissures due to Cambering x 10
Not shown	848.0	NE	473300 258400	Worked Ground	Lower Estuarine Series, Northampton Sand Formation, Upper Lias	Gulls/Fissures due to Cambering x 10

5.7 Brine Extraction

This data provides information from the Coal Authority issued on behalf of the Cheshire Brine Subsidence Compensation Board.

Are there any Brine Extraction areas within 1000m of the study site boundary? No

Database searched and no data found.

5.8 Gypsum Extraction

This dataset provides information on Gypsum extraction from British Gypsum records.

Are there any Gypsum Extraction areas within 1000m of the study site boundary? No

Database searched and no data found.

5.9 Tin Mining

This dataset provides information on tin mining areas and is derived from tin mining records. This search is based upon postcode information to a sector level..

Are there any Tin Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

5.10 Clay Mining

This dataset provides information on Kaolin and Ball Clay mining from relevant mining records.

Are there any Clay Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

---

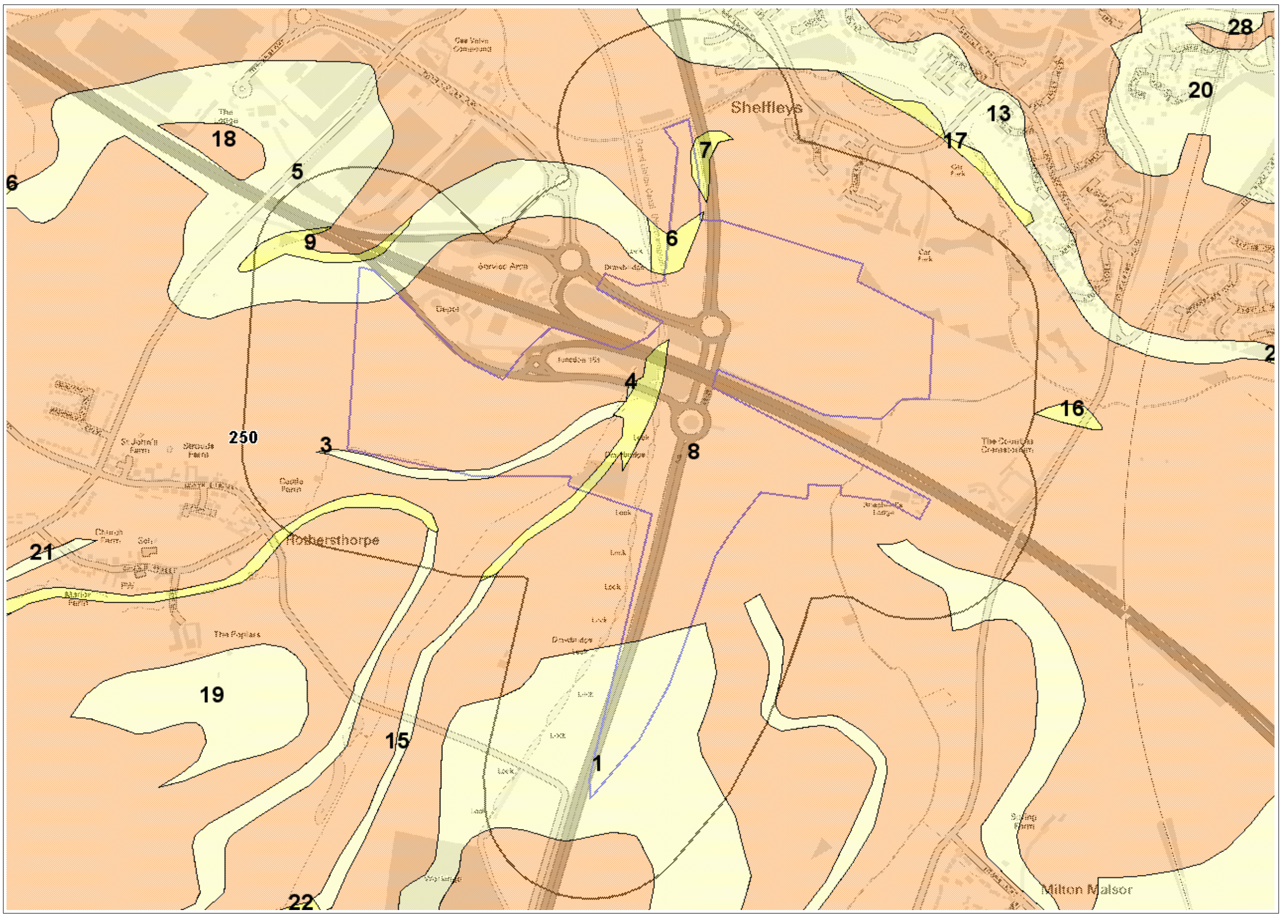
6 Natural Ground Subsidence

6.1 Shrink-Swell Clay Map

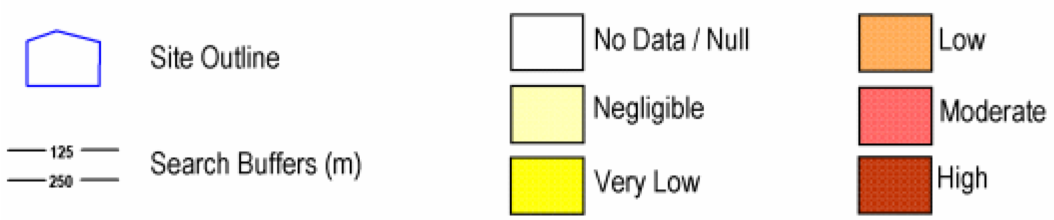
NW N NE

W E

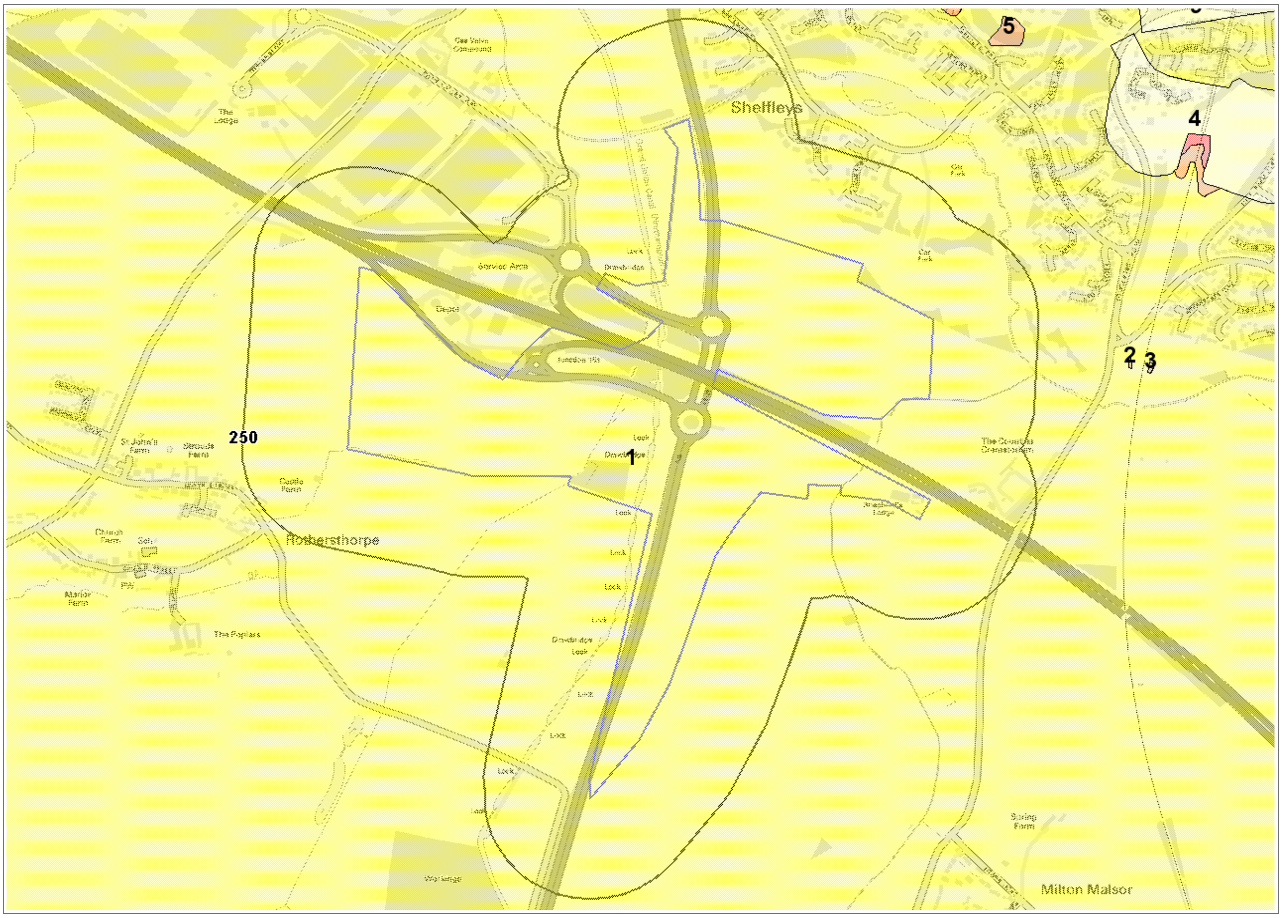
SW S SE



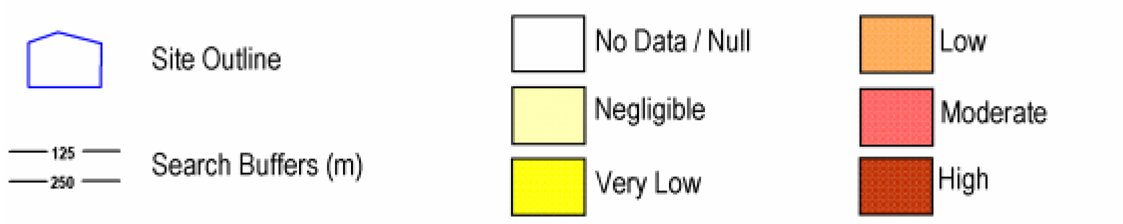
Shrink Swell Clay Legend



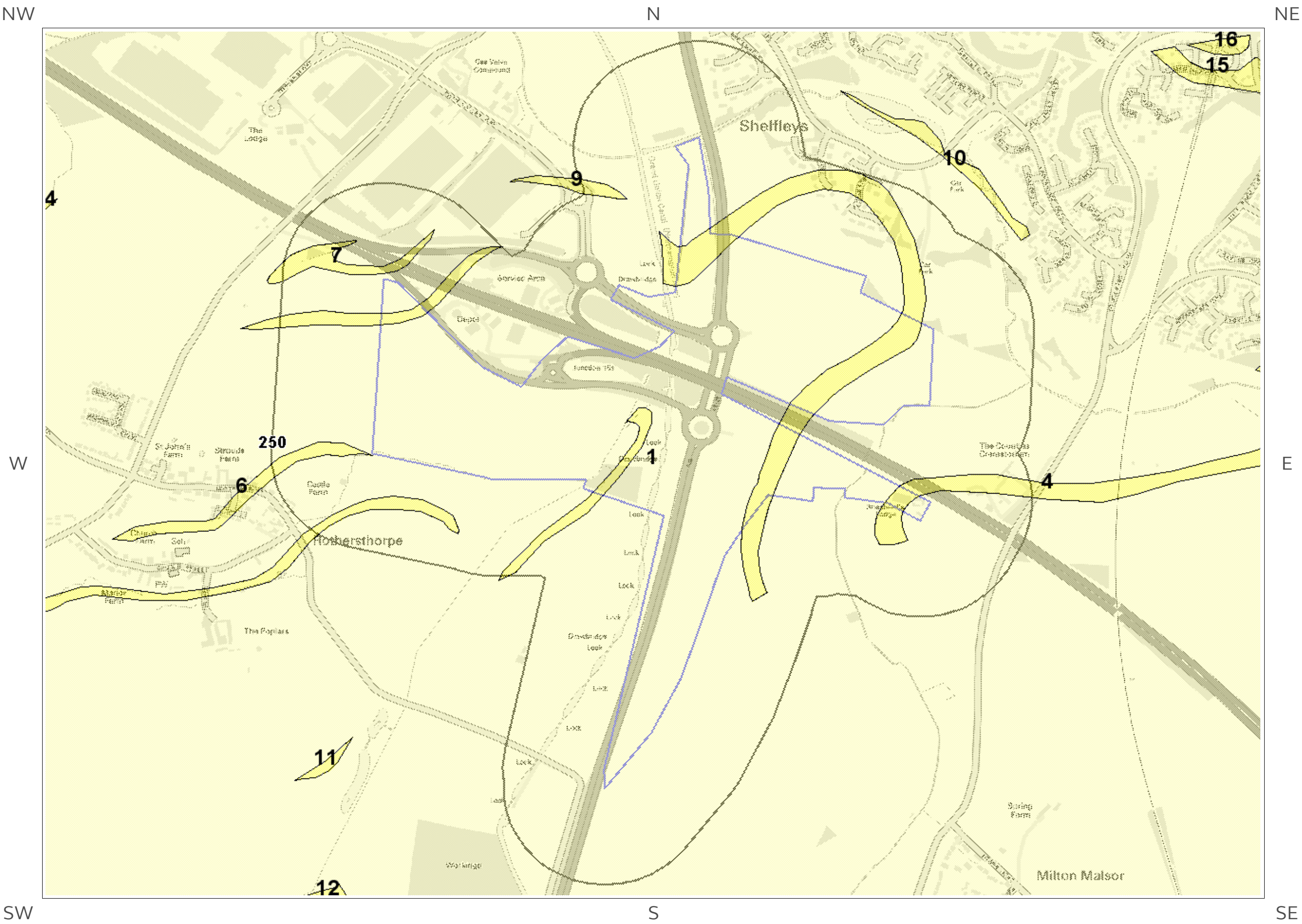
6.2 Landslides Map



Landslides Legend



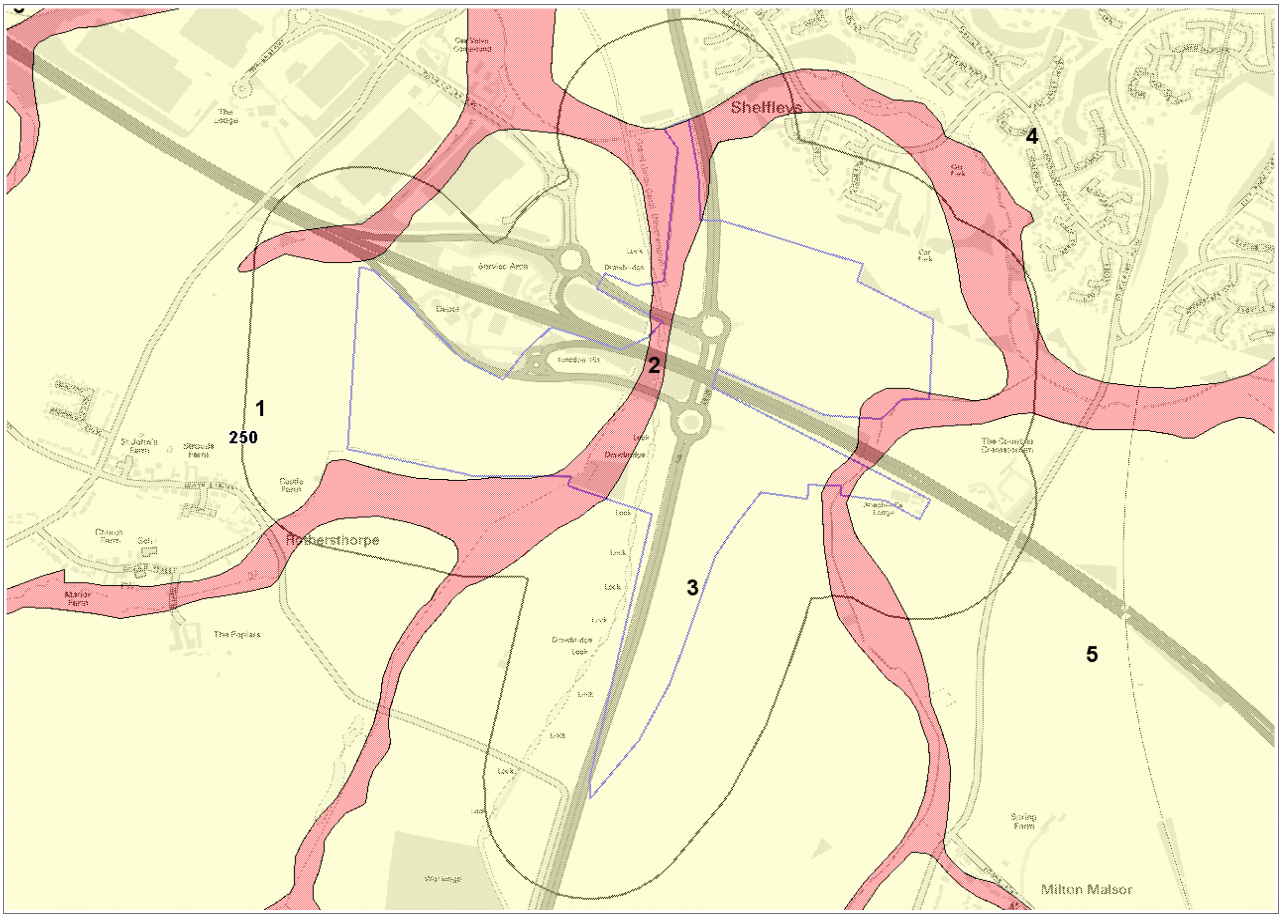
6.3 Ground Dissolution of Soluble Rocks Map



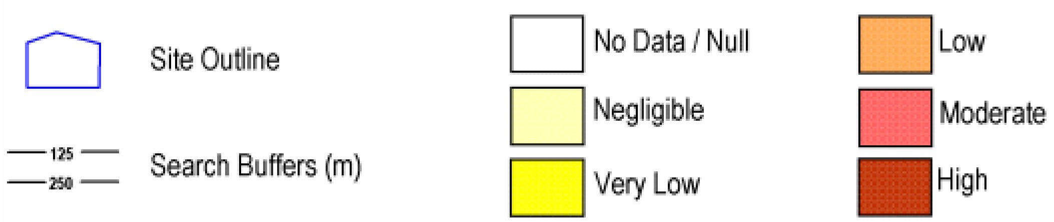
Ground Dissolution
Soluble Rocks Legend

Groundsure
LOCATION INTELLIGENCE

6.4 Compressible Deposits Map

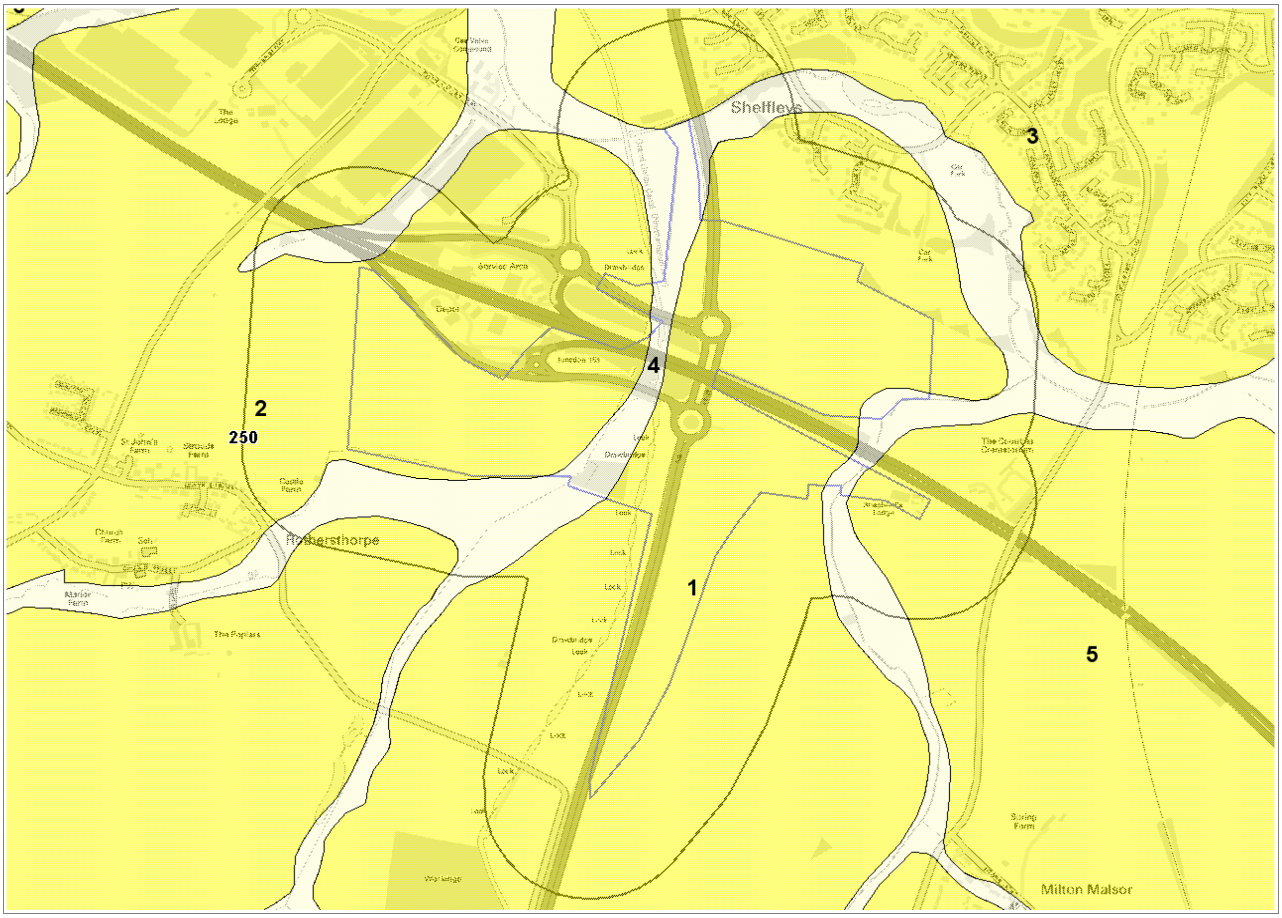


Compressible Deposits Legend



6.5 Collapsible Deposits Map

NW N NE



W E

SW S SE

Collapsible Deposits Legend

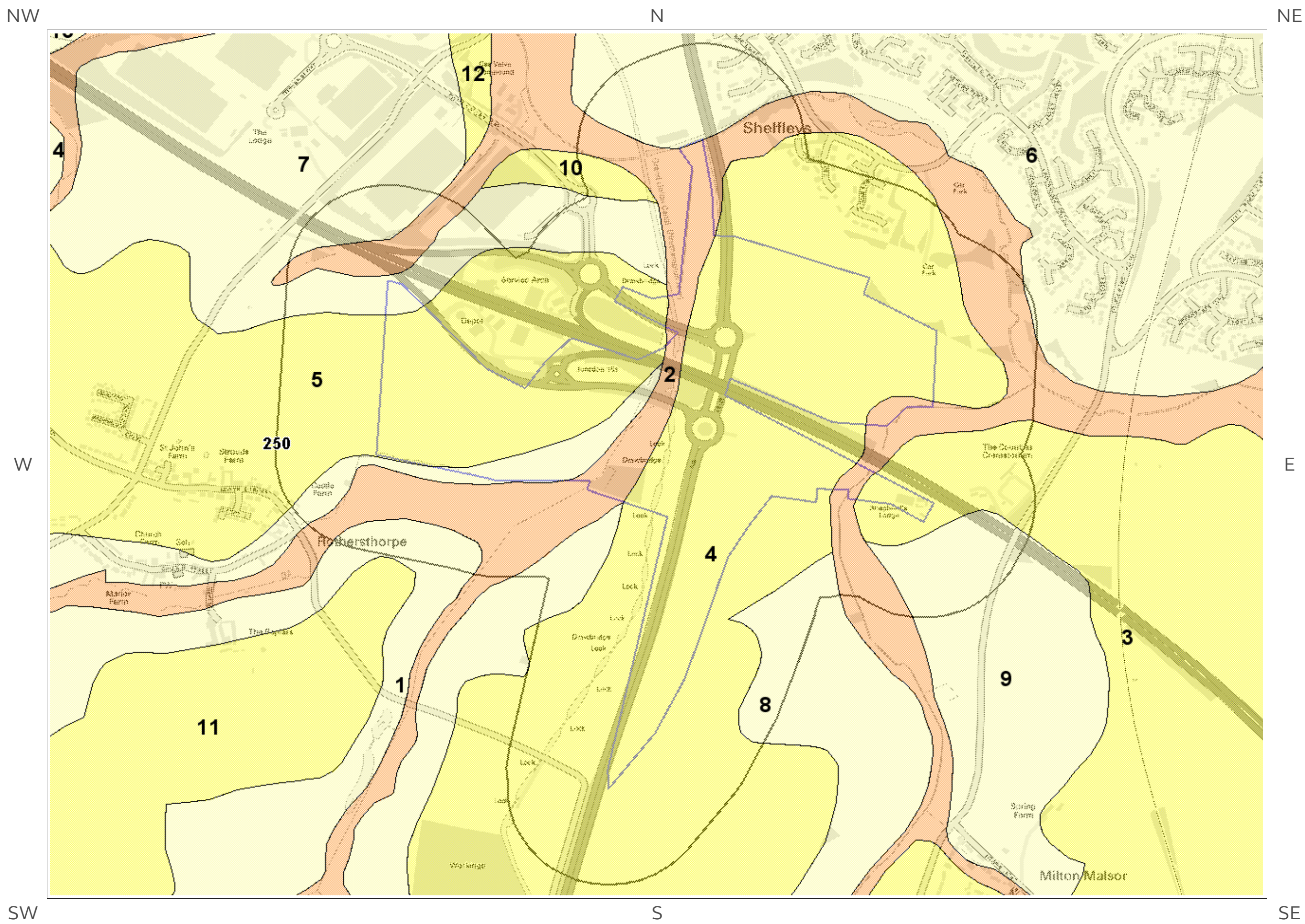
Site Outline

125
250
Search Buffers (m)

No Data / Null
Negligible
Very Low
Low
Moderate
High

Groundsure
LOCATION INTELLIGENCE

6.6 Running Sand Map



Running Sand Legend

6 Natural Ground Subsidence

The National Ground Subsidence rating is obtained through the 6 natural ground stability hazard datasets, which are supplied by the British Geological Survey (BGS).

The following GeoSure data represented on the mapping is derived from the BGS Digital Geological map of Great Britain at 1:50,000 scale.

What is the maximum hazard rating of natural subsidence within the study site** boundary? Moderate

6.1 Shrink-Swell Clays

The following Shrink Swell information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	Ground conditions predominantly non-plastic. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely likely due to potential problems with shrink-swell clays.
2	0.0	On Site	Very Low	Ground conditions predominantly low plasticity. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with shrink-swell clays.
3	0.0	On Site	Negligible	Ground conditions predominantly non-plastic. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely likely due to potential problems with shrink-swell clays.
4	0.0	On Site	Negligible	Ground conditions predominantly non-plastic. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely likely due to potential problems with shrink-swell clays.
5	0.0	On Site	Negligible	Ground conditions predominantly non-plastic. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely likely due to potential problems with shrink-swell clays.

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

ID	Distance (m)	Direction	Hazard Rating	Details
6	0.0	On Site	Very Low	Ground conditions predominantly low plasticity. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with shrink-swell clays.
7	0.0	On Site	Very Low	Ground conditions predominantly low plasticity. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with shrink-swell clays.
8	0.0	On Site	Low	Ground conditions predominantly medium plasticity. Do not plant trees with high soil moisture demands near to buildings. For new build, consideration should be given to advice published by the National House Building Council (NHBC) and the Building Research Establishment (BRE). There is a possible increase in construction cost to reduce potential shrink-swell problems. For existing property, there is a possible increase in insurance risk, especially during droughts or where vegetation with high moisture demands is present.
9	15.0	N	Very Low	Ground conditions predominantly low plasticity. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with shrink-swell clays.

6.2 Landslides

The following Landslides information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Slope instability problems are unlikely to be present. No special actions required to avoid problems due to landslides. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with landslides.

6.3 Ground Dissolution of Soluble Rocks

The following Ground Dissolution information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	Soluble rocks are present, but unlikely to cause problems except under exceptional conditions. No special actions required to avoid problems due to soluble rocks. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with soluble rocks.
2	0.0	On Site	Very Low	Significant soluble rocks are present. Problems unlikely except with considerable surface or subsurface water flow. No special actions required to avoid problems due to soluble rocks. No special ground investigation required or increased construction costs are likely. An increase in financial risk due to potential problems with soluble rocks is unlikely.
3	0.0	On Site	Very Low	Significant soluble rocks are present. Problems unlikely except with considerable surface or subsurface water flow. No special actions required to avoid problems due to soluble rocks. No special ground investigation required or increased construction costs are likely. An increase in financial risk due to potential problems with soluble rocks is unlikely.
4	0.0	On Site	Very Low	Significant soluble rocks are present. Problems unlikely except with considerable surface or subsurface water flow. No special actions required to avoid problems due to soluble rocks. No special ground investigation required or increased construction costs are likely. An increase in financial risk due to potential problems with soluble rocks is unlikely.
5	0.0	On Site	Very Low	Significant soluble rocks are present. Problems unlikely except with considerable surface or subsurface water flow. No special actions required to avoid problems due to soluble rocks. No special ground investigation required or increased construction costs are likely. An increase in financial risk due to potential problems with soluble rocks is unlikely.
6	6.0	SW	Very Low	Significant soluble rocks are present. Problems unlikely except with considerable surface or subsurface water flow. No special actions required to avoid problems due to soluble rocks. No special ground investigation required or increased construction costs are likely. An increase in financial risk due to potential problems with soluble rocks is unlikely.
7	15.0	N	Very Low	Significant soluble rocks are present. Problems unlikely except with considerable surface or subsurface water flow. No special actions required to avoid problems due to soluble rocks. No special ground investigation required or increased construction costs are likely. An increase in financial risk due to potential problems with soluble rocks is unlikely.

6.4 Compressible Deposits

The following Compressible Deposits information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.
2	0.0	On Site	Moderate	Significant potential for compressibility problems. Avoid large differential loadings of ground. Do not drain or de-water ground near the property without technical advice. For new build - consider possibility of compressible ground in ground investigation, construction and building design. Consider effects of groundwater changes. Extra construction costs are likely. For existing property - possible increase in insurance risk from compressibility, especially if water conditions or loading of the ground change significantly.

ID	Distance (m)	Direction	Hazard Rating	Details
3	0.0	On Site	Negligible	No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.
4	0.0	On Site	Negligible	No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.
5	0.0	On Site	Negligible	No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.

6.5 Collapsible Deposits

The following Collapsible Rocks information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.
2	0.0	On Site	Very Low	Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.
3	0.0	On Site	Very Low	Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.
4	0.0	On Site	Negligible	No indicators for collapsible deposits identified. No actions required to avoid problems due to collapsible deposits. No special ground investigation required, or increased construction costs or increased financial risk due to potential problems with collapsible deposits.
5	0.0	On Site	Very Low	Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.

6.6 Running Sands

The following Running Sands information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	No indicators for running sand identified. No special actions required to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.
2	0.0	On Site	Low	Possibility of running sand problems after major changes in ground conditions. Normal maintenance to avoid leakage of water-bearing services or water bodies (ponds, swimming pools) should reduce likelihood of problems due to running sand. For new build - consider possibility of running sand into trenches or excavations if water table is high or sandy strata are exposed to water. Avoid concentrated water inputs to site. Unlikely to be an increase in construction costs due to potential for running sand. For existing property - no significant increase in insurance risk due to running sand problems is likely.

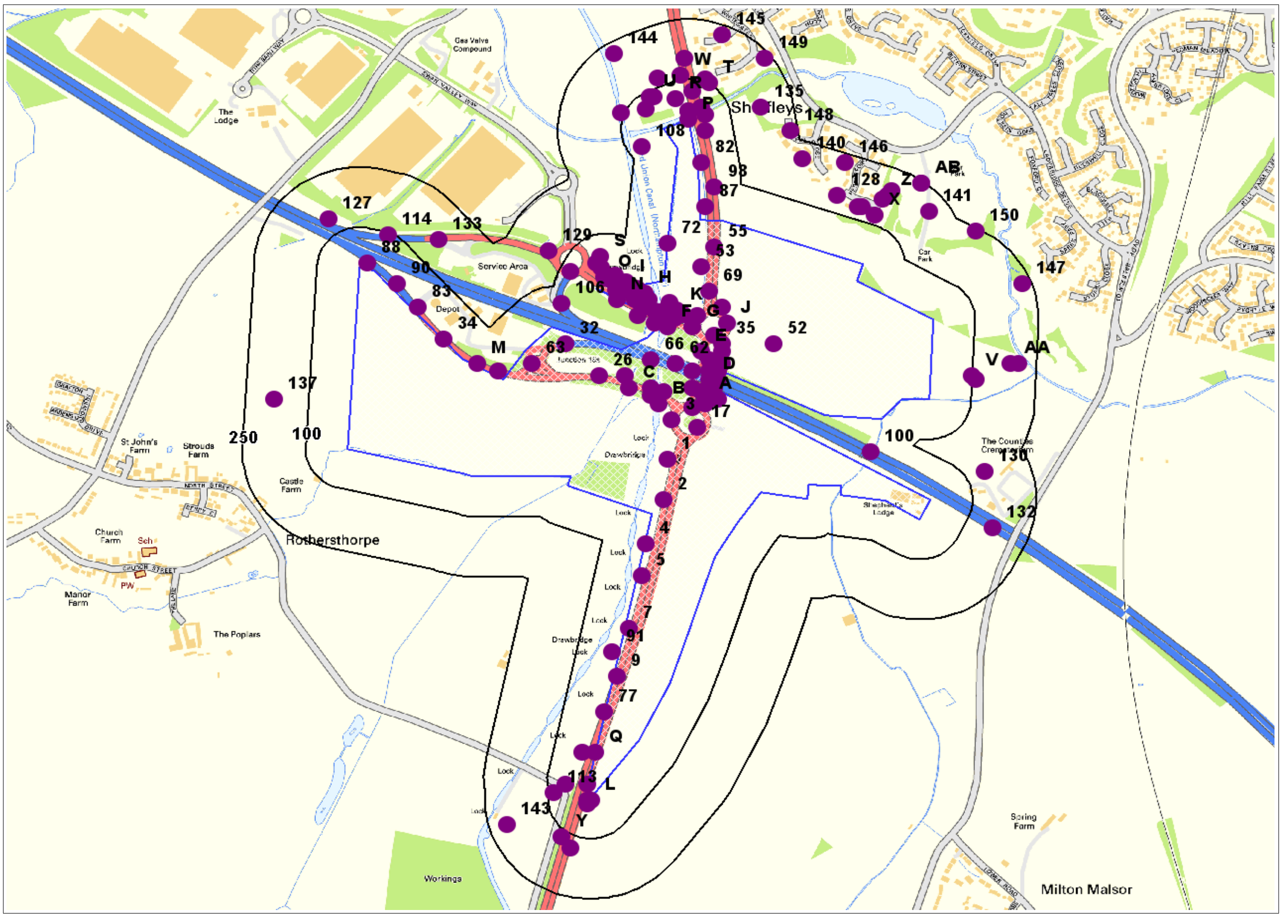
ID	Distance (m)	Direction	Hazard Rating	Details
3	0.0	On Site	Very Low	Very low potential for running sand problems if water table rises or if sandy strata are exposed to water. No special actions required, to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.
4	0.0	On Site	Very Low	Very low potential for running sand problems if water table rises or if sandy strata are exposed to water. No special actions required, to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.
5	0.0	On Site	Very Low	Very low potential for running sand problems if water table rises or if sandy strata are exposed to water. No special actions required, to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.
6	0.0	On Site	Negligible	No indicators for running sand identified. No special actions required to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.
7	0.0	On Site	Negligible	No indicators for running sand identified. No special actions required to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.
8	0.0	S	Negligible	No indicators for running sand identified. No special actions required to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.
9	31.0	SE	Negligible	No indicators for running sand identified. No special actions required to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.

Groundsure
LOCATION INTELLIGENCE

7 Borehole Records Map

NW N NE

W E



SW S SE

Borehole Records Legend

7 Borehole Records

The systematic analysis of data extracted from the BGS Borehole Records database provides the following information.

Records of boreholes within 250m of the study site boundary: 152

ID	Distance (m)	Direction	NGR	BGS Reference	Drilled Length	Borehole Name
1	0.0	On Site	472670 256930	SP75NW461	3.0	A43 MILTON BYPASS TP 47
2	0.0	On Site	472660 256830	SP75NW460	3.0	A43 MILTON BYPASS TP 46
3	0.0	On Site	472680 257030	SP75NW1111	-1.0	M1 JUNCTION 15A NORTHAMPTON TP 1
4	0.0	On Site	472620 256720	SP75NW459	4.0	A43 MILTON BYPASS TP 45
5	0.0	On Site	472610 256640	SP75NW458	3.0	A43 MILTON BYPASS TP 44
6B	0.0	On Site	472650 257070	SP75NW419	15.05	A43 MILTON BYPASS 243
7	0.0	On Site	472580 256510	SP75NW457	4.0	A43 MILTON BYPASS TP 43
8A	0.0	On Site	472760 257080	SP75NW1114	-1.0	M1 JUNCTION 15A NORTHAMPTON TP 6
9	0.0	On Site	472550 256390	SP75NW452	3.0	A43 MILTON BYPASS TP 41A
10A	0.0	On Site	472770 257100	SP75NW1123	-1.0	M1 JUNCTION 15A NORTHAMPTON TP 15
11A	0.0	On Site	472750 257100	SP75NW1115	-1.0	M1 JUNCTION 15A NORTHAMPTON TP 7
12B	0.0	On Site	472660 257100	SP75NW415	30.0	A43 MILTON BYPASS 239
13B	0.0	On Site	472630 257110	SP75NW416	19.8	A43 MILTON BYPASS 240
14A	0.0	On Site	472730 257110	SP75NW463	4.0	A43 MILTON BYPASS TP 49
15C	0.0	On Site	472580 257110	SP75NW420	6.0	A43 MILTON BYPASS 244
16D	0.0	On Site	472770 257130	SP75NW1103	-1.0	M1 JUNCTION 15A NORTHAMPTON 1A
17	0.0	On Site	472740 257010	SP75NW1112	-1.0	M1 JUNCTION 15A NORTHAMPTON TP 2
18A	0.0	On Site	472730 257060	SP75NW462	3.0	A43 MILTON BYPASS TP 48
19C	0.0	On Site	472570 257140	SP75NW418	6.0	A43 MILTON BYPASS 242
20D	0.0	On Site	472770 257150	SP75NW1125	-1.0	M1 JUNCTION 15A NORTHAMPTON W4
21A	0.0	On Site	472760 257070	SP75NW1113	-1.0	M1 JUNCTION 15A NORTHAMPTON TP 5
22D	0.0	On Site	472730 257150	SP75NW244	7.6	M1 MOTORMAY BH319

ID	Distance (m)	Direction	NGR	BGS Reference	Drilled Length	Borehole Name
23A	0.0	On Site	472790 257080	SP75NW1116	-1.0	M1 JUNCTION 15A NORTHAMPTON TP 8
24A	0.0	On Site	472770 257090	SP75NW1110	-1.0	M1 JUNCTION 15A NORTHAMPTON 7
25A	0.0	On Site	472780 257110	SP75NW1104	-1.0	M1 JUNCTION 15A NORTHAMPTON 2
26	0.0	On Site	472510 257140	SP75NW464	3.0	A43 MILTON BYPASS TP 50
27D	0.0	On Site	472780 257150	SP75NW1106	-1.0	M1 JUNCTION 15A NORTHAMPTON 3
28B	0.0	On Site	472630 257090	SP75NW417	15.0	A43 MILTON BYPASS 241
29A	0.0	On Site	472770 257110	SP75NW1102	-1.0	M1 JUNCTION 15A NORTHAMPTON 1
30D	0.0	On Site	472790 257160	SP75NW1124	-1.0	M1 JUNCTION 15A NORTHAMPTON TP 16
31E	0.0	On Site	472750 257200	SP75NW482	3.0	A43 MILTON BYPASS TP 67A
32	0.0	On Site	472430 257220	SP75NW465	3.0	A43 MILTON BYPASS TP 51
33E	0.0	On Site	472800 257200	SP75NW1109	-1.0	M1 JUNCTION 15A NORTHAMPTON 6
34	0.0	On Site	472140 257230	SP75NW469	3.0	A43 MILTON BYPASS TP 55
35	0.0	On Site	472800 257220	SP75NW1119	-1.0	M1 JUNCTION 15A NORTHAMPTON TP11
36E	0.0	On Site	472780 257240	SP75NW481	2.0	A43 MILTON BYPASS TP 67
37F	0.0	On Site	472670 257260	SP75NW424	19.95	A43 MILTON BYPASS 248
38G	0.0	On Site	472730 257260	SP75NW263	6.0	NORTHAMPTON SOUTHERN SOIL SURVEY S47
39F	0.0	On Site	472670 257290	SP75NW425	12.0	A43 MILTON BYPASS 249
40G	0.0	On Site	472740 257290	SP75NW1120	-1.0	M1 JUNCTION 15A NORTHAMPTON TP 12
41F	0.0	On Site	472660 257300	SP75NW423	15.0	A43 MILTON BYPASS 247
42F	0.0	On Site	472640 257300	SP75NW422	30.0	A43 MILTON BYPASS 246
43D	0.0	On Site	472800 257170	SP75NW1117	-1.0	M1 JUNCTION 15A NORTHAMPTON TP 9
44H	0.0	On Site	472616 257346	SP75NW1372	4.0	PINEHAM DEVELOPMENT NORTHAMPTON SECTION 3 WS404
45D	0.0	On Site	472790 257170	SP75NW1108	-1.0	M1 JUNCTION 15A NORTHAMPTON 5
46H	0.0	On Site	472574 257352	SP75NW1364	5.0	PINEHAM DEVELOPMENT NORTHAMPTON SECTION 3 BH302
47H	0.0	On Site	472597 257357	SP75NW1371	5.0	PINEHAM DEVELOPMENT NORTHAMPTON SECTION 3 WS403
48E	0.0	On Site	472770 257180	SP75NW1118	-1.0	M1 JUNCTION 15A NORTHAMPTON TP10
49I	0.0	On Site	472571 257373	SP75NW1370	4.0	PINEHAM DEVELOPMENT NORTHAMPTON SECTION 3 WS402

ID	Distance (m)	Direction	NGR	BGS Reference	Drilled Length	Borehole Name
50I	0.0	On Site	472531 257381	SP75NW1363	6.5	PINEHAM DEVELOPMENT NORTHAMPTON SECTION 3 BH301
51O	0.0	On Site	472521 257386	SP75NW1377	1.4	PINEHAM DEVELOPMENT NORTHAMPTON SECTION 3 TTC
52	0.0	On Site	472920 257220	SP75NW171	5.5	MILTON HAM
53	0.0	On Site	472750 257410	SP75NW484	3.0	A43 MILTON BYPASS TP 69
54J	0.0	On Site	472810 257270	SP75NW1121	-1.0	M1 JUNCTION 15A NORTHAMPTON TP 13
55	0.0	On Site	472780 257460	SP75NW488	3.0	A43 MILTON BYPASS TP 72
56F	0.0	On Site	472709 257291	SP75NW1368	5.0	PINEHAM DEVELOPMENT NORTHAMPTON SECTION 3 BH306
57F	0.0	On Site	472667 257300	SP75NW1366	30.0	PINEHAM DEVELOPMENT NORTHAMPTON SECTION 3 BH304
58K	0.0	On Site	472692 257304	SP75NW1367	20.0	PINEHAM DEVELOPMENT NORTHAMPTON SECTION 3 BH305
59J	0.0	On Site	472800 257310	SP75NW1122	-1.0	M1 JUNCTION 15A NORTHAMPTON TP 14
60H	0.0	On Site	472616 257315	SP75NW1159	5.0	PINEHAM A43 / M1 LINK ROAD NORTHAMPTON 504
61K	0.0	On Site	472674 257321	SP75NW1374	4.1	PINEHAM DEVELOPMENT NORTHAMPTON SECTION 3 TP102
62	0.0	On Site	472690 257170	SP75NW245	9.1	M1 MOTORMAY BH320
63	0.0	On Site	472350 257170	SP75NW466	3.0	A43 MILTON BYPASS TP 52
64H	0.0	On Site	472592 257329	SP75NW1160	4.0	PINEHAM A43 / M1 LINK ROAD NORTHAMPTON 505
65H	0.0	On Site	472625 257329	SP75NW1365	30.0	PINEHAM DEVELOPMENT NORTHAMPTON SECTION 3 BH303
66	0.0	On Site	472630 257180	SP75NW246	10.7	M1 MOTORMAY BH321
67K	0.0	On Site	472688 257283	SP75NW1156	7.0	PINEHAM A43 / M1 LINK ROAD NORTHAMPTON 501
68H	0.0	On Site	472613 257312	SP75NW1157	4.3	PINEHAM A43 / M1 LINK ROAD NORTHAMPTON 502
69	0.0	On Site	472770 257350	SP75NW483	1.0	A43 MILTON BYPASS TP 68
70I	0.0	On Site	472548 257352	SP75NW1158	7.0	PINEHAM A43 / M1 LINK ROAD NORTHAMPTON 503
71P	0.0	N	472720 257780	SP75NW428	12.0	A43 MILTON BYPASS 252
72	1.0	W	472670 257470	SP75NW264	10.0	NORTHAMPTON SOUTHERN SOIL SURVEY S48

ID	Distance (m)	Direction	NGR	BGS Reference	Drilled Length	Borehole Name
73Q	1.0	W	472500 256200	SP75NW450	3.0	A43 MILTON BYPASS TP 40B
74N	3.0	SW	472550 257330	SP75NW480	3.0	A43 MILTON BYPASS TP 66
75D	3.0	E	472790 257150	SP75NW1107	-1.0	M1 JUNCTION 15A NORTHAMPTON 4
76I	3.0	NE	472546 257390	SP75NW1369	5.0	PINEHAM DEVELOPMENT NORTHAMPTON SECTION 3 WS401
77	4.0	W	472520 256300	SP75NW451	4.0	A43 MILTON BYPASS TP 41
78M	4.0	NE	472220 257170	SP75NW468	4.0	A43 MILTON BYPASS TP 54
79L	6.0	S	472490 256080	SP75NW454	4.0	A43 MILTON BYPASS TP 42A
80L	8.0	W	472480 256120	SP75NW449	4.0	A43 MILTON BYPASS TP 40A
81D	8.0	E	472790 257130	SP75NW1105	-1.0	M1 JUNCTION 15A NORTHAMPTON 2A
82	9.0	E	472750 257670	SP75NW487	2.0	A43 MILTON BYPASS TP 71A
83	10.0	NE	472080 257310	SP75NW470	4.0	A43 MILTON BYPASS TP 56
84M	10.0	NE	472270 257150	SP75NW467	3.0	A43 MILTON BYPASS TP 53
85F	11.0	NW	472640 257270	SP75NW426	12.0	A43 MILTON BYPASS 250
86L	11.0	SW	472480 256080	SP75NW455	4.0	A43 MILTON BYPASS TP 42B
87	12.0	E	472760 257560	SP75NW485	3.0	A43 MILTON BYPASS TP 70
88	12.0	N	471960 257420	SP75NW472	3.0	A43 MILTON BYPASS TP 58
89N	15.0	SW	472600 257290	SP75NW421	6.0	A43 MILTON BYPASS 245
90	16.0	NE	472030 257370	SP75NW471	3.0	A43 MILTON BYPASS TP 57
91	17.0	W	472540 256450	SP75NW453	3.0	A43 MILTON BYPASS TP 42
92O	18.0	NW	472513 257409	SP75NW1373	3.2	PINEHAM DEVELOPMENT NORTHAMPTON SECTION 3 TP101
93L	19.0	SW	472480 256070	SP75NW456	3.0	A43 MILTON BYPASS TP 42C
94P	20.0	N	472720 257800	SP75NW429	9.0	A43 MILTON BYPASS 253
95P	20.0	N	472720 257800	SP75NW266	10.0	NORTHAMPTON SOUTHERN SOIL SURVEY S50
96Q	31.0	W	472470 256200	SP75NW448	3.0	A43 MILTON BYPASS TP 40
97P	33.0	E	472760 257750	SP75NW427	14.9	A43 MILTON BYPASS 251
98	34.0	E	472780 257610	SP75NW486	4.0	A43 MILTON BYPASS TP 71
99O	34.0	NW	472502 257421	SP75NW1376	1.7	PINEHAM DEVELOPMENT NORTHAMPTON SECTION 3 TTB

ID	Distance (m)	Direction	NGR	BGS Reference	Drilled Length	Borehole Name
100	35.0	NE	473150 256950	SP75NW243	7.6	M1 MOTORMAY BH318
101P	40.0	E	472760 257790	SP75NW430	10.0	A43 MILTON BYPASS 254
102P	41.0	NE	472750 257810	SP75NW431	12.0	A43 MILTON BYPASS 255
103S	44.0	N	472512 257437	SP75NW1375	1.4	PINEHAM DEVELOPMENT NORTHAMPTON SECTION 3 TTA
104L	58.0	W	472430 256120	SP75NW414	15.25	A43 MILTON BYPASS 238
105R	58.0	N	472690 257830	SP75NW153	4.0	WOOTON VALLEY SEWER BH7
106	62.0	N	472420 257320	SP75NW479	3.0	A43 MILTON BYPASS TP 65
107R	64.0	NW	472619 257804	SP75NW1182	3.0	LEACH & TOMPKINS SITE PHASE 4 NORTHAMPTON NH334
108	69.0	SW	472610 257710	SP75NW265	8.0	NORTHAMPTON SOUTHERN SOIL SURVEY S49
109R	70.0	N	472730 257850	SP75NW491	4.0	A43 MILTON BYPASS TP 73B
110S	76.0	NW	472440 257400	SP75NW478	3.0	A43 MILTON BYPASS TP 64
111R	82.0	N	472637 257835	SP75NW1183	3.0	LEACH & TOMPKINS SITE PHASE 4 NORTHAMPTON NH335
112U	86.0	N	472629 257836	SP75NW1187	1.0	LEACH & TOMPKINS SITE PHASE 4 NORTHAMPTON TP NH339
113	89.0	W	472400 256100	SP75NW545	14.63	NR.NO.1 LOCK GRAND JUNCTION CANAL ROTHERSTHORPE
114	92.0	N	472010 257490	SP75NW474	1.0	A43 MILTON BYPASS TP 60
115V	98.0	E	473390 257140	SP75NW957	8.0	WEST OF A43 TOWCESTER ROAD NORTHAMPTON 9
116T	102.0	NE	472770 257870	SP75NW152	4.0	WOOTON VALLEY SEWER BH6
117T	107.0	N	472760 257880	SP75NW615	2.6	HALCUTT NORTHAMPTON TP 92TW
118U	108.0	W	472561 257796	SP75NW1186	1.0	LEACH & TOMPKINS SITE PHASE 4 NORTHAMPTON TP NH338
119V	108.0	E	473400 257130	SP75NW299	8.0	NORTHAMPTON SOUTHERN SOIL SURVEY S83
120W	112.0	N	472700 257890	SP75NW490	3.0	A43 MILTON BYPASS TP 73A
121Y	118.0	SW	472420 255990	SP75NW444	4.0	A43 MILTON BYPASS TP 39
122X	123.0	N	473160 257540	SP75NW675	2.2	LADYBRIDGE PLOTS NORTHAMPTON TP TW37
123W	123.0	N	472646 257883	SP75NW1188	1.7	LEACH & TOMPKINS SITE PHASE 4 NORTHAMPTON TP NH340

ID	Distance (m)	Direction	NGR	BGS Reference	Drilled Length	Borehole Name
124X	130.0	N	473120 257560	SP75NW306	7.1	NORTHAMPTON SOUTHERN SOIL SURVEY S90
125X	133.0	N	473130 257560	SP75NW964	7.1	WEST OF A43 TOWCESTER ROAD NORTHAMPTON 16
126Y	135.0	S	472440 255960	SP75NW443	3.0	A43 MILTON BYPASS TP 38C
127	140.0	NW	471870 257530	SP75NW473	3.0	A43 MILTON BYPASS TP 59
128	143.0	N	473070 257590	SP75NW672	2.7	LADYBRIDGE PLOTS NORTHAMPTON TP TW34
129	144.0	NW	472390 257450	SP75NW477	3.0	A43 MILTON BYPASS TP 63
130	144.0	NE	473420 256900	SP75NW252	8.0	NORTHAMPTON SOUTHERN SOIL SURVEY S12
131W	150.0	N	472710 257930	SP75NW489	4.0	A43 MILTON BYPASS TP 73
132	164.0	SE	473440 256760	SP75NW242	3.0	M1 MOTORMAY BH317
133	164.0	NE	472130 257480	SP75NW475	3.0	A43 MILTON BYPASS TP 61
134X	167.0	N	473180 257580	SP75NW305	12.05	NORTHAMPTON SOUTHERN SOIL SURVEY S89
135	171.0	E	472890 257810	SP75NW664	1.65	LADYBRIDGE PLOTS NORTHAMPTON TP TW26
136Z	180.0	N	473190 257590	SP75NW963	12.05	WEST OF A43 TOWCESTER ROAD NORTHAMPTON 15
137	183.0	W	471740 257080	SP75NW165	4.0	NORTH OF ROTHERSTHORPE
138AA	186.0	E	473480 257170	SP75NW956	10.0	WEST OF A43 TOWCESTER ROAD NORTHAMPTON 8
139Z	193.0	N	473200 257600	SP75NW673	2.4	LADYBRIDGE PLOTS NORTHAMPTON TP TW35
140	204.0	N	472990 257680	SP75NW668	2.3	LADYBRIDGE PLOTS NORTHAMPTON TP TW30
141	205.0	NE	473290 257550	SP75NW676	2.9	LADYBRIDGE PLOTS NORTHAMPTON TP TW38
142AA	206.0	E	473500 257170	SP75NW298	10.0	NORTHAMPTON SOUTHERN SOIL SURVEY S82
143	210.0	W	472290 256020	SP75NW6	14.63	WELL NEAR TO NO.1 LOCK ROTHERSTHORPE
144	220.0	NW	472545 257943	SP75NW1184	3.0	LEACH & TOMPKINS SITE PHASE 4 NORTHAMPTON NH336
145	224.0	N	472800 257990	SP75NW613	2.2	HALCUTT NORTHAMPTON TP 90TW

ID	Distance (m)	Direction	NGR	BGS Reference	Drilled Length	Borehole Name
146	225.0	N	473090 257670	SP75NW669	2.4	LADYBRIDGE PLOTS NORTHAMPTON TP TW31
147	229.0	NE	473510 257370	SP75NW147	12.65	SOUTHERN DISTRICT BH11
148	230.0	E	472960 257750	SP75NW666	2.2	LADYBRIDGE PLOTS NORTHAMPTON TP TW28
149	233.0	NE	472900 257930	SP75NW614	2.2	HALCUTT NORTHAMPTON TP 91TW
150	241.0	NE	473400 257500	SP75NW677	1.9	LADYBRIDGE PLOTS NORTHAMPTON TP TW39
151A B	243.0	NE	473270 257620	SP75NW962	8.0	WEST OF A43 TOWCESTER ROAD NORTHAMPTON 14
152A B	243.0	NE	473270 257620	SP75NW304	8.0	NORTHAMPTON SOUTHERN SOIL SURVEY S88

The borehole records are available using the hyperlinks below: Please note that if the donor of the borehole record has requested the information be held as commercial-in-confidence, the additional data will be held separately by the BGS and a formal request must be made for its release.

#1: scans.bgs.ac.uk/sobi_scans/boreholes/344511
#2: scans.bgs.ac.uk/sobi_scans/boreholes/344510
#4: scans.bgs.ac.uk/sobi_scans/boreholes/344509
#5: scans.bgs.ac.uk/sobi_scans/boreholes/344508
#6B: scans.bgs.ac.uk/sobi_scans/boreholes/344469
#7: scans.bgs.ac.uk/sobi_scans/boreholes/344507
#9: scans.bgs.ac.uk/sobi_scans/boreholes/344502
#12B: scans.bgs.ac.uk/sobi_scans/boreholes/344465
#13B: scans.bgs.ac.uk/sobi_scans/boreholes/344466
#14A: scans.bgs.ac.uk/sobi_scans/boreholes/344513
#15C: scans.bgs.ac.uk/sobi_scans/boreholes/344470
#18A: scans.bgs.ac.uk/sobi_scans/boreholes/344512
#19C: scans.bgs.ac.uk/sobi_scans/boreholes/344468
#22D: scans.bgs.ac.uk/sobi_scans/boreholes/344294
#26: scans.bgs.ac.uk/sobi_scans/boreholes/344514
#28B: scans.bgs.ac.uk/sobi_scans/boreholes/344467
#31E: scans.bgs.ac.uk/sobi_scans/boreholes/344532
#32: scans.bgs.ac.uk/sobi_scans/boreholes/344515
#34: scans.bgs.ac.uk/sobi_scans/boreholes/344519
#36E: scans.bgs.ac.uk/sobi_scans/boreholes/344531
#37F: scans.bgs.ac.uk/sobi_scans/boreholes/344474
#38G: scans.bgs.ac.uk/sobi_scans/boreholes/344313
#39F: scans.bgs.ac.uk/sobi_scans/boreholes/344475
#41F: scans.bgs.ac.uk/sobi_scans/boreholes/344473
#42F: scans.bgs.ac.uk/sobi_scans/boreholes/344472
#44H: scans.bgs.ac.uk/sobi_scans/boreholes/19398610
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#47H: scans.bgs.ac.uk/sobi_scans/boreholes/19398609
#49I: scans.bgs.ac.uk/sobi_scans/boreholes/19398608
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#51O: scans.bgs.ac.uk/sobi_scans/boreholes/19398615
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#61K: scans.bgs.ac.uk/sobi_scans/boreholes/19398612
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#74N: scans.bgs.ac.uk/sobi_scans/boreholes/344530
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#139Z: scans.bgs.ac.uk/sobi_scans/boreholes/17673964
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#142AA: scans.bgs.ac.uk/sobi_scans/boreholes/344348
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#150: scans.bgs.ac.uk/sobi_scans/boreholes/17673968
#151AB: scans.bgs.ac.uk/sobi_scans/boreholes/17698524
#152AB: scans.bgs.ac.uk/sobi_scans/boreholes/344354

8 Estimated Background Soil Chemistry

Records of background estimated soil chemistry within 250m of the study site boundary: 100

For further information on how this data is calculated and limitations upon its use, please see the Groundsure Geo Insight User Guide, available on request.

Distance (m)	Direction	Sample Type	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Nickel (Ni)	Lead (Pb)
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	25 - 35 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	25 - 35 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	25 - 35 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg

Distance (m)	Direction	Sample Type	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Nickel (Ni)	Lead (Pb)
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	25 - 35 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
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0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
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0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
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0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
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0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	25 - 35 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	S	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
3.0	S	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	15 - 30 mg/kg	<100 mg/kg
3.0	S	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
5.0	S	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
6.0	SW	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
7.0	SW	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
8.0	E	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
8.0	NE	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
8.0	NE	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
8.0	S	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
11.0	W	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
15.0	N	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
22.0	S	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
26.0	S	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
27.0	S	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
28.0	N	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
28.0	N	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg

Distance (m)	Direction	Sample Type	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Nickel (Ni)	Lead (Pb)
31.0	SE	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
32.0	S	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
35.0	N	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
35.0	S	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
36.0	N	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	30 - 45 mg/kg	<100 mg/kg
36.0	N	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
46.0	W	RuralSoil	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg

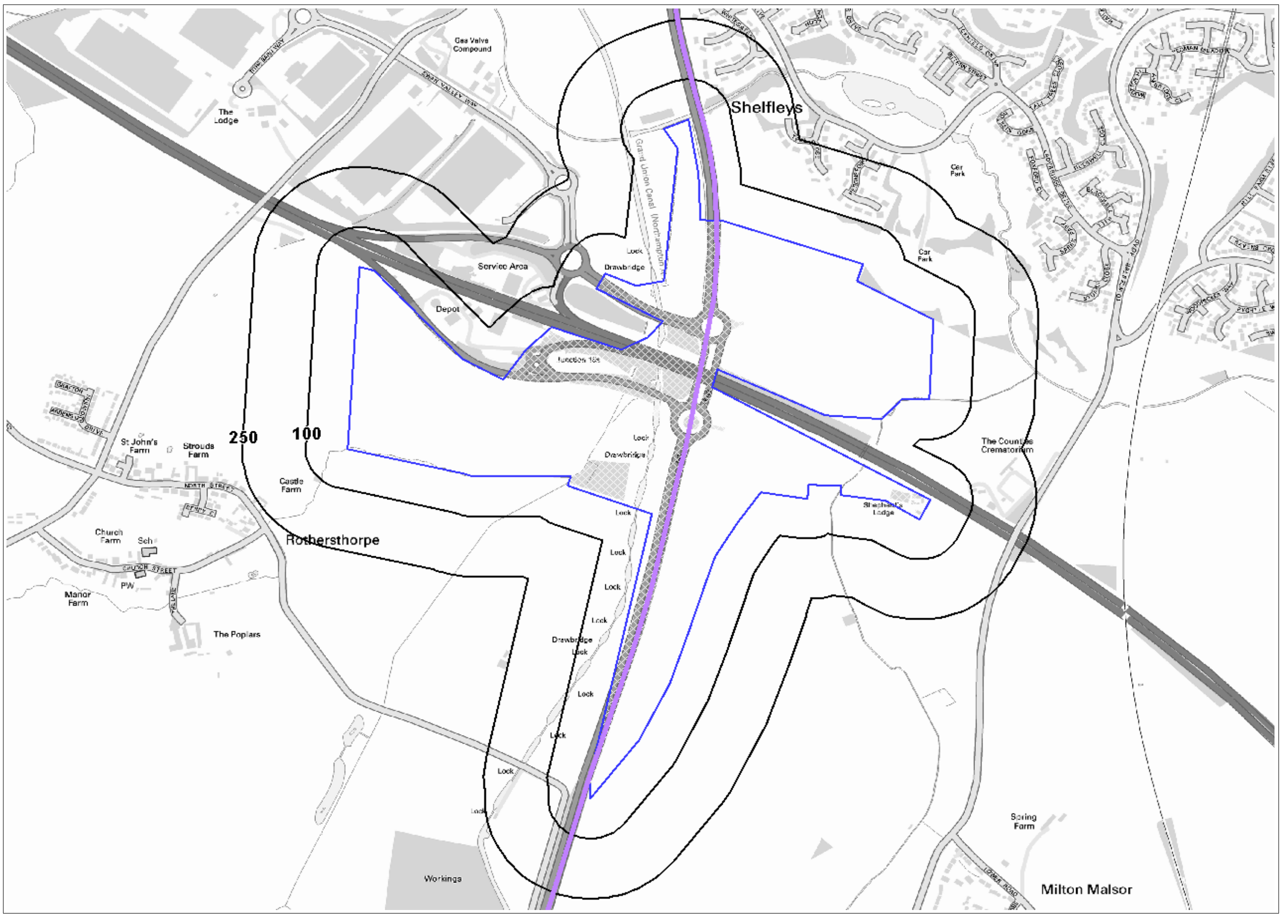
*As this data is based upon underlying 1:50,000 scale geological information, a 50m buffer has been added to the search radius.

9 Railways and Tunnels Map

NW N NE

W E

SW S SE



Railways and Tunnels Legend

Site Outline	Underground or Partially Underground Railway / Subway System	Railway Track (OpenStreetMap)
250 / 500 Search Buffers (m)	Railway Tunnel (OS Mapping)	High Speed 2
	Abandoned or Dismantled Railway (OpenStreetMap)	High Speed 2 Revised Proposed Route
	Railway Track (OS Mapping)	Crossrail 1
		Railway and/or Tunnel Feature from Historical Mapping

9 Railways and Tunnels

9.1 Tunnels

This data is derived from OpenStreetMap and provides information on the possible locations of underground railway systems in the UK - the London Underground, the Tyne & Wear Metro and the Glasgow Subway.

Have any underground railway lines been identified within the study site boundary?	No
Have any underground railway lines been identified within 250m of the study site boundary?	No

Database searched and no data found.

Any records that have been identified are represented on the Railways and Tunnels Map.

This data is derived from Ordnance Survey mapping and provides information on the possible locations of railway tunnels forming part of the UK overground railway network.

Have any other railway tunnels been identified within the site boundary?	No
Have any other railway tunnels been identified within 250m of the site boundary?	No

Database searched and no data found.

Any records that have been identified are represented on the Railways and Tunnels Map.

9.2 Historical Railway and Tunnel Features

This data is derived from Groundsure's unique Historical Land-use Database and contains features relating to tunnels, railway tracks or associated works that have been identified from historical Ordnance Survey mapping.

Have any historical railway or tunnel features been identified within the study site boundary?	No
Have any historical railway or tunnel features been identified within 250m of the study site boundary?	No

Database searched and no data found.

Any records that have been identified are represented on the Railways and Tunnels Map.

9.3 Historical Railways

This data is derived from OpenStreetMap and provides information on the possible alignments of abandoned or dismantled railway lines in proximity to the study site.

Have any historical railway lines been identified within the study site boundary? Yes

Have any historical railway lines been identified within 250m of the study site boundary? Yes

Distance (m)	Direction	Status
0	On Site	Abandoned
0	On Site	Abandoned
0	On Site	Dismantled

Multiple sections of the same track may be listed in the detail above
Any records that have been identified are represented on the Railways and Tunnels Map.

9.4 Active Railways

These datasets are derived from Ordnance Survey mapping and OpenStreetMap and provide information on the possible locations of active railway lines in proximity to the study site.

Have any active railway lines been identified within the study site boundary? No

Have any active railway lines been identified within 250m of the study site boundary? No

Database searched and no data found.

Multiple sections of the same track may be listed in the detail above
Any records that have been identified are represented on the Railways and Tunnels Map.

9.5 Railway Projects

These datasets provide information on the location of large scale railway projects High Speed 2 and Crossrail 1 .

Is the study site within 5km of the route of the High Speed 2 rail project? No

Is the study site within 500m of the route of the Crossrail 1 rail project? No

Further information on proximity to these routes, the project construction status and associated works can be obtained through the purchase of a Groundsure HS2 and Crossrail 1 Report*.*

The route data has been digitised from publicly available maps by Groundsure. The route as provided relates to the Crossrail 1 project only, and does not include any details of the Crossrail 2 project, as final details of the route for Crossrail 2 are still under consultation.

Please note that this assessment takes account of both the original Phase 2b proposed route and the amended route proposed in 2016. As the Phase 2b route is still under consultation, Groundsure are providing information on both options until the final route is formally confirmed. Practitioners should take account of this uncertainty when advising clients.

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Public Health England

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https://www.gov.uk/government/organisations/public-health-england
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Standard Terms and Conditions

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https://www.groundsure.com/terms-and-conditions-sept-2016/

REGIONAL UNEXPLODED BOMB RISK

NORTHAMPTONSHIRE

DENSITY OF BOMBS PER BOROUGH

Borough	High explosive	Anti-personnel	Incendiary
Brackley	159	0	2
Daventry	209	0	2
Northampton	206	0	0
Desborough	26	0	0
Brixworth	111	0	3
Oundle & Thrapston	132	0	5
Kettering	116	0	2

BOMB RISK MAP

OTHER WWII TARGETS

- military
- transport
- utilities
- industry
- docks
- other

BOMB TONNAGE

- >1000
- >500
- >100
- > 0
- unverified

BOMB RISK

- high
- moderate
- low

The information in this regional UXB risk map is derived from a number of sources and should be read in conjunction with the "Users' Guide" (printed overleaf). Zetica cannot guarantee the accuracy or completeness of the information or data.

This map covers regions of coast with beaches, estuaries and alike. Further consideration of the bomb risk is required in these areas. The often inaccessible nature and changing ground conditions (e.g. movement of silt that may contain ordnance) means that historical bombing records for these areas are often poor or inaccurate and further assessment of the bomb risk may be required as part of a site specific study.

A FOUR-STEP PROCESS

Risk assessment and method statement from a qualified explosive ordnance clearance (EOC) operative.

Surface geophysical survey to allow shallow groundwork.

MAGCONE detects UXBs and obstructions on piling layout to the no-risk depth.

Detected UXBs can be dealt with by our EOC engineers and a Clearance Certificate issued for the site.

zetica

For more details on this and related services, telephone: +44 (0) 1993 886682 or visit our website: www.zetica.com

BOMB MAP USERS' GUIDE

Sources of information and explanation of bomb risk

Why?
Unexploded bombs (UXB) still present a risk to construction projects long after the end of the Second World War (WWII). UXBs often entered the ground unnoticed at high velocity and penetrated to a depth of several metres. Here they remain – vulnerable to disturbances from construction work. Beyond the depth of shallow excavation work, the greatest risk is to piling, drilling and probing crews. A piling rig could repeatedly hit a UXBs with considerable force before the crew realises an obstruction has been impacted. It could then be up to 72 hours before the detonator activates.

Who?
The responsibility for avoiding UXB risk usually lies with construction companies or house builders particularly those who are redeveloping urban sites. In addition, project engineering or environmental consultants are expected to advise their clients of a site's history. Other interested parties include those organisations whose employees are physically at most risk from intrusive works, normally piling companies, drillers or probing operators.

How?
UXB risk should be assessed for every site, but especially those in known heavily bombed areas or those situated near war-time strategic installations that were priority targets for enemy aircraft, for example, airfields. Zetica's regional bomb risk map is therefore a first point of reference from which the relative, potential abundance of UXBs can be judged. Consultants then advise their clients that an ordnance-risk desk study is required, which they may obtain from external sources. Construction companies or house builders who assess their own risk could choose to come direct to Zetica.

When?
Do not wait for the piling or drilling company to be on site before thinking about UXB risk – it will inevitably cause delays and higher costs. Request the regional bomb risk map from Zetica as soon as a site is being considered, and then use it to help you or your clients to decide if an ordnance-risk desk study is required.

Where?
Maps can be obtained for any county in England, Scotland, Wales or Northern Ireland – or for any London borough. They can help determine the areas that were most heavily bombed – but no part of the country should be considered 100% safe from UXB risk. Even remote rural areas can have a high risk if, for example, they were locations for decoy airfields or beacons that were lit to fool enemy pilots into thinking they had located a burning city that had been successfully hit by others in the raid.

How to use this regional map
This map is designed to give you an indication of the potential risk from UXBs in your area. If you are conducting work that involves excavation, piling or other disturbance of the ground, then you should use the map to identify the category of risk for your site.

The risk boundaries are a guide, compiled from data based on the political areas for which records are held; being just outside a high-risk area does not mean there is no UXB risk. You should use the map to assist in your decision of whether to investigate the UXB risk further.

Information on the regional risk remaining from UXBs in the UK
Zetica has built the largest UXB database of its kind in the UK. It includes a unique digital library of bomb census data, and maps showing key strategic points and bombing densities from the First and Second World Wars. The main sources of information include records from central government (Public Records Office), the Ministry of Defence, and the German Luftwaffe.

Using information from this database, Zetica has published maps of UXB risk on a regional, county and borough scale. The maps indicate relative degrees of UXB risk based on available records for bombing densities and known targeted areas for regions within the UK. The risk is broken down into individual boroughs, towns or cities. The data are based on the historical boroughs and are then overlaid onto the modern map. It is important to note that more-detailed research may be required for individual sites, particularly where proximity to a potential WWII target means the local risk may be higher.

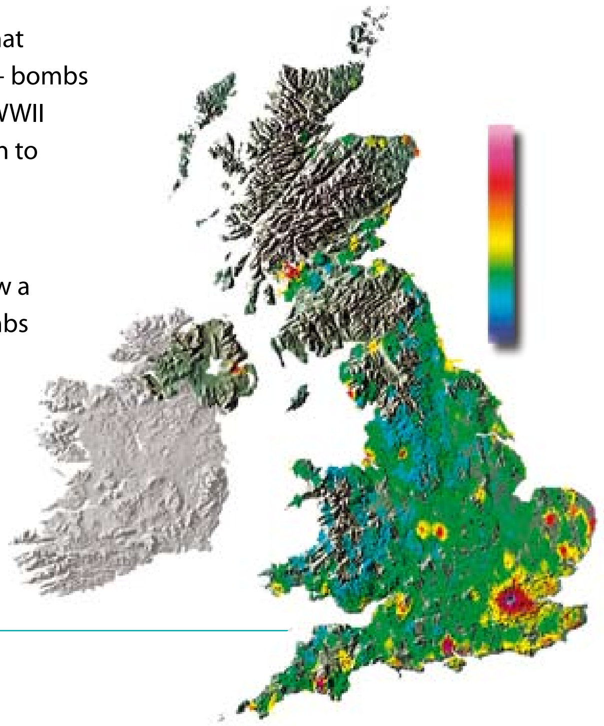
High risk
Areas designated as high risk are those that show a high density of bombing hits (50+ bombs per 1000 acres) and abundant potential WWII targets. In high-risk regions, further action to mitigate UXB risk is considered essential.

Moderate risk
Moderate-risk regions are those that show a bomb density of between 11 and 50 bombs per 1000 acres and that may contain potential WWII targets. Action to mitigate the risk is considered essential, albeit more likely that a reduced scope of work is required compared with that needed for high-risk regions.

Low risk
Low-risk regions are those with a bombing density of up to 10 bombs per 1000 acres. These areas are considered to have a significant but low UXB risk. In general, further action to mitigate the risk is considered prudent, although not essential. Care is required when assessing the risk for specific sites where the risk may be higher because of local wartime activity.

Other WWII targets
Other regions with the risk of UXBs are key strategic points as defined by the government during WWII as representing potential enemy targets. Where these exist outside areas mapped as high, moderate or low risk, a site-specific assessment of the UXB risk may be required.

Relative UXB risk across UK



What to do if…
…you have a site that has a potential UXB risk
In the absence of current legislation requiring you to address the risk from UXBs, your responsibilities under health and safety legislation and regulations such as construction design and management require that you address all identified risks. The first stage is to request further advice from a professional adviser such as Zetica, or to gain more site-specific information by commissioning an ordnance-risk desk study. Then a strategy to deal with the risk can be established that is tailored to your proposed work.

…you find a suspect item or require advice
If during site works you find a suspect (ordnance-related) item, it is very important that you do not touch or move it (even if it has already been moved by an excavator). If it is clearly ordnance related, then dial 999 and ask for the police. Ensure that the area around the item is kept as clear as possible without placing yourself at risk. If you are unsure and do not wish to cause undue alarm, or you just require some advice, then you can call Zetica. We have experienced qualified UXB specialists on hand who can offer support and advice during any site works.

More-detailed procedures should be established in advance if you are in an area where the risk of finding a UXB is shown to be significant (moderate to high).

Site-specific desktop studies
Zetica is able to provide high-quality, site-specific UXB risk information for any residential, industrial or commercial property in the UK. These desktop studies provide details of the bombing density within an area and for the site itself, in order to indicate the risks of UXBs still being present. A risk assessment is provided to facilitate informed decision making on whether any further risk mitigation measures are required.

1.0 HYDROCK REPORT APPENDIX ON HYDROCK METHODOLOGY

This appendix provides additional background information on certain approaches and methods used by Hydrock Consultants Ltd in the preparation of this report.

Throughout the report the term ‘geotechnical’ is used to describe aspects relating to the physical nature of the site (such as foundation requirements) and the term ‘geo-environmental’ is used to describe aspects relating to ground-related environmental issues (such as potential contamination). However, it should be appreciated that this is an integrated investigation and these two main aspects are inter-related. The geo-environmental sections are written in broad agreement with BS 10175:2011+A1:2013.

The **first stage** of a two-staged investigation and assessment of a site is the Preliminary Investigation (BS 10175:2011+A1:2013), often referred to as the Phase 1 Study[1], comprising desk study and walk-over survey, which culminates in the Preliminary Risk Assessment. A preliminary conceptual site model (CSM) is developed. From this are identified any geotechnical and geo-environmental hazards and the qualitative degree of risk associated with them. From the geo-environmental perspective, the Hazard Identification process uses professional judgement to evaluate all the hazards in terms of **possible contaminant linkages** (of source-pathway-receptor). Possible contaminant linkages are potentially unacceptable risks in terms of the current contaminated land regime legal framework and require either remediation or further assessment. These are normally addressed via intrusive ground investigation and generic risk assessment.

The **second stage** is the Ground Investigation, Generic Risk Assessment and Geotechnical Interpretation. This represents the further assessment mentioned above. The Ground Investigation comprises field work and laboratory testing based on the findings of the Preliminary Risk Assessment, to reduce uncertainty in the geotechnical and geo-environmental hazard identification. This may include the Exploratory, Main and Supplementary Investigations described in BS 10175:2011+A1:2013.

For the geotechnical aspects of the report, the general requirements of Eurocode 7 (BS EN 1997-2:2007) are to produce a Ground Investigation Report (GIR) which shall form part of the Geotechnical Design Report (GDR). The geotechnical section of this report is intended to fulfil the general requirements of the GIR as outlined in BS EN 1997-2, Section 6.

The GIR contains the factual information including geological features and relevant data, and a geotechnical evaluation of the information stating the assumptions made in the interpretation of the test results.

[1] Please note that it does not refer to a site development phase.

2.0 SITE INVESTIGATION INFORMATION

2.1 Unexploded Ordnance

Clients have a legal duty under the CDM 2015 Regulations to provide designers and contractors with project-specific health and safety information needed to identify hazards and risks. This includes the possibility of unexploded ordnance (UXO) being encountered on the site. Further details are given in CIRIA report C681 (Stone *et al* 2009).

A non-specialist UXO screening exercise has been carried out for the site by considering (a) any evidence of UK defence activities on or near the site evident from the gathered desk study information and (b) the unexploded aerial delivered bomb (UXB) regional risk maps produced by Zetica. Other data sources are available, but as a first stage screening exercise the freely available Zetica maps have been used. The level of risk stated is that determined by Zetica, a company experience in the desk study, field investigation and clearance of UX0/UXB.

2.2 Hydrogeology

Under the Water Framework Directive the designations of principal and secondary aquifers is based on the Environment Agency interactive aquifer designation map. Where aquifers have been mapped, and they are capable of sustaining a yield of 10 m^3/day or supplying 50 people on a continuous basis, the Environment Agency has designated a number of Groundwater Bodies to help manage water quality under the River Basin Management Plans. Groundwater Bodies are defined based on their support for ecosystems as well as their capacity to supply drinking water. Note that some localised small aquifers capable of supporting the above supply may be too small to map and can be identified only by investigation.

Where an aquifer exists and it contains groundwater but is incapable of sustaining the above supply, the groundwater is not part of a Groundwater Body and may not be considered a strategic resource. In which case the groundwater is not a receptor, but can be a pathway to other receptors by virtue of its ability to transport contaminants.

2.3 Geotechnical Testing

Derived values of geotechnical parameters and/or coefficients are obtained from test results, by theory, correlation or empiricism in line with BS EN 1997-2:2007, Section 1.6.

Where derived geotechnical parameters are to be used in designs in accordance with EC7, there are two further stages of interpretation that will be carried out by the geotechnical designer. The first of these is the selection of **characteristic values** for geotechnical parameters using the derived values and complemented by well-established experience as per EN BS 1997-1:2004, Section 2.4.5.2. The characteristic value is a cautious estimate of the value affecting the occurrence of the limit state. Consequently, any particular material type may have more than one characteristic value for each parameter because there may be more than one limit state depending what is being designed.

The second stage is the selection of **design values** as per EN BS 1997-1:2004, Section 2.4.6.2. The design values is either derived from the characteristic value by applying the relevant partial factor or is assessed directly. Similarly, there can be several design values for the same material type.

In the event that geotechnical designs are included in this report, selection of the characteristic and design values is included. Otherwise, it is the duty of the geotechnical designer to determine these within a separate design report.

3.0 RISK ASSESSMENT RATIONALE

The work presented in this report has been carried out in accordance with recognised best practice as detailed in guidance documents such as in the CLR 11 Model Procedures (Environment Agency 2004a), GP3 (Environment Agency August 2013), BS 5930:2015 and BS 10175:2011+A1:2013. Important aspects of the risk assessment process are transparency and justification. The particular rationale behind the risk assessments presented is given in this appendix.

A preliminary risk assessment is made of both geotechnical and geo-environmental hazards identified at the desk study stage and confirmed (or amended) at the ground investigation stage. In the case of geo-environmental hazards this is based on a simple matrix of probability of occurrence versus the consequence, as explained below, and is referred to as the **exposure model**. In the case of the geotechnical hazard identification, this is referred to as the **ground model**.

The geo-environmental risk assessment process proceeds to the next level, the generic risk assessment, in which actual contaminant concentrations are considered.

3.1 Preliminary Risk Assessment

In line with the CLR 11 Model Procedures (Environment Agency 2004a), the Preliminary Risk Assessment includes a geo-environmental Hazard Identification, which seeks to list all the suspected contaminant **sources**, the **receptors** that might be harmed by those sources and the **pathways** via which the sources might reach the receptors to cause the harm. The source-pathway-receptor concept is known as a contaminant linkage (formerly a pollutant linkage) and only when a linkage is complete is there any possibility of risk of harm arising.

The Hazard Identification process uses professional judgement to evaluate all the hazards in terms of **possible contaminant linkages**. Possible contaminant linkages are potentially unacceptable risks in terms of the current contaminated land regime legal framework and require either remediation or further assessment. These are normally addressed via intrusive ground investigation and the chemical analysis of soil and water samples.

Where no ground investigation has been carried out (i.e. in a desk study only report) there is greater uncertainty in the information available and so a geoenvironmental consequences and probability assessment is undertaken.

Some linkages may be identified which constitute a theoretical connection between a source and a receptor, but professional judgement shows them not to be possible for some reason. These are labelled 'no linkage' in the summary table and no further action is required. If a linkage is possible, a comparison is made of consequence against probability in accordance with the guidance given in CIRIA Report C552 (Rudland *et al* 2001), but is modified as mentioned below.

Classification of consequences and probability are given in CIRIA Report C552 Tables 6.3 and 6.4, respectively, but there are a number of inconsistencies in the original Table 6.3, in particular relating to 'significant harm or significant possibility of significant harm' (SH/SPOSH). Consequently, the table has been updated by Hydrock in line with current practice and the revision presented in R&D Publication 66, Annex 4 (NHBC and Environment Agency. 2008, and is given in Table 3.1 below.

The basis of the classification is that ‘severe’ and ‘medium’ are likely to result in SH/SPOSH as defined by the EPA 1990, Part 2A, with ‘severe’ resulting in acute harm. ‘Mild’ lies below the level of SH/SPOSH but above the level of ‘no harm’ as implied by the relevant Generic assessment criterion (GAC, see below). Minor lies below the ‘no harm’ level.

Table 3.1: Classification of Consequences of Geo-environmental Risks

Classification of Consequences for Geo-environmental Risks		
Classification	**Definition**	**Examples**
Severe	Concentration of contaminants is likely to (or is known from previous data to) exceed that indicative of unacceptable intake or contact. Highly elevated concentrations **likely** to result in “significant harm” to human health as defined by the EPA 1990, Part 2A, if exposure occurs. I.e. >>SH/SPOSH, concentrations are high enough to cause acute (short-term) effects. Equivalent to EA **Category 1** pollution incident including persistent and/or extensive effects on water quality; leading to closure of a potable abstraction point; major impact on amenity value or major damage to agriculture or commerce. Major damage to aquatic or other ecosystems, which is likely to result in a substantial adverse change in its functioning or harm to a species of special interest that endangers the long-term maintenance of the population. Catastrophic damage to crops, buildings or property.	Human health: short-term (acute) effects likely to result in significant harm. E.g. high conc. of cyanide on the surface of an informal recreational area. Significant harm to humans is defined as death, disease*, serious injury, genetic mutation, birth defects or the impairment of reproductive functions. Planting: complete and rapid die-back of landscaped areas. Controlled waters: short-term pollution, e.g. major spillage into controlled water. Major fish kill in surface water from large spillage of contaminants from site. Highly elevated concentrations of List I and II substances present in groundwater close to small potable abstraction (high sensitivity). Buildings etc.: catastrophic damage, e.g. explosion causing collapse. (can also equate to immediate human health risk if buildings are occupied). Ecosystems: acute risk to a particular ecosystem or organism forming part of that ecosystem in a designated protected area, e.g. by contamination spillage. Damage to a protected area of international significance (e.g. Ramsar site). Site workers: risk assessment required to determine PPE and this may involve USEPA Level A, B or C protection.

Classification of Consequences for Geo-environmental Risks		
Classification	**Definition**	**Examples**
Medium	Concentration of contaminants is likely to (or is known from previous data to) exceed that indicative of unacceptable intake or contact. Elevated concentrations which could result in "significant harm" to human health as defined by the EPA 1990, Part 2A if exposure occurs. I.e. >SH/SPOSH. Equivalent to **EA Category 2** pollution incident including significant effect on water quality; notification required to abstractors; reduction in amenity value or significant damage to agriculture or commerce. Significant damage to aquatic or other ecosystems, which may result in a substantial adverse change in its functioning or harm to a species of special interest that may endanger the long-term maintenance of the population. Significant damage to crops, buildings or property.	Human health: long-term (chronic) effects likely to result in significant harm. E.g. high conc. of contaminants close to the surface of a development site. Significant harm to humans is defined as death, disease*, serious injury, genetic mutation, birth defects or the impairment of reproductive functions. Planting: stressed or dead plants in landscaped areas. Controlled waters: pollution of sensitive water resources, e.g. leaching into principal or secondary aquifers or rivers. Buildings etc.: damage renders unsafe to occupy e.g. foundation damage resulting in instability. Ingress of contaminants through plastic potable water pipes. Ecosystems: chronic death of species in a particular ecosystem in a designated protected area, e.g. by contamination spillage. Damage to a protected area of national significance (e.g. Site of Special Scientific Interest). Site workers: risk assessment required to determine PPE and this may involve USEPA Level B, C or D protection.
Mild	Concentration of contaminants is likely to (or is known from previous data to) exceed that indicative of no harm but not unacceptable intake or contact. Exposure to human health **unlikely** to lead to "significant harm". I.e. >SVG/GAC but <SH/SPOSH. Equivalent to **EA Category 3** pollution incident including minimal or short lived effect on water quality; marginal effect on amenity value, agriculture or commerce. Minor or short lived damage to aquatic or other ecosystems, which is unlikely to result in a substantial adverse change in its functioning or harm to a species of special interest that would endanger the long-term maintenance of the population. Minor damage to crops, buildings or property.	Human health: harm but probably not significant harm unless particularly sensitive individual within the receptor group. May be aesthetic/olfactory impacts. Exposure could lead to slight short-term effects (e.g. mild skin rash). Planting: damage to plants in landscaped areas, e.g. stunted growth, discoloration. Controlled waters: pollution of non-sensitive water bodies e.g. leaching into non-classified groundwater or minor ditches. Buildings etc.: damage to sensitive buildings etc. Surface spalling of concrete. Ecosystems: minor change in a particular ecosystem in a designated protected area, but not significant harm. Damage to a locally important area. Site workers: risk assessment required to determine PPE and this may involve USEPA Level C or D protection.

Classification of Consequences for Geo-environmental Risks		
Classification	**Definition**	**Examples**
Minor	Concentration of contaminants is likely to (or is known from previous data to) be less than that indicative of no harm. No measurable effects on humans. I.e. <SGV/GAC. Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems. Repairable effects of damage to buildings, structures and services.	No measurable effects, but simple PPE required (USEPA Level D protection, i.e. overalls, boots, goggles, hard hat). The loss of plants in a landscaping scheme. Discoloration of concrete.

CIRIA Report C552 Table 6.4 is reproduced as Table 3.2 below. This provides an estimate of the probability that the event described by the contaminant linkage will occur. For example, the likelihood that pollution of groundwater will occur by leaching of metals into the aquifer.

Table 3.2: Classification of Probability of Geo-environmental Risks

Classification of Probability of Geo-environmental Risks	
Classification	**Definition**
High Likelihood	There is a contaminant linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Likely	There is a contaminant linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event in not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	There is a contaminant linkage and circumstances are possible under which an event could occur. However, it is no means certain that even over a longer period such event could take place, and is less likely in the shorter term.
Unlikely	There is a contaminant linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

The perceived level of risk for each pathway is then derived from the probability versus consequences matrix, modified after CIRIA Report C552 Table 6.5, given in Table 3.3 below. Note that by definition, no contaminant linkage equates to no risk.

Table 3.3: Qualitative Risk Level from Consequence and Probability

		Consequence			
Probability	*product*	**Severe**	**Medium**	**Mild**	**Minor**
	High Likelihood	Very high risk	High risk	Moderate risk	Low risk
	Likely	High risk	Moderate risk	Low risk	Very low risk
	Low Likelihood	Moderate risk	Low risk	Low risk	Very low risk
	Unlikely	Low risk	Very low risk	Very low risk	Very low risk
	No Linkage	No risk			

This approach assumes an equivalence between probability and consequences and ignores the difficulty that can arise where to probability of occurrence appears to be almost negligible but the consequences are very severe. In such conditions there is a degree of subjectivity in assessing the level of risk and it could be low, moderate or high. Such risks may require specialist consideration beyond the scope of this standard report.

Finally, a description of the classified risks and the likely action required can be determined from Table 3.4 below.

Table 3.4: Description of the Classified Risks and Likely Action Required

Description of Classified Risks and Likely Action Required	
Very High Risk	A significant contaminant linkage, including actual evidence of significant harm or significant possibility and significant harm, is clearly identifiable at the site (e.g. from visual or documentary evidence) under current conditions, with potential for legal and/or financial consequences for the site owner or other Responsible Person. Remediation advisable based on acute impacts being likely. Immediate action should be considered.
High Risk	A contaminant linkage is identifiable at the site under current and future use conditions. Although likely, there is no obvious actual evidence of significant harm or significant possibility and significant harm under current conditions. Extent of risk is therefore subject to confirmation by investigation and risk assessment and most likely to be deemed significant. Realisation of the risk is likely to present a substantial liability to the site owner or other Responsible Person. Remediation required for redevelopment and may also be required under Part 2A for existing receptors.
Moderate Risk	A contaminant linkage is identifiable at the site under current and future use conditions. However, it is not likely to be a significant linkage under current conditions. It is either relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely, that the harm would be relatively mild. Actual extent of risk subject to confirmation by additional investigation and risk assessment and most likely to lie between no possibility of harm (under current conditions) and significant possibility of significant harm (under conditions created by new use). Remediation may be required for redevelopment.
Low risk	Potential pathways and receptors exist but history of contaminative use or site conditions indicates that contamination is likely to be of limited extent and below the level of no possibility of harm. It is unlikely that the site owner or other Responsible Person would face substantial liabilities from suck a risk. Precautionary investigations and risk assessment advisable on change of use. Any subsequent remedial works are likely to be relatively limited.
Very Low Risk	No contaminant linkage likely to exist under current or future conditions, but this cannot be completely discounted. If harm is realised, it is likely at worst to be mild or minor. Site not capable of being determined under Part 2A where the local authority inspects the site. No further action recommended.
No Risk	No contaminant linkage exists.

3.2 Contaminant Analysis of Samples

The Model Procedures of CLR 11 provide guidance on key information sources with respect to potential contamination arising from past land uses of a site. In particular, the now withdrawn CLR 8 (Environment Agency 2002b), the DoE Industry Profile documents and ISO10381-5 provide good summaries of priority pollutants for UK sites. Additionally, the Environment Agency (2004b) has produced a list of priority pollutants for ecological risk assessment. These documents have been used, with the findings of the Phase 1 investigation, to scope the analyses of chemicals of potential concern. It should be noted that whilst CLR 8 was withdrawn in August 2008 it was not replaced and its findings are still considered useful.

Hydrock considers there to be a minimum requirement for soil chemical analysis, even for greenfield sites, in order to satisfy the 'suitable for use' criterion of the planning regime. This is represented by the 'Hydrock default list of determinands for solids'. The default list is derived from the above guidance, particularly Tables 2.1 and 2.2 of CLR 8, listing potential inorganic and organic contaminants on typical former **industrial** land in the UK.

Since not all redevelopment sites have former industrial land uses, the default list designed to screen for unacceptable risks to property development and future occupiers comprises those substances with human, vegetation and construction materials receptors. The list includes common metals, metalloids and inorganic species, pH, asbestos fibres and screening tests for common organic compound groups which are deemed chemicals of potential concern. Sulfate is a contaminant whose principal receptor is concrete in the ground and is not considered toxic except in extreme conditions. Sulfate analysis is included in the list of geotechnical tests. Some common determinands such as elemental sulfur and sulfide are not included because there is insufficient information available to calculate meaningful assessment criteria.

The Hydrock default list of determinands for water or soil leaching samples is based on the prevailing UK drinking water standards and the environmental quality standards (EQS) values under the UK's obligations under the European Water Framework Directive (WFD). It includes the most common contaminants for use as a screening exercise but does not represent a complete list.

The two Hydrock default lists of determinands are used as a minimum requirement whatever the findings of the Phase 1 investigation. Added to this may be other suites of determinands based on the findings and review of the aforementioned documents.

Assessment is made of all chemicals of potential concern recorded on the site above the laboratory reporting limit. The reporting limits are less than the generic assessment criteria where this is possible. There are two main reasons why this may not be the case.

Firstly, low-level detection may be available using a more detailed analysis method, but this would be disproportionally expensive for routine screening purposes. More detailed testing may be recommended in some instances as an additional phase of investigation once the results of the screening exercise are known.

Secondly, there may be no suitable laboratory method available. In which case it is impossible to give a definitive opinion.

3.3 Generic Risk Assessment Criteria for Human Health

3.3.1 Policy

Generic assessment criteria (GAC) are criteria derived using largely generic assumptions about the characteristics and behaviour of sources, pathways and receptors. These assumptions will be conservative in a defined range of conditions. The Contaminated Land Exposure Assessment (CLEA) framework uses Soil Guideline Values (SGV) in assessing risks to human health from exposure to soils contaminated with selected contaminants. It has been assumed in this report that the exposure conditions are within the generic conditions used to derive the SGVs.

It should be noted that exceedance of GACs does not automatically mean that the soil is "contaminated". The derivation of GACs includes a number of precautionary assumptions such that non-exceedance will indicate that risk to human health is acceptable and that the land is suitable for use, with regard to the contaminant in question. SGVs are not binding standards, but may be used to inform judgments about the need for action and the selection of remediation standards or target values for individual sites.

However, the legal test for land contamination under the statutory guidance of Part 2A of the Environment Protection Act 1990 (i.e. "significant harm or significant possibility of significant harm") is **unacceptable** intake or direct bodily contact. Defra (September 2005 and July 2008) has made it clear that exceedance of a GAC does not necessarily meet this legal test, i.e. exceedance of a GAC does not necessarily equate to unacceptable risk. Consequently, the GACs must be considered as screening values only. The situation was clarified by Defra (July 2008) in its guidance on the legal definition of contaminated land and in 2012 by the publication of revised contaminated land statutory guidance. One of the key policy aspects of this revision is to clarify that GACs are only one tool in the decision-making process and that background concentrations and a number of other relevant factors should also be taken into account. The aim is to prevent over-cautious determination of land as being contaminated.

The Environment Agency (2009a) has stated that the Health Criteria Values (HCV) used to derive GACs represent minimal or tolerable risk for long-term human exposure to chemicals in the soil. "Science alone cannot answer the question of whether or not a given *possibility of significant harm* is *significant*, since what is either *significant* or *unacceptable* is a matter of socio-political judgement, and the law entrusts decisions on this to the enforcing authorities (Defra July 2008)."

The former Health Protection Agency (2009) (now Public Health England) also described how HCVs do not represent unacceptable intake and that unacceptable intake is not a toxicological parameter. It further asserts that "unacceptable intake is a policy decision which can only be taken by the local authority." Pointers provided to local authorities in this regard are provided by the following: "The HCVs, and GACs based upon them represent trigger values above which there might be a possibility of significant harm. Whether there is a significant possibility will be linked to factors such as the margin of exceedance, the duration and frequency of exposure, and other site-specific factors."

The 2012 National Planning Policy Framework states that the standard of remediation to be achieved through the grant of planning permission for new development, including permission for land remediation activities, is the removal of unacceptable risk and making sure the site is suitable for its new use. As a minimum, after carrying out the development and commencement of its use, the land should not be capable of being determined as contaminated under Part 2A. The requirements for planning are, therefore, the same as for Part 2A.

The 2012 contaminated land statutory guidance says that GAC represent cautious estimates of levels of contaminants in soil at which there is considered to be no risk to health or, at most, a minimal risk to health. They may be used to indicate when land is very unlikely to pose a significant possibility of significant harm to human health. They should not:

- be used as direct indicators of whether a significant possibility of significant harm to human health may exist. Also, the local authority should not view the degree by which GACs are exceeded (in itself) as being particularly relevant to this consideration, given that the degree of risk posed by land would normally depend on many factors other than simply the amount of contaminants in soil.

- be seen as screening levels which describe the boundary between Categories 3 and 4 (see below);
- be viewed as indicators of levels of contamination above which detailed risk assessment would automatically be required under Part 2A or, under the planning system, in relation to ensuring that land affected by contamination does not meet the Part 2A definition of contaminated land after it has been developed; nor
- be used as generic remediation targets under the Part 2A regime.

Where it is judged that significant uncertainties remain following assessment against generic criteria, there are two options for the developer: either the implementation of an agreed remedial strategy, or to undertake additional testing and/or a detailed quantifiable risk assessment to determine whether remediation is indeed necessary.

Category 4 Screening Levels (C4SL) are criteria developed to screen out land affected by contamination under Part 2A of the EPA 1990 (see Section 3.12 below). They represent a low level of risk, whilst still being protective of human health. The Defra policy document (March 2014) states that "it is anticipated that, where they exist, C4SLs will be used as generic screening criteria that can be used within a GQRA, albeit describing a higher level of risk than the currently or previously available SGVs."

Defra also states that "the Part 2A regime and the planning regime are inter-linked such that the National Planning Policy Framework states that "after development, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990" and that "Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner." The Part 2A Statutory Guidance and accompanying Impact Assessment were developed on the basis that Category 4 Screening Levels could be used under the planning regime, as they would be in Part 2A investigations directly. The estimated benefits that were expected to accrue from the changes to the Part 2A Statutory Guidance and specifically from the use of the new Category 4 Screening Levels were based on this assumption. However, policy responsibility for the National Planning Policy Framework and associated Planning Practice Guidance falls to the Department for Communities and Local Government."

DCLG's Planning Policy Guidance (Reference ID: 33-007-20140612 Land affected by contamination, dated 12 June 2014) states that "if there is a reason to believe contamination could be an issue, developers should provide proportionate but sufficient site investigation information (a risk assessment) to determine the existence or otherwise of contamination, its nature and extent, the risks it may pose and to whom/what (the 'receptors') so that these risks can be assessed and satisfactorily reduced to an acceptable level. Defra has published a policy companion document considering the use of 'Category 4 Screening Levels' in providing a simple test for deciding when land is suitable for use and definitely not contaminated land."

In a letter to Local Authorities dated 3 September 2014, Defra Parliamentary Under Secretary Lord de Mauley confirmed that the Impact Assessment agreed during the revision of the Part 2A Statutory Guidance was developed on the basis that C4SLs could be used under the planning regime, and noted this intent is reflected in the above-mentioned revision of the Planning Policy Guidance. He highlighted that C4SLs provide a simple test for deciding when land is suitable for use. He concluded that the introduction of C4SLs has an important part to play in the assessment of potentially contaminated land and encouraged Local Authority officials to read Defra's Policy Companion Document.

The NHBC (October 2014) has endorsed the use of C4SLs in the planning framework. "NHBC considers that:

- C4SLs may be used for schemes in England and Wales as generic screening levels for contaminants in soils, as long as they are justifiable and defensible in the conceptual site model for the site. Where representative contaminant concentrations exceed C4SLs, remediation or further detailed assessment will normally be required.
- Developers should, however, check that the use of C4SLs would be accepted by regulators under the relevant planning regime.
- Where a land use scenario covered by a C4SL applies in England and Wales, that use of C4SLs will satisfy NHBC Standards – Chapter 4.1 requirements. For lead, the C4SL value should be adopted as the screening level, though normal background concentrations can be considered when appropriate."

Public Health England has also communicated with Hydrock on a site-specific basis, confirming (in this instance) that the soil benzo(a)pyrene levels below C4SL not to be of particular concern as long as the Local Authority as the regulator is also satisfied.

On this basis, Hydrock considers the C4SLs to be more pragmatic assessment criteria for use in the planning regime. However, it is recommended that the opinion be sought of the Local Authority in question.

3.3.2 Methodology

The sample analyses are divided into representative data sets for the assessment, based on the conceptual model and taking into account such characteristics as variation in soil properties or historical, existing or proposed land uses. The 'averaging area' is the area of soil to which a receptor is exposed or which otherwise contributes to the creation of hazardous conditions.

The determination of averaging areas is clarified in the CLEA Frequently Asked Questions (30 January 2006) document available from the Agency CLEA web pages. In applying statistical tests, the risk assessor is asking the question "are mean (95 percentile upper confidence limit) soil concentrations within the averaging area equal to, or greater than, the SGV/GAC?" If a garden lies within a larger averaging area, but that averaging area is representative of conditions within the garden, then this is the average concentration a receptor using the garden will be exposed to. An averaging area can, therefore, be larger than a single garden and part of a larger zoned area if:

- contaminant concentrations are within the same statistical population, the sample data being representative of the averaging area and the mean concentration of the averaging area;
- hot spots are treated as separate zones or averaging areas; and
- the sampling strategy takes into account uncertainty (spatial heterogeneity) in contaminant concentration.

The approach taken in this report is to characterize the materials that are likely to form the ground cover in garden areas by zoning the site. Each averaging area has been chosen to describe the area(s) of the site, zoned according to material type and existing conditions, within which assessment against GACs has taken place. As pointed out in P5-066/TR (Environment Agency 2000) and by Nathanail (2004), this is a logical way of investigating a large plot of land that is intended for residential use, particularly if the development layout may not have been finalised.

The original Soil Guideline Values were all withdrawn in August 2008 and the Agency started a programme of publishing replacements using its ‘new approach’, which involves a number of changes to the way exposure is assessed. This was started using the CLEA 1.04 software. The current version is CLEA 1.07. This programme was put in abeyance when Defra started to re-draft the Part 2A statutory guidance and was never re-started.

This new approach included SGVs only at 6% soil organic matter (SOM) content and none for the residential without plant uptake land use. The contaminated land community has addressed this deficiency by publishing other lists of GACs (EIC/AGS/CL:AIRE 2009 and LQM/CIEH (Nathanail *et al* 2009)) and these have been given equal status to the SGVs in the 2012 revised statutory guidance. Hydrock adopted all these SGVs and GACs and where none are published has derived in-house values using generic assumptions about the characteristics and behaviour of sources, pathways and receptors, the CLEA 1.07 software and research of the recommended data sources.

Since the publication of these lists, CL:AIRE (December 2013) has highlighted that several of the original USEPA data sets used as default input parameters in CLEA have been revised based on a better understanding of the science. These are the outdoor soil-to-skin adherence factor, the exposure frequency for dermal contact, the indoor soil vapour inhalation rates and the produce consumption rates. The first three of these changes are based on updated research in a USEPA 2011 document cited by CL:AIRE. These supersede a draft 2006 USEPA document that was used in the default CLEA model and represent new science. The produce consumption rates used by CL:AIRE are from the most recent National Diet and Nutrition Survey (NSDS) (2008/2009 to 2010/11).

In November 2014 Hydrock used these revised parameters to update all the previously published GACs using modifications to CLEA 1.06. These changes are now built into CLEA 1.07 when the C4SL land uses are selected.

The mean and 90th percentile consumption rates from SP1010 Table 3.4 are used. In the derivation of the C4SLs, CL:AIRE used the 90th percentile consumption rates for the “top two” produce types for each substance and mean consumption rates are used for the remaining produce types (SP1010 Table 3.3). This approach has been followed by Hydrock for the C4SL substances. However, the procedure for determining which are the “top two” is time consuming and has not been replicated by Hydrock for all the other chemicals. The 90th percentile values have been taken for all produce types (and is slightly more conservative).

The GACs adopted by Hydrock for the standard CLEA land uses are given in Table 3.5 together with the source of the GAC. The table also lists GACs for open space (see below).

Please note also that CLEA 1.07 allows for other variations, most notably of soil type (9 options) and building type (5 residential options). The defaults are a sandy loam soil, a small terraced house in the residential setting and a pre-1970s office block in the commercial setting. These are generally conservative and the resultant SGV/GAC are protective of other combinations (unlike the default SOM mentioned above). It is not practical to include all permutations in Table 3.5 and in the cases where specific GACs have been derived, this is referred to in the text of the report and the relevant values included in the assessment tables.

Lead is a special case as the former SGV was not based on the CLEA model, but equations utilising blood lead concentrations. There is currently no guidance on how to risk assess lead in order to produce a GAC. The provisional C4SL for lead was derived using a number approaches, again based on blood lead concentrations, but for three different toxicological effects. The use of biokinetic modelling allows conversion to units suitable for use in the CLEA model. The final C4SLs for residential (with home-ground produce) stipulated in the Defra policy document is less than the withdrawn SGV although the SGV was supposed to represent a lower level of risk. It is clear from the work undertaken to develop the C4SLs why the SGVs were withdrawn. Consequently, and in view of the Defra policy document, Hydrock has adopted the C4SLs for lead *in lieu* of the withdrawn SGV or any specifically derived GAC (which would require a thorough review of lead toxicology). The lead C4SLs are, therefore, included under the term "GACs" in this report.

Further details including data sources can be obtained on request. It is Hydrock's policy to continually review GACs and updates are made in response to the latest Government guidance or as more data on the substances becomes available. The date of the last update of the table is indicated.

Table 3.5: Soil GACs Adopted by Hydrock (mg/kg) - on following pages

Updated 18/11/15		Human Health Generic Assessment Criteria (mg/kg)											
Contaminant	**Source of GAC**	**Human health - residential without plant uptake (1%SOM)**	**Human health - residential without plant uptake (2.5%SOM)**	**Human health - residential without plant uptake (6%SOM)**	**Human health - residential with plant uptake (1%SOM)**	**Human health - residential with plant uptake (2.5%SOM)**	**Human health - residential with plant uptake (6%SOM)**	**Human health - allotments (1%SOM)**	**Human health - allotments (2.5%SOM)**	**Human health - allotments (6%SOM)**	**Human health - commercial (1%SOM)**	**Human health - commercial (2.5%SOM)**	**Human health - commercial (6%SOM)**
							Default for SGV			Default for SGV			Default for SGV
Hydrock Default Suite													
Arsenic	SGV report + CLEA 1.07	40	40	40	37	37	37	49	49	49	640	640	640
Beryllium	LQM/CIEH + CLEA 1.07	73	73	73	73	73	73	56	56	56	390	390	390
Boron	LQM/CIEH + CLEA 1.07	11000	11000	11000	300	300	300	47	47	47	190000	190000	190000
Cadmium	SGV report + CLEA 1.07	87	87	87	14	14	14	2.4	2.4	2.4	220	220	220
Chromium (III)	LQM/CIEH + CLEA 1.07	890	890	890	890	890	890	15000	15000	15000	8400	8400	8400
Chromium (VI)	LQM/CIEH + CLEA 1.07	6.1	6.1	6.1	6.1	6.1	6.1	2.3	2.3	2.3	33	33	33
Copper	LQM/CIEH + CLEA 1.07	7300	7300	7300	2500	2500	2500	540	540	540	69000	69000	69000
Lead	C4SL (NB not minimal risk)	310	310	310	200	200	200	80	80	80	2300	2300	2300
Mercury, inorganic	SGV report + CLEA 1.07	240	240	240	170	170	170	81	81	81	3600	3600	3600
Nickel	Hydrock + CLEA 1.07	180	180	180	130	130	130	55	55	55	1700	1700	1700
Selenium	SGV report + CLEA 1.07	600	600	600	360	360	360	130	130	130	13000	13000	13000
Vanadium	LQM/CIEH + CLEA 1.07	1200	1200	1200	410	410	410	94	94	94	9000	9000	9000
Zinc	LQM/CIEH + CLEA 1.07	40000	40000	40000	3900	3900	3900	640	640	640	670000	670000	670000
Cyanide (free)	Hydrock + CLEA 1.07	800	800	800	790	790	790	2300	2300	2300	16000	16000	16000
Phenol	SGV report + CLEA 1.07	750	1300	2300	290	560	1100	69	140	290	760	1500	3200
Acenaphthene	LQM/CIEH + CLEA 1.07	3000	4700	6000	220	520	1100	35	95	210	84000	97000	100000
Acenaphthylene	LQM/CIEH + CLEA 1.07	2900	4600	6000	180	430	940	29	71	170	83000	97000	100000
Anthracene	LQM/CIEH + CLEA 1.07	31000	35000	37000	2400	5500	11000	390	940	2300	520000	540000	540000
Benz(a)anthracene	LQM/CIEH + CLEA 1.07	5.5	7.8	9.4	4.2	6.7	8.6	2.5	5.4	10	86	91	94
Benzo(a)pyrene	LQM/CIEH + CLEA 1.07	1.5	1.6	1.6	1.50	1.50	1.5	2.10	2.2	2.4	14	14	14
Benzo(b)fluoranthene	LQM/CIEH + CLEA 1.07	11.0	11.0	11.0	7.6	9.4	10.0	3.5	7.3	13	97	98	99
Benzo(ghi)perylene	LQM/CIEH + CLEA 1.07	71	72	72	64	69	71	69	110	150	630	640	640
Benzo(k)fluoranthene	LQM/CIEH + CLEA 1.07	15	16	16	12.0	14.0	15	6.7	13	23	140	140	140
Chrysene	LQM/CIEH + CLEA 1.07	13.0	16.0	15	7.7	11.0	13.0	2.6	5.8	12	140	140	140
Dibenz(ah)anthracene	LQM/CIEH + CLEA 1.07	1.30	1.40	1.40	1.10	1.30	1.40	0.75	1.4	2.3	12	12	13
Fluoranthene	LQM/CIEH + CLEA 1.07	1500	1600	1600	290	560	900	52	130	290	23000	23000	23000
Fluorene	LQM/CIEH + CLEA 1.07	2800	3800	4500	170	410	880	28	68	160	63000	68000	71000
Indeno(123cd)pyrene	LQM/CIEH + CLEA 1.07	6.3	6.6	6.7	4.3	5.5	6.2	1.8	3.8	7.1	58	59	60
Naphthalene	LQM/CIEH + CLEA 1.07	2.3	5.6	13.0	2.2	5.2	12.0	4.2	10	24	190	460	1100
Phenanthrene	LQM/CIEH + CLEA 1.07	1300	1500	1500	97	220	440	16	39	92	22000	22000	23000
Pyrene	LQM/CIEH + CLEA 1.07	3700	3800	3800	620	1200	2000	110	270	620	54000	54000	55000
TPH fractions													
TPH ali EC05-EC06	LQM/CIEH + CLEA 1.07	42	78	160	42	78	160	760	1800	4000	300	560	1200
TPH ali >EC06-EC08	LQM/CIEH + CLEA 1.07	100	230	530	100	230	530	2400	5700	13000	140	320	740
TPH ali >EC08-EC10	LQM/CIEH + CLEA 1.07	27	65	160	27	65	150	320	760	1700	78	190	450
TPH ali >EC10-EC12	LQM/CIEH + CLEA 1.07	48	120	280	48	120	280	2100	4200	7000	48	120	280
TPH ali >EC12-EC16	LQM/CIEH + CLEA 1.07	24	59	140	24	59	140	11000	13000	13000	24	59	140
TPH ali >EC16-EC35	LQM/CIEH + CLEA 1.07	65000	93000	110000	65000	92000	110000	260000	270000	270000	1000000	1000000	1000000
TPH ali >EC35-EC44	LQM/CIEH + CLEA 1.07	65000	93000	110000	65000	92000	110000	260000	270000	270000	1000000	1000000	1000000
TPH aro EC05-EC07	LQM/CIEH + CLEA 1.07	370	690	1400	73	150	310	14	28	60	1200	2300	4700
TPH aro >EC07-EC08	LQM/CIEH + CLEA 1.07	860	1800	3900	130	300	680	23	53	120	870	1900	4400
TPH aro >EC08-EC10	LQM/CIEH + CLEA 1.07	47	120	270	35	84	190	8.9	22	52	610	1500	3600
TPH aro >EC10-EC12	LQM/CIEH + CLEA 1.07	250	590	1200	75	180	390	13	32	76	360	900	2200
TPH aro >EC12-EC16	LQM/CIEH + CLEA 1.07	1800	2300	2500	150	330	670	23	58	140	36000	37000	38000
TPH aro >EC16-EC21	LQM/CIEH + CLEA 1.07	1900	1900	1900	260	550	930	46	110	260	28000	28000	28000
TPH aro >EC21-EC35	LQM/CIEH + CLEA 1.07	1900	1900	1900	1100	1500	1700	360	790	1500	28000	28000	28000
TPH aro >EC35-EC44	LQM/CIEH + CLEA 1.07	1900	1900	1900	1100	1500	1700	360	790	1500	28000	28000	28000
TPH >EC44-EC70	LQM/CIEH + CLEA 1.07	1900	1900	1900	1600	1800	1900	1100	2000	2900	28000	28000	28000
VOCs - BTEX & MTBE													
Benzene	SGV report + CLEA 1.07	0.38	0.70	1.4	0.099	0.2	0.42	0.02	0.041	0.09	27	48	90
Toluene	SGV report + CLEA 1.07	860	1800	3900	130	300	680	23	53	120	870	1900	4400
Ethylbenzene	SGV report + CLEA 1.07	240	540	1200	76	180	410	17	40	94	520	1200	2800
Xylene, o-	SGV report + CLEA 1.07	85	200	460	59	140	320	29	70	160	480	1100	2600
Xylene, m-	SGV report + CLEA 1.07	79	190	430	58	140	320	32	77	180	630	1500	3500
Xylene, p- (use this for combined m & p)	SGV report + CLEA 1.07	76	180	410	55	130	300	30	72	170	580	1400	3200
MTBE	EIC/AGS/CL:AIRE + CLEA 1.07	100	170	320	62	110	210	23	45	92	7500	12000	27000
VOCs - other benzenes													
Iso-propylbenzene	EIC/AGS/CL:AIRE + CLEA 1.07	17	40	95	15	38	89	33	81	190	390	950	2300
Propylbenzene	EIC/AGS/CL:AIRE + CLEA 1.07	57	140	320	46	110	260	35	86	200	400	980	2300
1,2,4-Trimethylbenzene	EIC/AGS/CL:AIRE + CLEA 1.07	0.58	1.4	3.3	0.47	1.2	2.7	0.39	0.96	2.3	39	94	210

Updated 18/11/15		Human Health Generic Assessment Criteria (mg/kg)											
Contaminant	**Source of GAC**	**Human health - residential without plant uptake (1%SOM)**	**Human health - residential without plant uptake (2.5%SOM)**	**Human health - residential without plant uptake (6%SOM)**	**Human health - residential with plant uptake (1%SOM)**	**Human health - residential with plant uptake (2.5%SOM)**	**Human health - residential with plant uptake (6%SOM)**	**Human health - allotments (1%SOM)**	**Human health - allotments (2.5%SOM)**	**Human health - allotments (6%SOM)**	**Human health - commercial (1%SOM)**	**Human health - commercial (2.5%SOM)**	**Human health - commercial (6%SOM)**
VOCs - chlorobenzenes													
Bromobenzene	EIC/AGS/CL:AIRE + CLEA 1.07	1.3	3	7	1.2	2.8	6.6	3.3	7.9	18	92	210	490
Chlorobenzene	LQM/CIEH + CLEA 1.07	0.47	1.1	2.4	0.46	1.0	2.4	6.1	14	33	56	130	290
1,2-Dichlorobenzene	LQM/CIEH + CLEA 1.07	24	57	130	23	55	130	97	240	560	570	1400	3200
1,3-Dichlorobenzene	LQM/CIEH + CLEA 1.07	0.44	1.1	2.5	0.41	0.98	2.3	0.26	0.63	1.5	30	73	170
1,4-Dichlorobenzene	LQM/CIEH + CLEA 1.07	60	140	330	38	92	220	16	38	91	230	540	1300
Hexachlorobenzene	LQM/CIEH + CLEA 1.07	0.20	0.50	2.5	0.20	0.50	1.9	0.17	0.42	0.91	0.2	53	55
Pentachlorobenzene	LQM/CIEH + CLEA 1.07	20	30	38	5.9	12	22	1.3	3.1	7.1	640	770	830
1,2,3-trichlorobenzene	LQM/CIEH + CLEA 1.07	1.5	3.7	8.8	1.5	3.6	8.6	4.8	12	28	100	250	590
1,2,4-trichlorobenzene	LQM/CIEH + CLEA 1.07	2.6	3.4	15	2.6	6.4	15	31	77	180	220	530	1300
1,3,5-trichlorobenzene	LQM/CIEH + CLEA 1.07	0.33	0.81	1.9	0.33	0.81	1.9	4.9	12	28	23	55	130
1,2,3,4-tetrachlorobenzene	LQM/CIEH + CLEA 1.07	24	56	120	15	36	78	4.5	11	26	120	300	730
1,2,3,5-tetrachlorobenzene	LQM/CIEH + CLEA 1.07	0.75	1.9	4.3	0.67	1.6	3.7	0.39	0.95	2.2	39	98	240
1,2,4,5-tetrachlorobenzene	LQM/CIEH + CLEA 1.07	0.73	1.7	3.5	0.34	0.78	1.6	0.065	0.16	0.38	20	49	96
VOCs - chloroalkanes & alkanes													
Bromodichloromethane	EIC/AGS/CL:AIRE + CLEA 1.07	0.027	0.049	0.10	0.022	0.040	0.082	0.017	0.033	0.070	2.0	3.5	7.1
Bromoform	EIC/AGS/CL:AIRE + CLEA 1.07	7.4	15	32	3.5	7.3	16	0.98	2.1	4.8	710	1400	3000
Chloroethane	EIC/AGS/CL:AIRE + CLEA 1.07	12	16	26	12	16	26	120	210	390	900	1200	2000
Chloroethene (aka vinyl chloride)	LQM/CIEH + CLEA 1.07	0.00077	0.0010	0.0015	0.00064	0.00087	0.0014	0.00057	0.0010	0.0019	0.059	0.077	0.12
Chloromethane	EIC/AGS/CL:AIRE + CLEA 1.07	0.012	0.014	0.019	0.012	0.014	0.019	0.068	0.13	0.24	1.0	1.1	1.5
1,1-Dichloroethane	EIC/AGS/CL:AIRE + CLEA 1.07	3.6	5.8	11	3.4	5.5	11	9.6	18	37	260	430	800
1,2-Dichloroethane	LQM/CIEH + CLEA 1.07	0.0092	0.013	0.023	0.0071	0.011	0.019	0.0048	0.0086	0.016	0.67	0.97	1.7
1,1-Dichloroethene	EIC/AGS/CL:AIRE + CLEA 1.07	0.33	0.58	1.2	0.32	0.57	1.2	2.9	5.8	12	24	43	87
Cis 1,2 Dichloroethene	EIC/AGS/CL:AIRE + CLEA 1.07	0.17	0.29	0.56	0.16	0.27	0.52	0.27	0.52	1.1	14	23	44
Trans 1,2 Dichloroethene	EIC/AGS/CL:AIRE + CLEA 1.07	0.28	0.50	1.0	0.27	0.48	0.98	0.97	1.9	4.2	21	37	76
Dichloromethane	EIC/AGS/CL:AIRE + CLEA 1.07	3.0	4.0	6.4	0.62	1.1	1.9	0.11	0.19	0.35	260	340	530
1,2-Dichloropropane	EIC/AGS/CL:AIRE + CLEA 1.07	0.034	0.06	0.12	0.034	0.060	0.12	0.64	1.3	2.7	3.1	5.5	11
Hexachloroethane	EIC/AGS/CL:AIRE + CLEA 1.07	0.31	0.77	1.8	0.27	0.66	1.6	0.28	0.069	1.6	8.2	20	48
Tetrachloroethene	LQM/CIEH + CLEA 1.07	1.5	3.3	7.5	1.3	2.9	6.7	1.7	3.9	9.0	120	280	620
1,1,1,2-Tetrachloroethane	LQM/CIEH + CLEA 1.07	1.5	3.6	8.2	1.2	2.8	6.5	0.82	1.9	4.6	110	250	560
1,1,2,2-Tetrachloroethane	LQM/CIEH + CLEA 1.07	4.1	8.3	18	1.7	3.5	7.8	0.42	0.92	2.1	280	560	1200
Tetrachloromethane	LQM/CIEH + CLEA 1.07	0.026	0.056	0.13	0.026	0.056	0.13	0.17	0.38	0.88	2.9	6.3	14
Trichloroethene	LQM/CIEH + CLEA 1.07	0.16	0.33	0.73	0.15	0.31	0.69	0.44	0.99	2.2	11	24	52
1,1,1-Trichloroethane	LQM/CIEH + CLEA 1.07	9.0	18	40	8.8	18	39	50	110	250	660	1400	3000
1,1,2 Trichloroethane	EIC/AGS/CL:AIRE + CLEA 1.07	1.3	2.5	5.5	0.76	1.6	3.5	0.29	0.64	1.4	89	180	380
Trichloromethane	LQM/CIEH + CLEA 1.07	1.3	2.3	4.6	0.98	1.8	3.6	0.37	0.73	1.5	100	180	350
Other phenols & chlorophenols													
2-Chlorophenol	LQM/CIEH + CLEA 1.07	110	170	220	3.9	9.1	20	0.60	1.4	3.4	3600	4000	4300
2,4-Dichlorophenol	LQM/CIEH + CLEA 1.07	94	150	200	0.91	2.1	4.7	0.14	0.31	0.72	3500	3900	4200
2,4-Dimethylphenol	EIC/AGS/CL:AIRE + CLEA 1.07	300	590	1000	20	46	100	3.2	7.4	17	1400	3100	7200
2-Methylphenol	EIC/AGS/CL:AIRE + CLEA 1.07	5300	7700	9900	85	190	430	13	29	67	160000	180000	180000
3-Methylphenol	EIC/AGS/CL:AIRE + CLEA 1.07	6800	9100	11000	85	190	420	13	29	65	170000	180000	190000
4-Methylphenol	EIC/AGS/CL:AIRE + CLEA 1.07	5400	7900	10000	84	190	420	13	29	65	160000	180000	180000
Pentachlorophenol	LQM/CIEH + CLEA 1.07	37	56	69	0.56	1.3	3.1	0.085	0.21	0.49	1200	1300	1400
2,3,4,6-Tetrachlorophenol	LQM/CIEH + CLEA 1.07	140	200	240	0.89	2.1	4.8	0.14	0.32	0.74	3900	4200	4300
2,4,6-Trichlorophenol	LQM/CIEH + CLEA 1.07	140	200	250	1.5	3.5	7.8	0.22	0.53	1.2	3900	4200	4400
Phthalates													
Bis (2-ethylhexyl) phthalate	EIC/AGS/CL:AIRE + CLEA 1.07	3900	4000	4100	290	660	1300	48	120	280	85000	86000	86000
Butyl benzyl phthalate	EIC/AGS/CL:AIRE + CLEA 1.07	61000	63000	64000	1500	3500	7800	230	560	1300	940000	940000	950000
Diethyl Phthalate	EIC/AGS/CL:AIRE + CLEA 1.07	14	29	65	120	270	610	19	43	98	14	29	65
Di-n-butyl phthalate	EIC/AGS/CL:AIRE + CLEA 1.07	650	650	650	13	32	72	2.1	5.1	12	15000	15000	15000
Di-n-octyl phthalate	EIC/AGS/CL:AIRE + CLEA 1.07	4900	4900	4900	2800	3800	4300	920	2000	3900	89000	89000	89000
Pesticides													
Aldrin	LQM/CIEH + CLEA 1.07	3.0	3.1	3.1	2.3	2.7	2.9	1.3	2.5	4.0	54	54	54
Atrazine	LQM/CIEH + CLEA 1.07	45	46	46	0.25	0.58	1.3	0.038	0.089	0.21	870	880	880
DDD	Hydrock + CLEA 1.07	1300	1300	1300	910	1100	1200	400	780	1200	22000	22000	22000
DDE	Hydrock + CLEA 1.07	1300	1300	1300	870	1100	1200	360	740	1300	22000	22000	22000
DDT	Hydrock + CLEA 1.07	1300	1300	1300	830	1000	1200	320	650	1100	21000	21000	21000
Dichlorvos	LQM/CIEH + CLEA 1.07	36	45	53	0.30	0.62	1.3	0.046	0.094	0.20	840	870	890
Dieldrin	LQM/CIEH + CLEA 1.07	5.0	5.4	5.6	0.74	1.5	2.7	0.13	0.32	0.74	90	91	92
Endosulfan - alpha	LQM/CIEH + CLEA 1.07	62	110	160	3.1	7.4	17	0.49	1.2	2.8	2300	3000	3400
Endosulfan - beta	LQM/CIEH + CLEA 1.07	76	130	180	2.9	7.0	16	0.46	1.1	2.6	2500	3100	3500
Hexachlorocyclohexanes - alpha (inc. Lindane)	LQM/CIEH + CLEA 1.07	660	840	940	20	48	110	3.1	7.7	18	14000	15000	15000
Hexachlorocyclohexanes - beta (inc. Lindane)	LQM/CIEH + CLEA 1.07	73	75	76	1.7	4.1	9.2	0.27	0.66	1.6	1100	1100	1100
Hexachlorocyclohexanes - gamma (inc. Lindane)	LQM/CIEH + CLEA 1.07	27	31	33	0.60	1.4	3.3	0.092	0.23	0.54	530	550	550

Updated 18/11/15		Human Health Generic Assessment Criteria (mg/kg)											
Contaminant	**Source of GAC**	**Human health - residential without plant uptake (1%SOM)**	**Human health - residential without plant uptake (2.5%SOM)**	**Human health - residential without plant uptake (6%SOM)**	**Human health - residential with plant uptake (1%SOM)**	**Human health - residential with plant uptake (2.5%SOM)**	**Human health - residential with plant uptake (6%SOM)**	**Human health - allotments (1%SOM)**	**Human health - allotments (2.5%SOM)**	**Human health - allotments (6%SOM)**	**Human health - commercial (1%SOM)**	**Human health - commercial (2.5%SOM)**	**Human health - commercial (6%SOM)**
Dioxins, furans & dioxin-like-PCBs													
Total dioxins, furans & DL-PCB (aerial dep.)	SGV report + CLEA 1.07	0.012	0.012	0.012	0.0099	0.010	0.010	0.0075	0.0083	0.0086	0.24	0.24	0.24
Non-dioxin-like PCBs													
PCB-28	Hydrock + CLEA 1.07	0.63	0.63	0.63	0.24	0.37	0.47	0.056	0.12	0.22	9.0	9.0	9.0
PCB-52	Hydrock + CLEA 1.07	0.63	0.63	0.63	0.24	0.38	0.49	0.058	0.13	0.26	9.0	9.0	9.0
PCB-101	Hydrock + CLEA 1.07	0.63	0.63	0.63	0.50	0.57	0.60	0.290	0.52	0.74	9.0	9.0	9.0
PCB-138	Hydrock + CLEA 1.07	0.63	0.63	0.63	0.54	0.59	0.61	0.39	0.65	0.88	9.0	9.0	9.0
PCB-153	Hydrock + CLEA 1.07	0.63	0.63	0.63	0.56	0.60	0.61	0.49	0.75	0.95	9.0	9.0	9.0
PCB-180	Hydrock + CLEA 1.07	0.63	0.63	0.63	0.58	0.61	0.62	0.58	0.85	1.0	9.0	9.0	9.0
Explosives													
HMX	LQM/CIEH + CLEA 1.07	6700	6700	6700	5.9	13	27	0.89	2.0	4.0	110000	110000	110000
RDX	LQM/CIEH + CLEA 1.07	400	400	400	3.5	7.6	17	0.54	1.2	2.6	6400	6400	6400
2,4,6-Trinitrotoluene	LQM/CIEH + CLEA 1.07	65	65	66	1.6	3.8	8.4	0.25	0.61	1.4	1000	1000	1100
Other inorganics													
Antimony	EIC/AGS/CL:AIRE + CLEA 1.07	380	380	380	190	190	190	54	54	54	6600	6600	6600
Barium	EIC/AGS/CL:AIRE + CLEA 1.07	1400	1400	1400	790	790	790	270	270	270	22000	22000	22000
Mercury, elemental	SGV report + CLEA 1.07	0.24	0.60	1.5	0.24	0.60	1.5	4.3	11	26	4.3	11	26
Molybdenum	EIC/AGS/CL:AIRE + CLEA 1.07	670	670	670	250	250	250	59	59	59	18000	18000	18000
Thiocyanate	Hydrock + CLEA 1.07	13	13	13	13	13	13	28	28	28	190	190	190
Other organics													
Biphenyl	EIC/AGS/CL:AIRE + CLEA 1.07	34	84	200	34	84	200	15	36	86	34	84	200
Carbon disulphide	LQM/CIEH + CLEA 1.07	0.14	0.29	0.62	0.14	0.29	0.62	5.0	11	24	11	22	47
2,4-Dinitrotoluene	EIC/AGS/CL:AIRE + CLEA 1.07	240	250	250	1.5	3.4	7.6	0.23	0.51	1.2	3700	3800	3800
2,6-Dinitrotoluene	EIC/AGS/CL:AIRE + CLEA 1.07	110	120	130	0.82	1.8	4.1	0.12	0.28	0.63	1900	1900	1900
Hexachloro-1,3-butadiene	LQM/CIEH + CLEA 1.07	0.32	0.78	1.8	0.29	0.70	1.6	0.25	0.62	1.4	31	66	120
Mercury, methyl	SGV report + CLEA 1.07	12	16	20	10	13	15	8.0	8.0	8.0	370	390	410
Styrene	EIC/AGS/CL:AIRE + CLEA 1.07	52	120	280	11	25	58	1.6	3.9	9.1	630	1400	3400
Tributyl tin oxide	EIC/AGS/CL:AIRE + CLEA 1.07	12	14	15	0.28	0.67	1.5	0.040	0.11	0.25	230	230	240
2-Chloronaphthalene	EIC/AGS/CL:AIRE + CLEA 1.07	5.4	13	32	5.3	13	31	42	100	230	370	900	2100
Insufficient data to derive GAC													
n butylbenzene	Insufficient data (EIC)	-	-	-	-	-	-	-	-	-	-	-	-
sec butylbenzene	Insufficient data (EIC)	-	-	-	-	-	-	-	-	-	-	-	-
Carbazole	Insufficient data (EIC)	-	-	-	-	-	-	-	-	-	-	-	-
Dimethyl phthalate	Insufficient data (EIC)	-	-	-	-	-	-	-	-	-	-	-	-
Isopropyltoluene	Insufficient data (EIC)	-	-	-	-	-	-	-	-	-	-	-	-
1-Methylnaphthalene	Insufficient data (EIC)	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	Insufficient data (EIC)	-	-	-	-	-	-	-	-	-	-	-	-
Sulfur (elemental)	Insufficient data (Hydrock)	-	-	-	-	-	-	-	-	-	-	-	-
1,3,5-Trimethylbenzene	Insufficient data (EIC)	-	-	-	-	-	-	-	-	-	-	-	-
tert butylbenzene	Insufficient data (EIC)	-	-	-	-	-	-	-	-	-	-	-	-
NOTES													
If >1,000,000 is calculated, 1,000,000 is adopted.													
Red text - liquid at ambient temperature, calculated GAC exceeds saturation value and highlighed in red in CLEA - saturation value adopted for GAC													
Orange text - solid at ambient temperature, calculated GAC exceeds saturation value and highlighted red in CLEA - manual calculation not possible as only one HCV - saturated vapour concentration exceed, so saturation value adopted for GAC.													
Blue text - solid at ambient temperature, calculated GAC exceeds saturation value and highlighted red in CLEA - manual calculation not possible as only one HCV - aqueous solubility exceed, so original red-highlighted value adopted for GAC.													
Green text - solid at ambient temperature, calculated GAC exceeds saturation value and highlighted red in CLEA - manual calculation undertaken but result is greater than original red-highlighted value, so original red-highlighted value adopted for GAC.													

Updated 18/11/15

Contaminant	Source of GAC	Human health - POSresi (1%SOM)	Human health - POSresi (2.5%SOM)	Human health - POSresi (6%SOM)	Human health - POSpark (1%SOM)	Human health - POSpark (2.5%SOM)	Human health - POSpark (6%SOM)
Hydrock Default Suite							
Arsenic	SGV report + CLEA 1.07	79	79	79	170	170	170
Beryllium	LQM/CIEH + CLEA 1.07	92	92	92	670	670	670
Boron	LQM/CIEH + CLEA 1.07	21000	21000	21000	46000	46000	46000
Cadmium	SGV report + CLEA 1.07	120	120	120	560	560	560
Chromium (III)	LQM/CIEH + CLEA 1.07	1500	1500	1500	27000	27000	27000
Chromium (VI)	LQM/CIEH + CLEA 1.07	7.7	7.7	7.7	220	220	220
Copper	LQM/CIEH + CLEA 1.07	12000	12000	12000	44000	44000	44000
Lead	C4SL (NB not minimal risk)	630	630	630	1300	1300	1300
Mercury, inorganic	SGV report + CLEA 1.07	470	470	470	1100	1100	1100
Nickel	Hydrock + CLEA 1.07	290	290	290	800	800	800
Selenium	SGV report + CLEA 1.07	1400	1400	1400	2600	2600	2600
Vanadium	LQM/CIEH + CLEA 1.07	2000	2000	2000	5000	5000	5000
Zinc	LQM/CIEH + CLEA 1.07	81000	81000	81000	170000	170000	170000
Cyanide (free)	Hydrock + CLEA 1.07	1600	1600	1600	3400	3400	3400
Phenol	SGV report + CLEA 1.07	760	1500	3200	760	1500	3200
Acenaphthene	LQM/CIEH + CLEA 1.07	15000	15000	15000	29000	30000	30000
Acenaphthylene	LQM/CIEH + CLEA 1.07	15000	15000	15000	29000	30000	30000
Anthracene	LQM/CIEH + CLEA 1.07	74000	74000	74000	150000	150000	150000
Benz(a)anthracene	LQM/CIEH + CLEA 1.07	17	18	18	26	33	40
Benzo(a)pyrene	LQM/CIEH + CLEA 1.07	2.6	2.6	2.6	4.5	5.6	6.5
Benzo(b)fluoranthene	LQM/CIEH + CLEA 1.07	18	18	18	30	38	45
Benzo(ghi)perylene	LQM/CIEH + CLEA 1.07	120	120	120	270	310	350
Benzo(k)fluoranthene	LQM/CIEH + CLEA 1.07	26	26	26	46	57	67
Chrysene	LQM/CIEH + CLEA 1.07	25	26	26	34	45	55
Dibenz(ah)anthracene	LQM/CIEH + CLEA 1.07	2.3	2.3	2.3	4.5	5.5	6.3
Fluoranthene	LQM/CIEH + CLEA 1.07	3100	3100	3100	6300	6300	6400
Fluorene	LQM/CIEH + CLEA 1.07	9900	9900	9900	20000	20000	20000
Indeno(123cd)pyrene	LQM/CIEH + CLEA 1.07	11	11	11	17	22	26
Naphthalene	LQM/CIEH + CLEA 1.07	3900	4100	4200	1100	1600	2300
Phenanthrene	LQM/CIEH + CLEA 1.07	3100	3100	3100	6200	6300	6300
Pyrene	LQM/CIEH + CLEA 1.07	7400	7400	7400	15000	15000	15000
TPH fractions							
TPH ali EC05-EC06	LQM/CIEH + CLEA 1.07	300	590000	600000	300	560	1200
TPH ali >EC06-EC08	LQM/CIEH + CLEA 1.07	600000	610000	620000	140	320	740
TPH ali >EC08-EC10	LQM/CIEH + CLEA 1.07	13000	13000	13000	77	190	450
TPH ali >EC10-EC12	LQM/CIEH + CLEA 1.07	13000	13000	13000	48	120	280
TPH ali >EC12-EC16	LQM/CIEH + CLEA 1.07	13000	13000	13000	24	59	140
TPH ali >EC16-EC35	LQM/CIEH + CLEA 1.07	250000	250000	250000	460000	480000	490000
TPH ali >EC35-EC44	LQM/CIEH + CLEA 1.07	250000	250000	250000	460000	480000	490000
TPH aro EC05-EC07	LQM/CIEH + CLEA 1.07	56000	56000	56000	1200	2300	4700
TPH aro >EC07-EC08	LQM/CIEH + CLEA 1.07	56000	56000	56000	870	1900	4400
TPH aro >EC08-EC10	LQM/CIEH + CLEA 1.07	5000	5000	5000	610	1500	3600
TPH aro >EC10-EC12	LQM/CIEH + CLEA 1.07	5000	5000	5000	360	900	10000
TPH aro >EC12-EC16	LQM/CIEH + CLEA 1.07	5000	5000	5000	10000	10000	10000
TPH aro >EC16-EC21	LQM/CIEH + CLEA 1.07	3800	3800	3800	7600	7700	7800
TPH aro >EC21-EC35	LQM/CIEH + CLEA 1.07	3800	3800	3800	7800	7800	7900
TPH aro >EC35-EC44	LQM/CIEH + CLEA 1.07	3800	3800	3800	7800	7800	7900
TPH >EC44-EC70	LQM/CIEH + CLEA 1.07	3800	3800	3800	7800	7800	7900
VOCs - BTEX & MTBE							
Benzene	SGV report + CLEA 1.07	72	72	73	90	100	110
Toluene	SGV report + CLEA 1.07	56000	56000	56000	870	1900	4400
Ethylbenzene	SGV report + CLEA 1.07	25000	25000	25000	520	1200	2800
Xylene, o-	SGV report + CLEA 1.07	41000	42000	43000	480	1100	2600
Xylene, m-	SGV report + CLEA 1.07	41000	42000	43000	630	1500	3500
Xylene, p- (use this for combined m & p)	SGV report + CLEA 1.07	41000	42000	43000	580	1400	3200
MTBE	EIC/AGS/CL:AIRE + CLEA 1.07	75000	75000	75000	20000	33000	63000
VOCs - other benzenes							
Iso-propylbenzene	EIC/AGS/CL:AIRE + CLEA 1.07	25000	25000	25000	390	950	2300
Propylbenzene	EIC/AGS/CL:AIRE + CLEA 1.07	25000	25000	25000	400	980	2300
1,2,4-Trimethylbenzene	EIC/AGS/CL:AIRE + CLEA 1.07	250	250	250	310	360	410

Updated 18/11/15							
Contaminant	**Source of GAC**	**Human health - POSresi (1%SOM)**	**Human health - POSresi (2.5%SOM)**	**Human health - POSresi (6%SOM)**	**Human health - POSpark (1%SOM)**	**Human health - POSpark (2.5%SOM)**	**Human health - POSpark (6%SOM)**
VOCs - chlorobenzenes							
Bromobenzene	EIC/AGS/CL:AIRE + CLEA 1.07	5200	5400	5600	850	2000	3500
Chlorobenzene	LQM/CIEH + CLEA 1.07	12000	13000	14000	680	1500	2900
1,2-Dichlorobenzene	LQM/CIEH + CLEA 1.07	95000	100000	100000	570	1400	3300
1,3-Dichlorobenzene	LQM/CIEH + CLEA 1.07	300	300	300	390	440	470
1,4-Dichlorobenzene	LQM/CIEH + CLEA 1.07	17000	17000	17000	220	540	1300
Hexachlorobenzene	LQM/CIEH + CLEA 1.07	6.5	6.5	6.5	11	11	11
Pentachlorobenzene	LQM/CIEH + CLEA 1.07	110	110	110	190	190	190
1,2,3-trichlorobenzene	LQM/CIEH + CLEA 1.07	1700	1800	1800	130	330	1600
1,2,4-trichlorobenzene	LQM/CIEH + CLEA 1.07	10000	11000	12000	320	790	1900
1,3,5-trichlorobenzene	LQM/CIEH + CLEA 1.07	1600	1700	1800	37	91	220
1,2,3,4-tetrachlorobenzene	LQM/CIEH + CLEA 1.07	830	830	830	120	1600	1600
1,2,3,5-tetrachlorobenzene	LQM/CIEH + CLEA 1.07	79	79	79	39	120	130
1,2,4,5-tetrachlorobenzene	LQM/CIEH + CLEA 1.07	13	13	13	25	26	26
VOCs - chloroalkanes & alkanes							
Bromodichloromethane	EIC/AGS/CL:AIRE + CLEA 1.07	73	73	74	56	67	81
Bromoform	EIC/AGS/CL:AIRE + CLEA 1.07	3900	3900	4000	2700	4700	5200
Chloroethane	EIC/AGS/CL:AIRE + CLEA 1.07	2600	3500	5700	2600	3500	5700
Chloroethene (aka vinyl chloride)	LQM/CIEH + CLEA 1.07	3.5	3.5	3.5	4.8	5	5.4
Chloromethane	EIC/AGS/CL:AIRE + CLEA 1.07	540	550	560	140	150	170
1,1-Dichloroethane	EIC/AGS/CL:AIRE + CLEA 1.07	46000	47000	48000	1800	3000	5600
1,2-Dichloroethane	LQM/CIEH + CLEA 1.07	29	29	29	21	24	28
1,1-Dichloroethene	EIC/AGS/CL:AIRE + CLEA 1.07	2200	3900	11000	2200	3900	5900
Cis 1,2 Dichloroethene	EIC/AGS/CL:AIRE + CLEA 1.07	1300	1300	1400	690	840	1000
Trans 1,2 Dichloroethene	EIC/AGS/CL:AIRE + CLEA 1.07	3800	4000	4000	1700	2100	2700
Dichloromethane	EIC/AGS/CL:AIRE + CLEA 1.07	760	760	760	1500	1500	1500
1,2-Dichloropropane	EIC/AGS/CL:AIRE + CLEA 1.07	1700	1900	2200	160	210	290
Hexachloroethane	EIC/AGS/CL:AIRE + CLEA 1.07	120	130	130	8.2	20	48
Tetrachloroethene	LQM/CIEH + CLEA 1.07	3400	3400	3400	420	950	2200
1,1,1,2-Tetrachloroethane	LQM/CIEH + CLEA 1.07	1400	1400	1400	1500	1800	2100
1,1,2,2-Tetrachloroethane	LQM/CIEH + CLEA 1.07	1400	1400	1400	1800	2100	2300
Tetrachloromethane	LQM/CIEH + CLEA 1.07	340	350	350	170	240	320
Trichloroethene	LQM/CIEH + CLEA 1.07	1200	1300	1300	660	860	1100
1,1,1-Trichloroethane	LQM/CIEH + CLEA 1.07	140000	140000	140000	1400	2900	6400
1,1,2 Trichloroethane	EIC/AGS/CL:AIRE + CLEA 1.07	990	990	1000	1100	1300	1500
Trichloromethane	LQM/CIEH + CLEA 1.07	1700	1700	1700	2700	2900	3100
Other phenols & chlorophenols							
2-Chlorophenol	LQM/CIEH + CLEA 1.07	610	610	610	1100	1100	1100
2,4-Dichlorophenol	LQM/CIEH + CLEA 1.07	610	610	610	1000	1100	1100
2,4-Dimethylphenol	EIC/AGS/CL:AIRE + CLEA 1.07	5000	5000	5000	1400	9600	9900
2-Methylphenol	EIC/AGS/CL:AIRE + CLEA 1.07	25000	25000	25000	15000	48000	49000
3-Methylphenol	EIC/AGS/CL:AIRE + CLEA 1.07	25000	25000	25000	27000	48000	49000
4-Methylphenol	EIC/AGS/CL:AIRE + CLEA 1.07	25000	25000	25000	27000	48000	49000
Pentachlorophenol	LQM/CIEH + CLEA 1.07	180	180	180	220	250	270
2,3,4,6-Tetrachlorophenol	LQM/CIEH + CLEA 1.07	610	610	610	1000	1100	1100
2,4,6-Trichlorophenol	LQM/CIEH + CLEA 1.07	610	610	610	1100	1100	1100
Phthalates							
Bis (2-ethylhexyl) phthalate	EIC/AGS/CL:AIRE + CLEA 1.07	9700	9700	9700	17000	17000	17000
Butyl benzyl phthalate	EIC/AGS/CL:AIRE + CLEA 1.07	130000	130000	130000	250000	260000	260000
Diethyl Phthalate	EIC/AGS/CL:AIRE + CLEA 1.07	49000	50000	50000	14	93000	96000
Di-n-butyl phthalate	EIC/AGS/CL:AIRE + CLEA 1.07	1300	1300	1300	2600	2700	2600
Di-n-octyl phthalate	EIC/AGS/CL:AIRE + CLEA 1.07	11000	11000	11000	20000	20000	20000
Pesticides							
Aldrin	LQM/CIEH + CLEA 1.07	6.6	6.6	6.6	13	13	13
Atrazine	LQM/CIEH + CLEA 1.07	100	100	100	180	180	180
DDD	Hydrock + CLEA 1.07	2700	2700	2700	5700	5700	5700
DDE	Hydrock + CLEA 1.07	2700	2700	2700	5700	5700	5700
DDT	Hydrock + CLEA 1.07	2600	2600	2600	5500	5500	5500
Dichlorvos	LQM/CIEH + CLEA 1.07	120	120	120	140	160	180
Dieldrin	LQM/CIEH + CLEA 1.07	12	12	12	23	23	23
Endosulfan - alpha	LQM/CIEH + CLEA 1.07	490	490	490	940	970	990
Endosulfan - beta	LQM/CIEH + CLEA 1.07	490	490	490	950	980	990
Hexachlorocyclohexanes - alpha (inc. Lindane)	LQM/CIEH + CLEA 1.07	2000	2000	2000	4000	4100	4100
Hexachlorocyclohexanes - beta (inc. Lindane)	LQM/CIEH + CLEA 1.07	150	150	150	300	300	310
Hexachlorocyclohexanes - gamma (inc. Lindane)	LQM/CIEH + CLEA 1.07	71	71	71	140	140	140

Updated 18/11/15							
Contaminant	**Source of GAC**	**Human health - POSresi (1%SOM)**	**Human health - POSresi (2.5%SOM)**	**Human health - POSresi (6%SOM)**	**Human health - POSpark (1%SOM)**	**Human health - POSpark (2.5%SOM)**	**Human health - POSpark (6%SOM)**
Dioxins, furans & dioxin-like-PCBs							
Total dioxins, furans & DL-PCB (aerial dep.)	SGV report + CLEA 1.07	0.023	0.023	0.023	0.049	0.049	0.049
Non-dioxin-like PCBs							
PCB-28	Hydrock + CLEA 1.07	1.2	1.2	1.2	2.5	2.5	2.5
PCB-52	Hydrock + CLEA 1.07	1.2	1.2	1.2	2.5	2.5	2.5
PCB-101	Hydrock + CLEA 1.07	1.2	1.2	1.2	2.5	2.5	2.5
PCB-138	Hydrock + CLEA 1.07	1.2	1.2	1.2	2.5	2.5	2.5
PCB-153	Hydrock + CLEA 1.07	1.2	1.2	1.2	2.5	2.5	2.5
PCB-180	Hydrock + CLEA 1.07	1.2	1.2	1.2	2.5	2.5	2.5
Explosives							
HMX	LQM/CIEH + CLEA 1.07	13000	13000	13000	23000	23000	24000
RDX	LQM/CIEH + CLEA 1.07	790	790	800	19	1500	1600
2,4,6-Trinitrotoluene	LQM/CIEH + CLEA 1.07	130	130	130	260	270	270
Other inorganics							
Antimony	EIC/AGS/CL:AIRE + CLEA 1.07	740	740	740	1700	1700	1700
Barium	EIC/AGS/CL:AIRE + CLEA 1.07	2700	2700	2700	5800	5800	5800
Mercury, elemental	SGV report + CLEA 1.07	4.3	11	26	4.3	11	26
Molybdenum	EIC/AGS/CL:AIRE + CLEA 1.07	1400	1400	1400	2900	2900	2900
Thiocyanate	Hydrock + CLEA 1.07	25	25	25	53	53	53
Other organics							
Biphenyl	EIC/AGS/CL:AIRE + CLEA 1.07	9500	9500	9500	34	84	19000
Carbon disulphide	LQM/CIEH + CLEA 1.07	11000	11000	12000	1300	1900	2700
2,4-Dinitrotoluene	EIC/AGS/CL:AIRE + CLEA 1.07	500	500	500	140	960	990
2,6-Dinitrotoluene	EIC/AGS/CL:AIRE + CLEA 1.07	250	250	250	290	490	500
Hexachloro-1,3-butadiene	LQM/CIEH + CLEA 1.07	25	25	25	48	50	51
Mercury, methyl	SGV report + CLEA 1.07	53	53	53	73	93	97
Styrene	EIC/AGS/CL:AIRE + CLEA 1.07	3000	3000	3000	630	1400	3400
Tributyl tin oxide	EIC/AGS/CL:AIRE + CLEA 1.07	31	31	31	63	64	65
2-Chloronaphthalene	EIC/AGS/CL:AIRE + CLEA 1.07	7500	8400	9000	110	1800	2800
Insufficient data to derive GAC							
n butylbenzene	Insufficient data (EIC)	-	-	-	-	-	-
sec butylbenzene	Insufficient data (EIC)	-	-	-	-	-	-
Carbazole	Insufficient data (EIC)	-	-	-	-	-	-
Dimethyl phthalate	Insufficient data (EIC)	-	-	-	-	-	-
Isopropyltoluene	Insufficient data (EIC)	-	-	-	-	-	-
1-Methylnaphthalene	Insufficient data (EIC)	-	-	-	-	-	-
2-Methylnaphthalene	Insufficient data (EIC)	-	-	-	-	-	-
Sulfur (elemental)	Insufficient data (Hydrock)	-	-	-	-	-	-
1,3,5-Trimethylbenzene	Insufficient data (EIC)	-	-	-	-	-	-
tert butylbenzene	Insufficient data (EIC)	-	-	-	-	-	-
NOTES							
If >1,000,000 is calculated, 1,000,000 is adopted.							
Red text - liquid at ambient temperature, calculated GAC exceeds saturation value anc							
Orange text - solid at ambient temperature, calculated GAC exceeds saturation value ;							
Blue text - solid at ambient temperature, calculated GAC exceeds saturation value anc							
Green text - solid at ambient temperature, calculated GAC exceeds saturation value ai							

3.3.3 Exceedance of Saturation Limits

In some instances the CLEA 1.07 model produces GACs with a warning that the value exceeds the saturation value, which is either the solubility of the substance in water or the vapour saturation limit. Limited guidance is given in SR4 (Section 4.12) on how to assess the GAC in these circumstances. Precedence is also set in a number of SGV reports, to date those dealing with the BTEX compounds. These two sets of documentation are contradictory. The original issue of SR4 (CLEA 1.04) (Environment Agency 2009b) gives an example of how to carry out a manual calculation using data for ethylbenzene, whereas the BTEX SGV reports (e.g. Environment Agency March 2009) state that the GAC should be limited to the saturation level. The revised version of SR4 (CLEA 1.05/6) (Environment Agency 2009c) retains the example, but the name ethylbenzene has been removed.

There are three options: to adopt the value as calculated, to limit the GAC to the saturation value, or to undertake a manual calculation as per Section 4.12 of SR4. Again, the guidance is confusing. SR3 (Environment Agency 2009b) cautions against adopting the saturation limit, which is the most conservative, saying that it may be over-conservative. However, this is the approach taken in the BTEX SGV reports.

Clearly, the adoption of a GAC under conditions where the saturation level is exceeded is subjective and professional judgement is involved. With this in mind, the protocol adopted by Hydrock is as follows, and has been derived at by considering the possible values from the three methods given above.

1. For substances where the GAC is highlighted in amber in CLEA, this is adopted as the GAC. For substances where the GAC is highlighted in red, the following apply.

2. For VOCs including BTEX and the volatile TPH Fractions (less than EC10), the saturation value is adopted in line with the latest recommendations in the BTEX SGV reports.

3. For substances which are liquid at ambient temperature, the saturation value is adopted.

4. For substances which are solid at ambient temperature, the manual calculation is undertaken provided there are both oral and inhalation HCVs. The result is compared with the red-highlighted GAC and the lower of the two adopted as the GAC. If there is only one HCV and the calculation cannot be performed, the red-highlighted value is adopted as the GAC where the saturation limit exceed the aqueous solubility, but the saturation value is adopted where the saturation limit exceed the saturated vapour concentration.

5. In some instances the GACs shows a large difference between different SOM where the saturation value has been taken for, say, 1% SOM and the calculated values for 2.5% and 6% SOM. Whilst this may appear inconsistent on first inspection, the results have been adopted as they are and the difference must be attributed to the physico-chemical influence of organic matter in the soil as modelled by CLEA.

3.3.4 GACs for Public Open Space

The first UK methodology for assessing public open space (POS) was published for the C4SLs (CL:AIRE December 2013) based on two land use scenarios:

- Public open space near residential housing (POS_{resi}) includes the predominantly grassed areas adjacent to high density housing and the central green area around which houses are located, as on many housing estates from the 1930s to 1970s. It also includes the smaller areas commonly incorporated in new developments as informal grassed areas or more formal landscaped areas with a mixture of open space and covered soil with planting. It is considered to be a predominantly grassed area up to 0.05 ha and a considerable portion of this (up to 50%) may be bare soil. The site is regularly used by children for playing and may be used for informal sports activities such as a football "kickabout".
- Public park (POS_{park}) is an area of open space provided for recreational use and usually owned and maintained by the Local Authority and could be used for a wide range of activities such as family visits and picnics, children's play area, sporting activities such as football on an informal basis (although this POS is not considered as a dedicated sports pitch) and dog walking. It is considered to be a relatively large are (>0.5 ha) of predominantly grassed open space with no more than 25% of exposed soil.

Hydrock has calculated GACs for these two standard land uses using the land use scenarios given in Tables 3.6 and 3.7 of the CL:AIRE report, but with the following modifications:

- POS_{resi} (Table 3.6), items omitted from the published table in error: building = small terraced house; occupancy period for lifetime averaging (for Cd) AC10-12 = 19, AC13-16 = 15 & AC17-18 = 16; and indoor inhalation rates updated according to a USEPA 2011 publication that supersedes the draft 2006 version used in the CLEA model previously.
- POS_{park} (Table 3.7), typographic errors in the published table: soil ingestion rate for AC1-12 = 50 mg/day and for AC13-18 = 20 mg/day.

Note that these corrections are included in the revised CLEA 1.07 when the C4SL land uses are selected. The calculated GACs are presented in Table 3.5 and are based on a sandy loam soil of pH 7 su.

3.4 Note on Petroleum Hydrocarbons

Petroleum hydrocarbon contamination is complex. The type of crude oil, its distillation, processing and blending, and the subsequent weathering in the environment all result in the development of petroleum residues of extreme chemical complexity (Environment Agency, 2003). The laboratory analysis of petroleum hydrocarbons is highly method dependent. In addition to contaminants such as fuels and lubricating oils, the analyses also pick up a range of other chemicals such as PAHs and phenols, together with naturally occurring substances like humic and fulvic matter in organic soils. For example, TPH determination on dried oak leaves can give a result of 18,000 mg/kg of TPH.

TPH can only be used as a surrogate for estimating the petroleum load of a soil if a spill is well defined but is generally not a sound basis for risk management and regulatory control. International approaches for assessing risks from petroleum hydrocarbons focus on dividing the components into groups and assigning toxicologically potency and fate-transport to each group.

Approaches have been developed internationally, one such proposal is discussed by the Dutch National Institute of Public Health and the Environment (RIVM) (Franken *et al* 1999). The approach is broadly to sub-divide the TPH into fractions based on equivalent carbon length for aliphatic (straight chain) and aromatic (cyclic) compounds. The choice of the fractions is based on work carried out by, amongst others, the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG). The Working Group is guided by a steering committee consisting of representatives from industry, government and academia, with the remit *to develop scientifically defensible information for establishing soil cleanup levels that are protective of human health at petroleum contaminated sites.*

Generic assessment criteria can be developed for each TPH fraction in the same way as they can be for named substances, providing certain assumptions are made regarding the applicability of the data to all the compounds in each fraction. A significant part of the TPHCWG activity has been in determining fraction boundaries to maximize confidence in the eventual criteria.

A modified TPHCWG approach has been adopted in a framework developed by the Environment Agency (2005) for use within the UK. The 13 original TPHCWG fractions have been adopted, with the addition of >EC35-EC44. An undifferentiated (i.e. without aliphatic – aromatic split) fraction of >EC44-EC70 has also been suggested but the Agency says it will be reviewing the need for this in due course, once research has been carried out into the toxicity of these heavy-end products like resins and asphaltenes.

The UK suggested approach to petroleum hydrocarbon risk assessment is summarised as follows:

- Measure indicator chemicals and compare with their GAC – these are chemicals which are considered as key risk drivers at petroleum hydrocarbon contaminated sites. The chemicals of potential concern depend on the type of hydrocarbon product, but a (non-exhaustive) list has been suggested by the Environment Agency (2005):

  Non-threshold: benzene, benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3,cd)pyrene.

  Threshold: toluene, ethylbenzene, xylene, naphthalene, fluoranthene, phenanthrene, pyrene.

- Measure TPH fractions and compare with their GAC, based on threshold toxicity only.

  Aliphatic fractions: >EC5-EC6, >EC6-EC8, >EC8-EC10, >EC10-EC12, >EC12-EC16, >EC16-EC35, >EC35-EC44.

  Undifferentiated: >EC44-EC77 (subject to review and confirmation by Agency).

  Aromatic fractions: >EC5-EC7, >EC7-EC8, >EC8-EC10, >EC10-EC12, >EC12-EC16, >EC16-EC21, >EC21-EC35, >EC35-EC44.

- Carry out an additivity check on the TPH fractions if none of the individual fractions exceed their GAC. A Hazard Quotient is calculated for each fraction by dividing the measured concentration by the GAC and these are summed to give the Hazard Index. Where the Hazard Index exceeds unity, this can indicate a potentially significant risk to human health and consideration should proceed to the next stage (remediation or further assessment). Including all the fractions in a Hazard Index is conservative as it assumes all fractions add together in acting on the same target organ within the critical receptor. The Environment Agency (2005) has stated that fractions exhibiting different toxicological properties might be excluded from this process in due course, once research has been completed and further guidance published. The Louisiana Department of Environmental Quality (LDEQ) (2003) has published more detailed guidance, suggesting the following fractions be grouped: (a) aliphatic >EC8-EC10, >EC10-EC12 & >EC12-EC16, (b) aromatic >EC8-EC10, >EC10-EC12 & >EC12-EC16 and (c) aromatic >EC16-EC21 & >EC21-EC35.

Hydrock has adopted the first two points from above approach and has developed generic assessment criteria for the TPH fractions up to EC35. These are used for assessment where an appropriate level of sampling and laboratory analysis has been carried out, but cannot be used where more generalised TPH analysis has been scheduled (such as DRO/GRO only).

There is, however, some uncertainty concerning the validity of the additivity check. The Environment Agency (2002a) stated in the now withdrawn CLR 9, Section 4.4, "that it is not valid to simply calculate the sum of the fractions 'soil concentration divided by SGV', and compare this with 1.", because total intake, not just intake from soil, needs to be included. It is assumed that the 2005 document takes this into account and that it is erring on the side of conservatism. Until this is formally resolved, Hydrock will report the additivity check for information, using the LDEQ groupings, but will caution against its use in setting remedial goals without further study or publication of definitive guidance. It is more realistic to carry out the additivity test on individual samples rather than on US_{95} values for the whole population, because it is unlikely that the TPH profile of the averaging area will be represented by the US_{95}s of every fraction. More likely, a sample high in one fraction will be low in another, particularly where a mixture of products is present in the ground.

The analysis required for the above methodology, using the aliphatic / aromatic split of TPH fractions, is referred to by Hydrock its "**TPH Level 2 suite**" of determinands. In instances where a full numerical risk assessment is not required, Hydrock carries out a screening analysis known as its "**TPH Level 1 suite**" of determinands. The TPH is divided into fractions, but without the aliphatic / aromatic split. This allows a semi-quantitative risk assessment on the basis of taking a worst case condition. The fraction split with the lowest GAC is deemed to apply to the whole fraction. For example, if the Level 1 analysis indicates the presence of >EC8-EC10, the result is compared to the GACs for the aliphatic >C8-C10 and the aromatic >EC8-EC10 fractions. The worst case would be to assume the whole fraction is aliphatic because this is the lower of the two GACs. This is a conservative approach, and if the test is passed, there is no need to proceed further. However, if the test is failed this does not necessarily indicate unacceptable risks and a more detailed risk assessment is required, with the full TPH Level 2 analysis suite.

3.5 Note on PAHs

A number of authors have used to concept of PAH double ratio plots to investigate the possible source of PAHs in environmental samples.

NAVFAC (Appendix A, April 2003) defines three major source type: petrogenic - generated from organic matter in ancient sediments by geologic conditions (i.e. including petroleum hydrocarbons and refined products); pyrogenic – generated by combustion of organic matter (wood, coal, petroleum, wastes etc.); and biogenic – generated by modern biological processes or by diagenetic processes (e.g. oxidation of organic matter). The following broad trends in the data were recognised:

- a ratio of fluoranthene to pyrene (Fl/Py) of <1 is indicative petrogenic sources, and of >1 is indicative of pyrogenic sources; and

- a ratio of anthracene to phenanthrene (An/Ph) of <0.2 is indicative of pyrogenic sources and of >0.2 is indicative of petrogenic sources.

Yunker *et al* (2002) carried out a literature study of published PAH ratios for a number of petroleum sources, combustion sources and environmental sources. They identified the following broad trends in the data:

- a ratio of fluoranthene to fluoranthene plus pyrene (Fl/(Fl+Py)) of <0.4 is indicative of petroleum hydrocarbon sources; of 0.4-0.5 is indicative of liquid fossil fuel combustion products; and of >0.5 is indicative of grass, wood and coal combustion products;

- a ratio of benzo(a)anthracene to benzo(a)anthracene plus chyrsene (BaA/(BaA+Ch)) of <0.2 is indicative of petroleum hydrocarbon sources; of 0.2-0.35 is indicative of either petroleum hydrocarbon sources or combustion and of >0.35 is indicative of combustion products;

- a ratio of anthracene to anthracene plus phenanthrene (An/(An+Ph)) of <0.1 is indicative petroleum hydrocarbon sources, but can be emissions from lignite, diesel or oil combustion, and of >0.1 is indicative of combustion sources, but can be diesel, coal or some crude oil hydrocarbons;

- a ratio of indeno(1,2,3)pyrene to indeno(1,2,3)pyrene plus benzo(ghi)perylene (IP/(IP+Bghi)) of <0.2 is indicative of petroleum hydrocarbon sources; of 0.2-0.5 is indicative of petroleum hydrocarbon combustion; and >0.5 is indicative of grass, wood or coal combustion products.

Note that in these authors' study of these and a number of other ratios they cautioned there are exceptions to these generalisations on account of the variability and complexity of, for example, different crude oil sources.

Costa *et al* (2004) and Costa and Sauer (2005) used plots of fluoranthene to pyrene (Fl/Py) against benzo(a)anthracene to chrysene (BaA/Ch), benzo(a)anthracene to benzo(a)pyrene (BaA/BaP) and chrysene to benzo(a)pyrene (Ch/BaP) to distinguish coal tar and creosote contaminants from combustion products they referred to as urban background. They report distinctive areas on the plots relating to the sites being studied. Litton (2006) has also used these ratios to similar effect on other sites.

ALcontrol Laboratories (2006) also uses plots of fluoranthene to pyrene (Fl/Py) against benzo(a)anthracene to chrysene (BaA/Ch). Jones (2008) confirms that the following broad trends are derived from unpublished work at the laboratory:

- a ratio of Fl/Py of <0.65 is indicative of used engine oil when the ratio of BaA/Ch is higher (approaching 1.40) or other petroleum products when the ratio of BaA/Ch is lower (above about 0.35);

- a ratio of F/Py of 0.65-1 is indicative of petroleum combustion products; and

- a ratio of Fl/Py of <1 is indicative of coal when the ratio of BaA/Ch is higher (approaching 1.40) or other combustion soots when the ratio of BaA/Ch is lower (above about 0.35).

Stogiannidis and Laane (2015) undertook a review of published literature and produced a summary (their Table 4 plus supporting text) of a number of PAH ratios and threshold values for the initial screening or identification of pyrogenic or petrogenic PAHs.

It is evident from the literature that if a cross plot is made of two ratios it is often possible to see a separation in samples from different sources and, together with other supporting information, gain a better understanding of the likely source of the PAHs. Different ratios may give differing degrees of separation and so trying several plots is often useful. The work of Stogiannidis and Laane can help distinguish between oil-spill related PAHs and those produced by combustion.

3.6 Note on Cyanide

Cyanide toxicity is complicated but it is generally accepted that cyanide species exist in 'free' and 'complex' forms. Free cyanide species are toxic and it is generally agreed that free cyanide provides a more scientifically correct basis for the establishment of generic criteria. This approach has been followed in this report.

Metal-cyanide complexes (complex cyanide) are generally not considered toxic but in certain environmental fate reactions it is possible that dissociation may release toxic free cyanide into the water environment. This might occur where complex cyanides are exposed to direct sunlight and photolysis takes place. Such circumstances are considered very rare.

There is no published approach to assessing acute toxicity, but this can be a concern on gas works sites where spent oxide or, more particularly foul lime (aka "blue billy") from the older processes, may contain significant concentrations of free cyanide. This is a particular problem because young children may be attracted to the bright blue deposits.

A methodology was presented by Macklin *et al* (December 2012): an acute oral LOAEL dose was identified by the then Health Protection Agency as 0.4 mg/kg bw/day; a dose of 5 g of soil was selected based on USEPA studies, eaten by a 10 kg weight child. This equates to a trigger level of 800 mg/kg free cyanide in soil. Above this concentration, there is a plausible hazard of ingestion of a harmful or fatal dose.

3.7 Note on Polychlorinated Biphenyls

PCBs fall into two groups, the dioxin-like (DL) and the non-dioxin-like (NDL), by virtue of their toxicity.

The Environment Agency methodology for DL-PCBs is included with dioxins and furans in the published dioxins SGV report (Science Report SC050021 / Dioxins SGV). The basis of this report is that because of the additive nature of these substances it is inappropriate to produce individual SGVs. The approach is to obtain speciated analyses of 12 DL-PCBs and, using an Agency spreadsheet, calculate a Hazard Index for a prescribed mixture of substances. SGVs can only be produced for atmospheric fall-out sites where the proportions of the individual substances are assumed to be uniform across the UK according to a table listed in the document.

For potentially industrially contaminated sites (such as where PCBs have escaped from transformers) only a Hazard Index can be produced. This can be converted into a GAC by calculation, but such a GAC is only applicable to conditions where the mixture of substances is unchanged. In effect, Hazard Indices will be calculated for each soil sample and provided these are all less than unity, the site poses no significant risk.

There is not Agency guidance with respect to NDL-PCBs. Hydrock has produced individual GACs for a number of these. A precautionary approach has been taken, in that the NDL-PCBs are assumed to have additive effects and the same approach is taken as with Hydrock's assessment of contamination by TPH fractions. Namely, each substance is compared with its GAC, but there is an additional stage in which a Hazard Index is also calculated. This is similar to the Agency's approach for DL-PCBs, but the Hazard Index calculation is performed at a different stage in the process.

Currently, these two approaches are separate. That is to say, there is no assumption of additvity of effect between DL- and NDL-PCBs. The logic for this is the fact that these two groups where established in the first place on account of their different effects.

The toxicity of the DL-PCBs is far greater than that of the NDL-PCBs. For example, the residential SGV for the full list of dioxins, furans and DL-PCBs under atmospheric fall-out conditions is 0.0087 mg/kg (NB: using only the 12 DL-PCBs in this list gives a GAC of 0.051 mg/kg), whist the lowest GAC for the NDL-PCBs is 0.32 mg/kg under the same exposure conditions. Analyses for DL-PCBs must be undertaken with very low laboratory reporting limits (typically 1ng/kg).

In real life examples, it is almost certain that both forms of PCBs will be present at a site. This is because the marketed products (known as Aroclors) were mixtures of many PCB congeners and they all appear to contain members from both groups (according to literature researched by Hydrock). Perhaps this is why the Agency has only issued guidance on the DL-PCBs.

Logically, if a site contains any PCBs (for example as a 'total' analysis) it is likely to contain DL-PCBs. In which case, the safe concentrations will be very low and can only be confirmed by re-analysing using low detection methods and following the Agency methodology on a sample-by-sample basis. This is effect means that GACs for NDL-PCBs are redundant. The implications of the Agency methodology have yet to be fully understood by the contaminated land community. For example, it would appear that standard laboratory tests for NDL-PCBs are irrelevant. Furthermore, standard reporting limits are far too high, typically 1ug/kg. The only instance where NDL-PCBs become the risk driver at a PCB contaminated site would be if for some reason the DL-PCBs had preferentially degraded.

The Hydrock methodology for PCB risk assessment is to carry out analyses for the 12 DL-PCBs (commonly referred to as the WHO-12) and the 7 most persistent NDL-PCBs (commonly referred to as the ICES-7) at a detection limit of 1 ng/kg (Table 3.6). This is considered conservative because it covers both groups even though the risk driver is most likely to be the DL-PCB group.

The WHO-12 are assessed using the Environment Agency SGV report methodology, to produce a Hazard Index, and the ICES-7 are compared to Hydrock-derived GACs with additivity check. Note that PCB118 appears in both lists and so in assessed under the Environment Agency methodology as a DL-PCB.

Table 3.6: PCB Suites

WHO-12 (dioxin-like)	ICES-7 (most persistent)
PCB-77 PCB-81 PCB-126 PCB-169 PCB-105 PCB-114 PCB-118 PCB-123 PCB-156 PCB-157 PCB-167 PCB-189	PCB-28 PCB-52 PCB-101 PCB-118 PCB-138 PCB-153 PCB-180 (Non-dioxin-like apart from PCB-118)

3.8 Note on Pesticides and Herbicides

Unless there is evidence to suggest that a certain pesticide or herbicide has been used on the land, the standard approach adopted by Hydrock is to screen for the presence of common pesticides in the organochlorine, organophosphorous and organonitrogen groups (OCP, OPP & OPN), for example on agricultural land. Note that the only available GACs are for pesticides in these groups (and then only a sub-set of the whole).

3.9 Note on Radon

Advice on radon protection in England is provided by Public Health England (www.ukradon.org), formerly the Health Protection Agency (*The Indicative Atlas of Radon in England and Wales,* HPA-RPD-033 (Miles *et al* 2007) and RCE-15 (2010)), and by the BRE (BRE Report BR 211 (Scivyer 2015)). An area of the country can be categorised according to the percentage of existing homes where radon is present above the Action Level: 0-1% lower probability, 1-3% and 3-10% intermediate probability and >10% higher probability. It is important to understand that the database on which these numbers are based is incomplete and contains more data points in areas of the country that have traditionally been known for high radon concentrations. As more properties are monitored, the categorisation may change.

The areas where >1% of homes exceed the Action Level are known as Radon Affected Areas.

The Building Regulations cite BR 211 and require basic radon protection measures in new buildings in areas of England and Wales where 3-10% of properties exceed the Action Level and full radon protection measures where >10% exceed the Action Level.

Landlords and employers have a legal duty to keep radon levels as low as practicable and to install remedial measures if levels are too high. Commercial new build includes protection measures similar to those for new homes, but once occupied they are subject to the HSW Act and the Ionising Radiations Regulations 1999.

Private residents are advised to have a radon test where their property is in a Radon Affected Area, and to fit remedial measures if levels are too high.

The Law Society's advice to conveyancing solicitors is to ask the vendor standard questions concerning whether the property is in a radon affected area, whether it was constructed with radon protection measures and whether a radon test has been carried out by the vendor. Hydrock understands that PHE is discussing with the Law Society the adoption of stronger wording to these questions.

In 2009 the then Health Protection Agency recommended that Building Regulations and supporting documents should be amended to ensure that *all* new buildings, extensions, conversions and refurbished buildings in the UK include basic radon protective measures as a minimum. This recommendation was rejected by the Government. Consequently, the current situation is that a developer is *required* only to install protective measures in buildings where >3% of existing properties are above the Action Level, but is not required to install them in Radon Affected Areas where 1-3% of existing properties exceed the Action Level (even though there may be future implications for occupiers of these buildings).

Note that whilst membranes intended to protect against radon *may* also protect against methane and carbon dioxide, this will only be the case if they have also been specifically designed (and installed) to protect against those gases (BS 8485:2015, Annex G).

3.10 Note on the Use of Non-UK Assessment Criteria

In rare instances reference to assessment criteria or other trigger values published by other authoritative bodies (other than those concerned with the UK contaminated land regime) may provide background information on the likely degree of contamination of a substance. Trigger levels indicative of naturally occurring concentrations or risk-based guidance from other countries often help place site analysis results into context. It must be remembered that use of non-UK assessment criteria is not in compliance with the UK contaminated land assessment regime given in the Model Procedures. However, these criteria can be of use as an aid to professional judgement and can help in determining a cost-effective and sustainable remedial strategy for a site, in consultation with the regulatory authorities.

3.11 Site-specific Assessment Criteria for Volatile Substances

The CLEA methodology includes the inhalation of indoor vapours where there are occupied buildings in the standard land use scenarios. For volatile substances such as those listed in Table 3.7 the percentage contribution of the indoor vapour pathway to the average daily exposure (ADE) can be seen to be significant (up to 100%). Consequently, if this pathway can be severed by the installation of a suitably designed and installed organic vapour barrier in the buildings only the remaining CLEA exposure pathways need to be considered for the site. Assessment criteria can be calculated for the remaining exposure pathways.

Site Specific Assessment Criteria (SSAC) have been calculated using CLEA UK using the same input parameters etc. as for the Hydrock GACs but with the indoor vapour pathway turned off in the model. The resulting SSACs can be used to inform on risk from these contaminants in the same way as GACs are used, but apply only if suitable membranes are provided and verified.

Table 3.7: Derivation of Site Specific Assessment Criteria for Volatile Substances for CLEA Standard Land Uses *Excluding the Indoor Vapour Pathway* (mg/kg) – on following page(s).

Updated 18/11/15		Human Health Generic Assessment Criteria (no indoor vapour pathway) (mg/kg)								
Contaminant	**Source of GAC**	**Human health - residential without plant uptake, no indoor vapour (1%SOM)**	**Human health - residential without plant uptake, no indoor vapour (2.5%SOM)**	**Human health - residential without plant uptake, no indoor vapour (6%SOM)**	**Human health - residential with plant uptake, no indoor vapour (1%SOM)**	**Human health - residential with plant uptake, no indoor vapour (2.5%SOM)**	**Human health - residential with plant uptake, no indoor vapour (6%SOM)**	**Human health - commercial, no indoor vapour (1%SOM)**	**Human health - commercial, no indoor vapour (2.5%SOM)**	**Human health - commercial, no indoor vapour (6%SOM)**
TPH fractions										
TPH ali EC05-EC06	LQM/CIEH + CLEA 1.07	320000	320000	320000	5000	11000	25000	300	560	1200
TPH ali >EC06-EC08	LQM/CIEH + CLEA 1.07	320000	320000	320000	15000	34000	71000	140	320	740
TPH ali >EC08-EC10	LQM/CIEH + CLEA 1.07	6400	6400	6400	1600	2900	4300	78	94000	94000
TPH ali >EC10-EC12	LQM/CIEH + CLEA 1.07	6500	6500	6500	4600	5500	6000	94000	95000	95000
TPH ali >EC12-EC16	LQM/CIEH + CLEA 1.07	6500	6500	6500	6300	6300	6400	95000	95000	95000
TPH ali >EC16-EC35	LQM/CIEH + CLEA 1.07	-	-	-	-	-	-	-	-	-
TPH ali >EC35-EC44	LQM/CIEH + CLEA 1.07	-	-	-	-	-	-	-	-	-
TPH aro EC05-EC07	LQM/CIEH + CLEA 1.07	29000	29000	29000	90	180	390	1200	2300	4700
TPH aro >EC07-EC08	LQM/CIEH + CLEA 1.07	29000	29000	29000	150	350	800	870	420000	420000
TPH aro >EC08-EC10	LQM/CIEH + CLEA 1.07	2600	2600	2600	58	140	310	38000	38000	38000
TPH aro >EC10-EC12	LQM/CIEH + CLEA 1.07	1800	1800	1800	83	200	430	38000	38000	38000
TPH aro >EC12-EC16	LQM/CIEH + CLEA 1.07	-	-	-	-	-	-	-	-	-
TPH aro >EC16-EC21	LQM/CIEH + CLEA 1.07	-	-	-	-	-	-	-	-	-
TPH aro >EC21-EC35	LQM/CIEH + CLEA 1.07	-	-	-	-	-	-	-	-	-
TPH aro >EC35-EC44	LQM/CIEH + CLEA 1.07	-	-	-	-	-	-	-	-	-
TPH >EC44-EC70	LQM/CIEH + CLEA 1.07	-	-	-	-	-	-	-	-	-
VOCs - BTEX & MTBE										
Benzene	SGV report + CLEA 1.07	37	37	37	0.13	0.27	0.59	530	530	540
Toluene	SGV report + CLEA 1.07	29000	29000	29000	150	350	800	870	420000	420000
Ethylbenzene	SGV report + CLEA 1.07	13000	13000	13000	110	260	600	180000	180000	190000
Xylene, o-	SGV report + CLEA 1.07	22000	22000	22000	190	460	1100	260000	280000	300000
Xylene, m-	SGV report + CLEA 1.07	22000	22000	22000	210	500	1200	260000	280000	300000
Xylene, p- (use this for combined m & p)	SGV report + CLEA 1.07	22000	22000	22000	200	470	1100	260000	280000	300000
MTBE	EIC/AGS/CL:AIRE + CLEA 1.07	39000	39000	39000	150	300	600	550000	550000	560000
VOCs - other benzenes										
Iso-propylbenzene	EIC/AGS/CL:AIRE + CLEA 1.07	13000	13000	13000	220	520	1200	180000	180000	180000
Propylbenzene	EIC/AGS/CL:AIRE + CLEA 1.07	13000	13000	13000	230	550	1200	180000	190000	190000
1,2,4-Trimethylbenzene	EIC/AGS/CL:AIRE + CLEA 1.07	130	130	130	2.5	6.1	14	1800	1800	1900
VOCs - chlorobenzenes										
Bromobenzene	EIC/AGS/CL:AIRE + CLEA 1.07	2900	3000	3000	22	52	120	31000	34000	37000
Chlorobenzene	LQM/CIEH + CLEA 1.07	6200	6300	6400	40	94	210	63000	77000	91000
1,2-Dichlorobenzene	LQM/CIEH + CLEA 1.07	54000	55000	56000	640	1500	3500	580000	670000	730000
1,3-Dichlorobenzene	LQM/CIEH + CLEA 1.07	130	130	130	1.7	4.1	9.3	3000	3100	3100
1,4-Dichlorobenzene	LQM/CIEH + CLEA 1.07	8800	8900	8900	100	250	570	130000	130000	130000
Hexachlorobenzene	LQM/CIEH + CLEA 1.07	-	-	-	-	-	-	-	-	-
Pentachlorobenzene	LQM/CIEH + CLEA 1.07	-	-	-	-	-	-	-	-	-
1,2,3-trichlorobenzene	LQM/CIEH + CLEA 1.07	950	960	960	31	74	160	12000	13000	13000
1,2,4-trichlorobenzene	LQM/CIEH + CLEA 1.07	6300	6500	6600	200	480	1100	49000	60000	69000
1,3,5-trichlorobenzene	LQM/CIEH + CLEA 1.07	920	940	940	31	74	160	9300	11000	12000
1,2,3,4-tetrachlorobenzene	LQM/CIEH + CLEA 1.07	-	-	-	-	-	-	-	-	-
1,2,3,5-tetrachlorobenzene	LQM/CIEH + CLEA 1.07	34	34	34	2.4	5.4	11.0	690	700	700
1,2,4,5-tetrachlorobenzene	LQM/CIEH + CLEA 1.07	-	-	-	-	-	-	-	-	-
VOCs - chloroalkanes & alkanes										
Bromodichloromethane	EIC/AGS/CL:AIRE + CLEA 1.07	38	38	38	0.11	0.22	0.46	500	520	530
Bromoform	EIC/AGS/CL:AIRE + CLEA 1.07	-	-	-	-	-	-	-	-	-
Chloroethane	EIC/AGS/CL:AIRE + CLEA 1.07	350000	350000	350000	780	1400	2600	2600	3500	5700
Chloroethene (aka vinyl chloride)	LQM/CIEH + CLEA 1.07	1.8	1.8	1.8	0.0038	0.0069	0.013	26	26	26
Chloromethane	EIC/AGS/CL:AIRE + CLEA 1.07	310	310	310	0.45	0.88	1.6	1900	2200	3000
1,1-Dichloroethane	EIC/AGS/CL:AIRE + CLEA 1.07	25000	25000	25000	64	120	240	1800	3000	5600
1,2-Dichloroethane	LQM/CIEH + CLEA 1.07	15	15	15	0.032	0.057	0.11	200	200	210
1,1-Dichloroethene	EIC/AGS/CL:AIRE + CLEA 1.07	5700	5700	5700	19	39	82	2200	3900	8000
Cis 1,2 Dichloroethene	EIC/AGS/CL:AIRE + CLEA 1.07	680	690	690	1.8	3.5	7.1	3900	6600	9900
Trans 1,2 Dichloroethene	EIC/AGS/CL:AIRE + CLEA 1.07	2100	2100	2100	6.5	13	27	3400	6200	13000
Dichloromethane	EIC/AGS/CL:AIRE + CLEA 1.07	390	390	390	0.70	1.3	2.3	7300	9000	9000
1,2-Dichloropropane	EIC/AGS/CL:AIRE + CLEA 1.07	1200	1300	1400	4.3	8.4	18	1200	2100	11000
Hexachloroethane	EIC/AGS/CL:AIRE + CLEA 1.07	64	64	64	1.8	4.3	9.3	900	920	930
Tetrachloroethene	LQM/CIEH + CLEA 1.07	1700	1700	1700	11	26	58	420	950	26000
1,1,1,2-Tetrachloroethane	LQM/CIEH + CLEA 1.07	730	730	730	5.4	13	29	10000	10000	11000
1,1,2,2-Tetrachloroethane	LQM/CIEH + CLEA 1.07	730	730	730	2.8	6.1	14	11000	11000	11000
Tetrachloromethane	LQM/CIEH + CLEA 1.07	180	180	180	1.1	2.5	5.7	1500	2500	2500
Trichloroethene	LQM/CIEH + CLEA 1.07	660	660	660	3.0	6.5	15	1500	3200	9000
1,1,1-Trichloroethane	LQM/CIEH + CLEA 1.07	75000	76000	76000	330	730	1600	1400	2900	6400
1,1,2 Trichloroethane	EIC/AGS/CL:AIRE + CLEA 1.07	510	510	510	2.0	4.2	9.4	7100	7300	7400
Trichloromethane	LQM/CIEH + CLEA 1.07	880	880	880	2.5	4.8	10	5200	9100	20000
Other inorganics										
Antimony	EIC/AGS/CL:AIRE + CLEA 1.07	-	-	-	-	-	-	-	-	-
Barium	EIC/AGS/CL:AIRE + CLEA 1.07	-	-	-	-	-	-	-	-	-

Updated 18/11/15		Human Health Generic Assessment Criteria (no indoor vapour pathway) (mg/kg)								
Contaminant	**Source of GAC**	**Human health - residential without plant uptake, no indoor vapour (1%SOM)**	**Human health - residential without plant uptake, no indoor vapour (2.5%SOM)**	**Human health - residential without plant uptake, no indoor vapour (6%SOM)**	**Human health - residential with plant uptake, no indoor vapour (1%SOM)**	**Human health - residential with plant uptake, no indoor vapour (2.5%SOM)**	**Human health - residential with plant uptake, no indoor vapour (6%SOM)**	**Human health - commercial, no indoor vapour (1%SOM)**	**Human health - commercial, no indoor vapour (2.5%SOM)**	**Human health - commercial, no indoor vapour (6%SOM)**
Mercury, elemental	SGV report + CLEA 1.07	4.3	11	26	4.3	11	26	4.3	11	26
Molybdenum	EIC/AGS/CL:AIRE + CLEA 1.07	-	-	-	-	-	-	-	-	-
Thiocyanate	Hydrock + CLEA 1.07									
Other organics										
Biphenyl	EIC/AGS/CL:AIRE + CLEA 1.07	-	-	-	-	-	-	-	-	-
Carbon disulphide	LQM/CIEH + CLEA 1.07	6200	6300	6300	33	70	150	2100	4200	75000
2,4-Dinitrotoluene	EIC/AGS/CL:AIRE + CLEA 1.07	-	-	-	-	-	-	-	-	-
2,6-Dinitrotoluene	EIC/AGS/CL:AIRE + CLEA 1.07	-	-	-	-	-	-	-	-	-
Hexachloro-1,3-butadiene	LQM/CIEH + CLEA 1.07	13	13	13	1.5	3.1	5.6	290	290	290
Mercury, methyl	SGV report + CLEA 1.07	-	-	-	-	-	-	-	-	-
Styrene	EIC/AGS/CL:AIRE + CLEA 1.07	1500	1500	1500	11	25	58	23000	23000	23000
Tributyl tin oxide	EIC/AGS/CL:AIRE + CLEA 1.07	-	-	-	-	-	-	-	-	-
2-Chloronaphthalene	EIC/AGS/CL:AIRE + CLEA 1.07	-	-	-	-	-	-	-	-	-
NOTES										
If >1,000,000 is calculated, 1,000,000 is adopted.										

Red text - liquid at ambient temperature, calculated GAC exceeds saturation value and highlighed in red in CLEA - saturation value adopted for GAC

Orange text - solid at ambient temperature, calculated GAC exceeds saturation value and highlighted red in CLEA - manual calculation not possible as only one HCV - saturated vapour concentration exceed, so saturation valu

Blue text - solid at ambient temperature, calculated GAC exceeds saturation value and highlighted red in CLEA - manual calculation not possible as only one HCV - aqueous solubility exceed, so original red-highlighted value a

Green text - solid at ambient temperature, calculated GAC exceeds saturation value and highlighted red in CLEA - manual calculation undertaken but result is greater than original red-highlighted value, so original red-highlighte

3.12 Determination of Contaminated Land Under Part 2A of the Environmental Protection Act 1990

The legal test for land contamination under the statutory guidance of Part 2A of the Environment Protection Act 1990 (i.e. "significant harm or significant possibility of significant harm") is **unacceptable** intake or direct bodily contact.

The situation was clarified by Defra (July 2008) in its guidance on the legal definition of contaminated land.

Part 2A does not prescribe number-based thresholds because it would be very difficult to produce numbers which are meaningful and proportionate, given the lack of scientific information about many substances and the site specific nature of risks. Instead, it relies on local authorities to assess risks posed on individual sites, then decide whether (in their view) the risks represent SPOSH, and thus whether land qualifies as **contaminated**.

The intention of the approach is that local authorities can use their judgement to ensure that Part 2A focuses on the SPOSH it was designed to address, whilst avoiding unnecessary burdens on land where contaminants may be present but there is no SPOSH.

In making Part 2A decisions, local authorities are likely to face some difficult decisions caused by uncertainty on the nature of risks. But they should be confident in exercising their judgement on the basis of available information. Part 2A clearly leaves judgements about what constitutes a SPOSH to local authorities, and it is up to them to make decisions.

GACs are not proxy thresholds for SPOSH, and should not be used as such. They describe levels (based on cautious estimates and assumptions in hypothetical example situations) at which concentrations of contaminants in soil may cease to pose **no appreciable/ minimal** risk. They do not seek to describe levels at which there might be a SPOSH.

Thus, if a GAC is exceeded, the assessor will usually need to conduct a detailed quantitative risk assessment to discover whether there is a **possibility of significant harm** and, if so, the nature of that risk. Whether or not SPOSH exists will depend on the results of risk assessment, the existence and nature of any pollutant linkages, and (ultimately) the judgement of the local authority.

As a general guide:

(i) For substances where there is a GAC, the more the GAC is exceeded, the more likely it is that an authority should consider the risks to be SPOSH.

(ii) Generally, the cautious nature of GACs means that local authorities may conclude that SPOSH is unlikely to exist at concentrations close to GACs.

(iii) In some cases, land with concentrations of contaminants which marginally exceed a GAC (say, up to a few times the GAC) might give rise to SPOSH if, for example, the receptor is particularly sensitive; or if further assessment finds that exposure is higher than that estimated in the GAC; or if there is little uncertainty in the underlying toxicology and HCV.

(iv) In other cases a GAC may be exceeded by tens of times and there might be no SPOSH (e.g. if further assessment found that exposure was much lower than that estimated using the GAC).

In view of the above, Hydrock has not to attempted to derive numerical SPOSH concentrations, but to use GACs as screening values. Where GACs are exceeded, it is recommended that the linkages and the uncertainties in the data are reviewed in consultation the regulatory authority to aid its judgment on determination.

A possible next phase would be to refine the generic risk assessment with a detailed risk assessment. This would involve using site-specific input parameters relevant to the particular site, in the CLEA model.

Revised contaminated land statutory guidance was published by Defra in 2012 with respect to Part 2A. The Act itself is unchanged. A new four category test (and associated classifications) has been introduced to ensure a high standard without being excessive. The aims are to make the regime target higher risk sites more efficiently, remove excessive cost burdens and facilitate the development of technical tools to increase consistency over time. This includes supporting non-technical guidance including a possible framework to aid in deciding into which of the proposed four new Categories of land a site should be placed.

Conversely, the regime is not intended to intervene where there is only a low level of risk, particularly in cases where it is difficult to demonstrate anything other than a very small hypothetical risk, as might be the case with vast swathes of land.

Defra states that there is a need for a more pragmatic approach. In practice, deciding when regulatory intervention is justified involves making decisions about when to act on a wide spectrum of risk, with varying levels of uncertainty over the precise nature of the risks. A number of the changes are intended to clarify when land is "contaminated land". These are most likely to affect the assessment and remediation of contaminated land and are listed below.

1. Statutory explanation of broad objectives of the regime to explain that regulators should seek a reasonable balance between dealing with unacceptable risks whilst ensuring that burdens on businesses and society are manageable and sustainable. The regime should be seen as an option of last resort; that land is in effect "innocent until proven guilty". This should give greater clarity for all concerned on what the regime seeks to achieve, and what it seeks to avoid.

2. Local Authorities to produce risk summaries before land may be determined as "contaminated". Summaries must be understandable to non-experts to provide greater transparency and accountability. Easier for all involved to understand what local authority considers risks to be. It should be easier for Local Authorities managers, lawyers and councillors to be involved in decision making, particularly more difficult sites where wider socio-economic effects need to be take into account. Easier to share experience between Local Authorities leading to greater consistency in decision making.

3. Clarification of the legal test of significant harm to human health to mean serious unhealthy conditions of the body or part of it, and not minor/trivial complaints. This is unlikely to have a major effect because, to date, no site in England and Wales has been determined on

grounds that significant harm to human health has actually been caused. However, greater clarity on the meaning of significant harm is likely to help clarify the related legal test of significant possibility of significant harm.

4. Explanation of how to decide when land is (and is not) “contaminated land”. A new four category test which recognises the spectrum of risk encountered by assessors, and the reality that some sites are clearly contaminated land (Category 1), some clearly are not (Category 4), and others need more detailed consideration before a decision can be taken (Categories 2 and 3). Greater clarity that decision making is a two stage process in which the regulator must first understand the risk before deciding whether the risk is sufficiently high to justify regulatory intervention. The aim is to create legal certainty around what definitely is, and is not, contaminated land, whilst leaving Local Authorities with discretion to exercise local judgement on less straightforward land.

5. Category 4 will include normal background levels of contamination unless there is some exceptional reason to consider otherwise. Clarification that land at SGV/GAC levels is likely to be well into Category 4. Statutory backing for the sector to develop new tests to describe the top of Category 4 (including the production of Category 4 Screening Levels). This should provide clarity on when land will not be caught, reduced uncertainty and costs for landowners and businesses and faster decision making on non-problematic land.

6. Clarify the status of GACs and how they should (and should not) be used including a legal backing for the use of robust GACs produced by reputable, non-governmental, organisations within the sector (LQM/CIEH, EIC/AGS/CL:AIRE). Backing the development of new GACs (or similar tools) as might be developed by the sector to help implement the new Guidance. Specific legal backing for the current set of SGVs/GACs, and clarity on how they can (and cannot) be used.

7. Category 1 land is clearly caught by the regime when there is clear evidence of an unacceptable risk (e.g. similar land is known to have caused significant harm). This should give clarity on when land is definitely “contaminated land”, and help frame the spectrum of risk raised by land contamination.

8. New category of land under which Local Authorities would decide whether a site is in Category 2 (contaminated land) or Category 3 (not contaminated land). The new test would rest on whether or not the local authority believes there is a strong case for regulatory action, taking account of the scientific evidence, the objectives of the regime, and other factors. The local authority would start by considering health risks alone, and if they clearly tend towards the Category 4 or the Category 1 the decision could be taken at this point. However, if this does not lead to a decision, the local authority would consider wider socio-economic factors (e.g. cost, views of local people, etc) before deciding. If the local authority still cannot decide, the default decision is that the site is not contaminated land.

9. Reduce “regulatory creep” (excessive remediation of land forced by regulatory uncertainty) with greater clarity on what the enforcing authority can “reasonably” require by way of remediation. Clarity that SGVs/GACs must not be used as “one size fits all” remediation requirements; and that Part 2A can only be used to force remediation to a level where land

is no longer contaminated land (i.e. to a point where land is in Category 3), but it should not be used to force remediation beyond this point.

10. Guidance on the process of risk assessment: the need to take a strategic approach; the aim of dismissing low risk sites as soon as possible in order to focus on finding higher risk sites; and the general need to ensure that risk assessment is conducted in a timely and efficient manner. Clarify that in considering possible future risks the local authority should consider likely future situations (e.g. rather than hypothetical worst possible case situations). Recognise that in practice there is often a need for authorities to bring in external experts and act in accordance with their advice. Recognise that scientific and technical uncertainty is an inevitable part of contaminated land risk assessment, and set out broadly how regulators should deal with it. It is important that this is recognised in the Guidance to support the regulators who have to make decisions in the face of uncertainty.

In deciding whether or not a significant possibility of significant harm to human health exists, the local authority should first understand the possibility of significant harm from the relevant contaminant linkage(s) and the levels of uncertainty attached to that understanding, before it goes on to decide whether or not the possibility of significant harm is significant.

The term “possibility of significant harm” means the risk posed by one or more relevant contaminant linkage(s) relating to the land. It comprises:

- the estimated likelihood that significant harm might occur to an identified receptor, taking account of the current use of the land in question; and
- the estimated impact if the significant harm did occur i.e. the nature of the harm, the seriousness of the harm to any person who might suffer it, and (where relevant) the extent of the harm in terms of how many people might suffer it.

Having completed its estimation of the possibility of significant harm, the local authority should produce a risk summary.

The decision on whether the possibility of significant harm being caused is significant (SPOSH) is a regulatory decision to be taken by the relevant local authority. In deciding whether the possibility of significant harm being caused is significant, the authority is deciding whether the possibility of significant harm posed by contamination in, on or under the land is sufficiently high that regulatory action should be taken to reduce it, with all that would entail.

In deciding whether or not land is contaminated land on grounds of significant possibility of significant harm to human health, the local authority should use the four categorisations.

The decision between Categories 2 and 3 is a positive legal test, which means that the starting assumption should be that land does not pose a significant possibility of significant harm unless there is reason to consider otherwise. Category 3 may include land where the risks are not low, but nonetheless the authority considers that regulatory intervention under Part 2A is not warranted.

The local authority should first consider its assessment of the possibility of significant harm to human health, including the estimated likelihood of such harm, the estimated impact if it did occur, the timescale over which it might occur, and the levels of certainty attached to these estimates. If the authority considers, on the basis of this consideration alone, that the strong case does or does not exist, the authority should make its decision on whether the land falls into Category 2 or Category 3 on this basis regardless of any other factors.

However, if the authority considers that it cannot make a decision, it should consider other factors which it considers are relevant, including:

- The likely direct and indirect health benefits and impacts of regulatory intervention including benefits of reducing or removing the risk posed by contamination, any risks from contaminants being mobilised during remediation and any indirect impacts such as stress-related health effects that may be experienced by affected people, particularly local residents. If it is not clear to the authority that the health benefits of remediation would outweigh the health impacts, the authority should presume the land falls into Category 3 unless there is strong reason to consider otherwise.
- The authority's initial estimate of what remediation would involve; how long it would take; what benefit it would be likely to bring; whether the benefits would outweigh the financial and economic costs; and any impacts on local society or the environment from taking action that the authority considers to be relevant.

Deregulatory Change to Definition of Contaminated Land as it Relates to Water Pollution.

Defra will commence Section 86 of the Water Act 2003 so that in future this would only be the case if there is significant pollution of controlled waters or significant possibility of such pollution. To explain how to decide whether or not "significant" pollution is being caused, the Statutory Guidance introduced new Category 1-4 tests similar to those for deciding when there is a significant risk to human health as described above. There will be new technical guidance produced by the Environment Agency. In practice, this change is likely to have little effect on the practical implementation of the Part 2A regime because the Environment Agency has already been prioritising sites likely to meet the new "significance" test.

The 'pollution of Controlled Waters' means the entry into controlled Waters of any poisonous, noxious or polluting matter or any solid waste matter. Given that the Part 2A regime seeks to identify and deal with significant pollution (rather than lesser levels of pollution), the local authority should seek to focus on pollution which: (i) may be harmful to human health or the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems; (ii) which may result in damage to material property; or (iii) which may impair or interfere with amenities and other legitimate uses of the environment.

In deciding whether significant pollution of Controlled Waters is being caused, the local authority should consider that this test is only met where it is satisfied that the substances in question are continuing to enter controlled Waters; or that they have already entered the waters and are likely to do so again in such a manner that past and likely future entry in effect constitutes on-going pollution.

3.13 Generic Risk Assessment Criteria for Risk to Plants

Soil contaminants, if present at sufficient concentrations, can have an adverse effect on the plant population. Phytotoxic effects can be manifested by a variety of responses, such as growth inhibition, interference with plant processes, contaminant-induced nutrient deficiencies and chlorosis (yellowing of leaves). All chemicals are probably capable of causing phytotoxic effects. Thus the phytotoxic potential of substances is dependent on the concentrations capable of having adverse effects on plants and the concentrations likely to be found at contaminated sites. Phytotoxicity is a difficult parameter to quantify given that experimental techniques vary widely and variations exist in plant tolerances, soil effects and synergistic/antagonistic reactions between chemicals.

Contaminants may be taken up and accumulated by plants through a range of mechanisms. The principal pathways are active and/or passive uptake through the plant root, adsorption to root surfaces and volatilisation from the soil surface followed by foliar uptake. After plant uptake, contaminants may be metabolised or excreted, or they may be bioaccumulated.

Many of the substances capable of adversely affecting vegetation exert this effect because of their water solubility, a characteristic that could result in their transport from contaminated sites into adjacent locations where the chemical may generate a phytotoxic response. This could be important if, for example, the adjacent site has important conservation status.

Whilst many contaminants may be phytotoxic, data are limited. Some heavy metals are essential as trace elements for plant growth but may become toxic at higher concentrations. Toxicity may be displayed in many forms, including signs of stress such as reduction in growth or yellowing of the tissue. The concentration in soil at which substances become phytotoxic depend on a range of factors including plant type, soil type, pH, the form and availability of the contaminant and other vegetation stress factors that may be present (such as drought).

Hydrock has carried out a review of a number of current and former guidance documents and other texts on phytotoxicity. It is not possible to produce a definitive list of phytotoxic substances on account of the variables mentioned above. However, a number of metals are repeatedly cited as commonly occurring priority pollutants. As a result, the following list is adopted as Hydrock's indicators of the potential for phytotoxicity: As, B, Cr, Cu, Ni and Zn.

As the CLEA framework is a risk based approach, applied to humans, an alternative strategy is required to assess the risk to plants from substances that are phytotoxic. Reference to published criteria and background concentrations can help put site data into context.

Published assessment criteria for the protection of plant life from a number of countries are given in Table 3.8. Also included in the table are some measures of natural background concentrations in typical soils.

The most authoritative source is the British Standard for topsoil, but this only lists three elements. CLR 11 states that the ICRCL Guidance Note 70/90 can be used for initial screening criteria.   This approach has been adopted by Hydrock where BS 3882 is lacking, but where an ICRCL 70/90 criterion is lacking, the lowest criterion in Table 3.8 from, firstly MAFF, and, secondly, another country has been adopted. The adopted criteria are highlighted in Table 3.8. The MAFF value of 250 mg/kg has been chosen for As over the ICRCL value of 50 mg/kg as MAFF explains the 50 is applicable to vegetables and human health, whereas 250 is applicable to the plants themselves.

Table 3.8: Published Assessment Criteria and Natural Background Concentrations for Phytotoxic Elements (mg/kg)

Reference	As	B	Cr (total)	Cr (III)	Cr (VI)	Cu	Ni	Zn
Published assessment criteria (mg/kg)								
British Standard for topsoil (BS 3882:2015)						200 (pH>7) 135 (pH 6-7) 100 (pH 5.5-6.0)	110 (pH>7) 75 (pH 6-7) 60 (pH 5.5-6.0)	300 (pH>7) 200 (pH 6-7) 200 (pH 5.5-6.0)
MAFF Code of Good Agricultural Practice for the Protection of Soil (1998)	250			unlikely to be toxic except in v low pH. 400 for sites containin g sewage sludge		500 (grass) but may fall to 250 for clover and sensitive species (at pH≥6)	110 (pH>7) 75 (pH 6-7) 60 (pH 5.5-6.0)	1000 (clover & grass at pH 6), may fall to 300 for sensitive species (at pH 6-7)
Australian Guideline B(1) (1999), Interim Urban Ecological Investigation Level (EIL). Soils not generally considered phytotoxic below these EILs.	20			400	1	100	60	200
Considered toxic to plants - Ponnamperuma *et al* (1979)		5 (hot water soluble)						
Dutch ecotoxicological intervention value (Swartjes 1993 & 1994) *	40	7	230			190		
Alberta Environment (1990) Tier 1 (draft) *	10 acid sandy soils			600 acid sandy soils	25 acid sandy soils	130 acid sandy soils		
Ontario MoE (1989) *	20 acid sandy soils 25 clay soils							
ICRCL 59/83 (1987) now withdrawn for human health assessment		3 (hot water soluble)				130	70	300
ICRCL 70/90 (1990) threshold trigger value	50				25	250		1000
New Zealand guidelines for timber treatment sites (1997), estimated based on Cu bioavailability *						500-1000 clay soils		
New Zealand guidelines for timber treatment sites (1997), soil criteria for protection of plant life (residential/agricultural setting)	10-20	3 (soluble)		600	25	130		

Reference	As	B	Cr (total)	Cr (III)	Cr (VI)	Cu	Ni	Zn
Natural Background Concentrations (mg/kg)								
Dutch background level (target value) (VROM 2000)	29		100			36	35	140
UK ICRCL 42/80 (2nd ed. 1983) - Normal conc. In agricultural soil	0.1-40	2-100	5-500			2-100	5-500	10-300
UK ICRCL 70/90 (1st ed. 1990) - Typical range (and mean) in agricultural soils	2.3 - 53 (11.0)					5.8-62 (19) [1.2-19 4.9) extractable]		29-210 (78.1) [1.5-21 (5.6) extractable]
Canadian assessment criteria (i.e. background) (CCME 1991)	5	1(hot water soluble)	20		2.5	30		60
New Zealand timber sites (1997) – background	2-30							
Australian Guideline B(1) (1999), typical background levels	1-50		5-1000			2-100	5-500	10-300
* cited in New Zealand Ministry for the Environment (1997) timber treatment chemicals guidelines.								

3.14 Generic Risk Assessment Criteria for Controlled Waters

The following aquifer definitions are adopted.

- **Principal aquifers** - These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.
- **Secondary aquifers** - These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into two types:
- **Secondary A** - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers; and
- **Secondary B** - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.
- **Secondary undifferentiated** - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type
- **Unproductive strata** - These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

The Environment Agency (August 2013) Groundwater Protection Policy (known as GP3) contains the legal framework, detailed policies, technical background and the tools to be used in the protection of groundwater.

The European Water Framework Directive (2000/60/EC) (WFD) and its daughter Directives establish a consolidated way of controlling water quality of the whole water environment. The UK Government has revised its guidance to the Environment Agency and Natural Resources Wales (the Agencies) to remain relevant to the second and subsequent planning cycles. *River basin planning guidance* (Defra and Welsh Government July 2014) is a point of reference for other regulators, bodies and individuals affected by or contributing to the river basin planning process. Parts of this guidance are transposed into The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015, which support The Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations 2015 (Statutory Instrument 2015 No. 1623) which came into force on 14 September 2015. This updates the 2003 Regulations to include the revised EQS Directive (2013/39/EU) which has been amended to cover the second planning cycle, starting on 22 December 2015.

Water Framework Directive implementation in England and Wales: new and updated standards to protect the water environment (Defra and Welsh Government May 2014) informs interested parties of the new and updated environmental standards. There are a number of support documents produced by the UK Technical Advisory Group on the Water Framework Directive (UKTAG), including *Updated Recommendations on Environmental Standards* for the 2015-21 river basin management programme.

A groundwater body is defined as groundwater in an aquifer capable of supporting an abstraction of 10 m^3/day or 50 people over a sustained period under the WFD. Groundwater bodies are a strategic resource, even if there is no current abstraction. Lesser amounts of groundwater in an aquifer may not be considered as receptors in their own right, but may still be pathways to other receptors such as surface water bodies or aquatic ecosystems. However, if the conceptual site model indicates a potable supply of less than 10 m^3/day, this source will be included in the risk assessment.

One of the main objectives of the Agencies is to ‘prevent or limit’ inputs of substances. Substances are defined as either ‘hazardous substances’ or ‘non-hazardous pollutants’. Directive 2006/118/EC include the objective of preventing the input of hazardous substances into groundwater and limiting inputs of other (non-hazardous) pollutants so as to avoid deterioration of the groundwater body. The revised EQS Directive 2013/39/EU Annex I contains a list of ‘priority substances’ in the field of water policy and includes those identified as ‘priority hazardous substances’.

For practical purposes, the Agency interprets prevention of inputs of hazardous substances and any other substances which meet the criteria for persistence, toxicity and bioaccumulation taking into account those substances listed in WFD (2000/60/EC) Annex VIII.

The ‘prevent’ objective applies to active inputs such as industrial discharges and *de minimus* concentrations are set as a series of minimum reporting values (MRV). Inputs to Controlled Waters from contaminated land sites are classed as passive inputs under the WFD and, as such, were regulated under the Agency’s ‘limit’ objective. However, paragraph 9.3 of the revised *River* *basin planning guidance* (Defra and Welsh Government July 2014) states that the governments will issue revised Directions to take into account the recommendations of UKTAG (November 2013, amended January 2014) as well as Directive 2013/39/EU. These recommendations provide approached for hazardous and non-hazardous substances as follows.

- Hazardous substances – standards in groundwater help to assess whether or not measures to prevent inputs from identified sources have been successful and are based on 'limits of quantification' achieved routinely by competent laboratories (also known as minimum reporting values, MRV). Recommended standards are given in Table 13 of the UKTAG document. These standards are recommended for use in assessing risks posed by new developments (such as landfills) and whether or not existing activities and contaminated land with the potential to cause inputs are doing so.

  This is potentially more onerous than the previous 'limit' objective and the UKTAG document states that actions currently taken with respect to contaminated land are not always sufficient to prevent inputs of hazardous substances and additional remediation may be required. However, it also states that exemptions are available where measures would be disproportionately costly.
- Non-hazardous pollutants – standards in groundwater help to assess the extent to which inputs need to be limited to ensure they do not cause deterioration. Standards vary depending on the receptor at risk. Acceptable water quality targets are defined for protection of human health (based on drinking water standards (DWS)) and for protection of aquatic ecosystems (environmental quality standards (EQS)).

In the event, when the revised Directions were issued (namely, The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015) there was no mention of the use of MRVs with respect to inputs from land subjected to contamination. Consequently, MRVs are not used by Hydrock in this report.

All substances which are not determined to be hazardous are potentially non-hazardous pollutants. The final say lies with the Agencies as to which chemicals they consider to be of potential concern and whilst the indicator substances analysed for by Hydrock in this report may be indicative of the likely risk of pollution of Controlled Waters, this report may not be definitive and the relevant Agency may require additional work.

The definition of pollution is "the direct or indirect introduction, as a result of human activity, of substances or heat into the air water or land which may be harmful to human health or the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems, which result in damage to material property, or which impair or interfere with amenities and other legitimate uses of the environment."

Pollution equates to harm. In order to protect receptors there is a regulatory regime. This involves setting an environmental standard at the receptor (i.e. minimum acceptable water quality). In recognition that pollutants may degrade *en route* to the receptor it is possible to set a limit value at the source of the pollution and compliance values at locations along the pathway, such that water reaching the receptor does not exceed the environmental standard. By definition, the target value is greater than or equal to the compliance value, which in turn is greater than or equal to the environmental standard, depending on the amount of degradation expected. This concept is used in the Remedial Targets Methodology (Environment Agency 2006a) to determine how land contamination impacts on groundwater and surface water quality.

The applied environmental standards vary with the hydrogeological conditions and the perceived value of the water resource, and are subject to local assessment by the relevant Agency. Note that protection of Controlled Waters may involve work over and above that required for 'suitable use' of a site for the proposed development.

Note also that Article 6.3(e)(ii) of the WFD enables the regulatory authorities to exempt measures from the prevent and limit requirements where it would be disproportionately costly to remove or control the further movement of pollutants that are already in the ground. Where a continuing source that has given rise in the past to land contamination this must be brought under control to prevent further unacceptable inputs to groundwater, but it is clear that the extent is limited by what is considered to be 'reasonableness'.

This report provides an initial assessment of the risks of pollution of Controlled Waters using water quality targets (WQT) as screening values. These are the drinking water standards (DWS) and the environmental quality standards (EQS), the latter designed to protect the surface water ecosystems. EQS are available for inland surface waters (freshwater) and other surface waters (transitional and marine). In addition, the recommended standards for hazardous substances in groundwater (UKTAG November 2013, amended January 2014, Table 13, Column 2) are also used where appropriate.

DWS are given in the Water Supply Regulations 2010 (which amends to Water Quality (Water Supply) Regulations 2000, Schedule 1, Table B, Part 1 (Directive requirements) and Part 2 (national requirements)). Where no UK or EU drinking water standard exists, reference is made to the World Health Organization (2011).

The list of EQS for priority substances is published in Directive 2013/39/EU. In addition, each Member State has to define country-specific substances and their EQS (river basin specific pollutants). Those adopted by the UK listed by Defra and Welsh Government (May 2014) and the 2015 Directions. These documents form the basis for the DWS and EQS used in this report.

It is noted that the EQS for iron in *Water Framework Directive implementation in England and Wales: new and updated standards to protect the water environment* is given in Table 5.2a as 1 µg/l. The 'standard status' in that table is listed as an existing standard. However, the existing standard was 1 mg/l (i.e. 1000 µg/l) and the tabulated value appears to be an error. This has been carried forward to the 2015 Directions. Consequently, Hydrock continues to use 1000 µg/l in its assessments.

Several EQS are based on bioavailable metal proportions (i.e. copper, lead, manganese, nickel and zinc). For zinc, this is the concentration in excess of the ambient background concentration (ABC). A software tool (M-BAT) is available from the Water Framework Directive - UK TAG web site for calculating the bioavailable fraction of Cu, Mn, Ni and Zn, but not Pb, and it also lists regional ABC values (WFD-UKTAG July 2014). Use of the tool requires knowledge of certain determinants of the receiving waters. Consequently, unless otherwise stated in the report text, this modelling has not been used in Hydrock's initial screening exercise and so an assessment based on the total dissolved metal concentrations will be conservative and a further level of risk assessment may be required.

Where this tool has been used, the bioavailability has been taken into account by calculating site-specific $PNEC_{dissolved}$ (Predicted No Effect Concentration) values. These enable the dissolved concentration data to be compared with the PNEC as if it were an EQS.

The WFD imposes a duty on the Agencies to classify surface water and groundwater bodies and to ensure long-term improvement (where necessary) to achieve acceptable standards. Threshold Values (TV) for individual groundwater bodies (GWB) are published. Each GWB has been identified by the Agencies and specific TVs calculated based on the perceived risks to that GWB. Failure of a TV is an indicator of potential adverse impact in specific circumstances. These TVs are not intended to be applied to meet the 'prevent or limit' objective of the Agencies (UKTAG September 2008) and are not to be used as part of specific site investigations (The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015) and they are not used by Hydrock in this report.

Generic criteria for contaminated soils which might result in groundwater contamination can be derived from generic assumptions using the Environment Agency (2006) Remedial Targets Methodology. A tiered approach is detailed in this document. In accordance with CLR 11, EQS and DWS can be used as generic water quality targets with respect to contamination of controlled waters.

It is clearly not cost-effective to analyse every water sample for all determinands. Hydrock has produced a default *de minimus* suite which includes a number of common water quality indicators plus a selection of the more common chemicals of potential concern, drawn from the lists of Specific Pollutants and Priority Substances / Priority Hazardous Substances plus additional common contaminants listed in the EPA-H1 Part 2 document, as being indicators of Good water quality under the terms of the Directive.

In addition to this, Hydrock will add to this list any chemicals identified as potential risks by reference to the conceptual site model.

Using the WQTs discussed above, the risks to groundwater and surface water from contaminants on site have been assessed according to the remedial targets methodology (RTM) prescribed by the Environment Agency (2006a).

The Level 1 soil zone assessment considers whether the contaminant concentrations in the soil moisture are sufficient to impact the water receptor(s). It is a conservative model and compares soil pore water concentrations with the above criteria, taking no account of dilution, dispersion or attenuation. Pore water concentrations can be estimated by analysis of perched water samples, analysis of eluates produced in the laboratory by standard leaching of soil samples, or by calculation from physico-chemical properties of the substances. Calculation may be more appropriate for poorly soluble substances where retention times may not be long enough during the standard leaching tests to reach equilibrium. However, the Environment Agency (2009d) cautions that the use of published k_d values to calculate pore water concentrations "can lead to a conservative estimate of risk" and suggest that leaching tests may be designed for non-volatile organics using BS 18772:2008.

The Level 2 groundwater assessment is applicable where groundwater quality data are available and compares these with the above criteria, again taking no account of dilution, dispersion or attenuation.

The remedial targets methodology also allows for more detailed assessment (soil Level 2, 3 or 4, or groundwater Level 3 or 4) for substances which fail the above-mentioned assessments. These are progressively more complex assessments and do take into account attenuation and/or dilution, as applicable to the conceptual exposure model. Such assessment is beyond the scope of this report.

Where more than one water quality target is available it is important to apply the one relevant to the critical receptor. The DWS apply to groundwater or to surface water used for abstraction and the EQS apply to surface water where the aquatic ecosystem is the receptor. EQS are available for *inland* surface waters (freshwater) and *other* surface waters (transitional and marine). Where the most appropriate water quality target cannot be determined with certainty, the lowest one is adopted in line with the precautionary principle.

For the purposes of this report, the site data are compared with the various targets as set out in Table 3.9

Table 3.9: Summary of Water Quality Risk Assessment Protocol

Scenario	**Water body Receptors**	**Secondary Receptors**	**Example Contaminant Linkages**	**RTM Level and Samples Used (if Available)**	**Water Quality Targets**
A	Groundwater.	Human health (abstraction).	Contaminants from site leach or seep into groundwater body and this is a (potential/actual) source of human consumption or a strategic resource.	RTM Level 2 - Groundwater. RTM Level 1 - Soil leachate (including any calculated pore water concentrations) or pore water.	DWS
A	Groundwater. Surface water.	Human health (abstraction).	Contaminants from site leach or seep into groundwater body and this feeds surface water by base flow. The surface water may be used for human consumption.		DWS
B	Groundwater. Surface water.	Aquatic ecosystem.	Contaminants from site leach or seep into groundwater body and this feeds surface water by base flow. The surface water may be an aquatic ecosystem.		EQS (inland)
C	Groundwater. Surface water.	Aquatic ecosystem.	Contaminants from site leach or seep into groundwater body and this feeds surface water by base flow. The surface water may be an aquatic ecosystem.		EQS (other)
D	Groundwater. Surface water.	Human health (abstraction). Aquatic ecosystem.	Contaminants from site leach or seep into groundwater body and this feeds surface water by base flow. The surface water may be used for human consumption and is an aquatic ecosystem.		DWS EQS (inland)

Scenario	Water body Receptors	Secondary Receptors	Example Contaminant Linkages	RTM Level and Samples Used (if Available)	Water Quality Targets
E	Surface water.	Human health (abstraction).	Contaminants from site leach or seep into surface water which may be used for human consumption.	RTM Level 1 - Soil leachate (including any calculated pore water concentrations) or pore water. Although not part of the RTM, these scenarios are used to compare surface water data to the water quality targets.	DWS
F	Surface water.	Aquatic ecosystem.	Contaminants from site leach or seep into surface water which may be an aquatic ecosystem.		EQS (inland)
G	Surface water.	Aquatic ecosystem.	Contaminants from site leach or seep into surface water which may be an aquatic ecosystem.		EQS (other)
H	Surface water.	Human health (abstraction). Aquatic ecosystem.	Contaminants from site leach or seep into surface water which may be used for human consumption and is an aquatic ecosystem.		DWS EQS (inland)

Notes:
Some EQS are water hardness dependent. This is measured either in the receiving water or in groundwater (if it is part of the pathway), or is estimated from national maps.
Inland waters EQS applicable to freshwater, other waters EQS applicable to marine or transitional waters.
Where both DWS and EQS are applicable, it is assumed that the EQS is for inland waters.
This table and the results of the assessment are considered as a first screening for potential risks of pollution of Controlled Waters. More specific requirements may be stipulated by the Environment Agency.

Note that in some instances the reporting limit (or detection limit) quoted by the laboratory may be greater than the water quality target that it is being assessed against. Where this is the case it is noted in the table. The current exercise is an initial screening assessment.

There are three main possible reasons for this. Firstly, it may be that the ‘standard’ method gives a relatively higher reporting limit, but that a lower one could be obtained using a more specialised technique. However, it would be disproportionately expensive to adopt the more costly specialist technique for this initial screening exercise. Secondly, it may be that the sample in question was not ‘clean’ because the matrix was contaminated by other substances which interfere with the analysis and so a less sensitive method has been used to protect the laboratory equipment. Thirdly, it may be that no method exists that can reach the required limit. Hydrock has contacted the Environment Agency’s own National Laboratory Service and even they cannot reach low enough limits for several of the substances in the Hydrock default suite (Cr(VI), total cyanide, phenols and certain PAHs). Consequently, and depending on the particular chemicals, it may be possible with additional effort to refine the assessment, or it may be the case that it is not possible to say for certainty because suitable techniques are not available. Methods are being continually updated and new ones may become available.

The problem is compounded when EQS are revised downwards (eg the PAHs in 2013/39/EU Annex II) on the basis of toxicology, but laboratory techniques have yet to catch up. Indeed, the Directive acknowledges this in the revised Article 3b and where it states “... measurement, when carried out using the best available technique not entailing excessive costs, is referred to as “less than limit of quantification”, and the limit of quantification of that technique is above the EQS, the result for the substance being measured shall not be considered for the purposes of assessing the overall chemical status of that water body.”

In some cases all samples are below the detection limit but above the water quality target. It is not possible to make any judgement about these. However, in other cases, even though the detection limit is greater than the water quality target, some sample results do exceed the target.

3.14.1 Petroleum Hydrocarbons in Water

With respect to hydrocarbons in water, the Water Supply (Water Quality) Regulations 1989 (as amended 1999) contained a prescribed concentration of 10 µg/l for "dissolved or emulsified hydrocarbons (after extraction with petroleum ether); mineral oils". This was removed from the 2000 (consolidated 2007) Regulations. It was confirmed by email from the Drinking Water Inspectorate to Hydrock (1 November 2005) that dissolved hydrocarbons are no longer a prescribed substance under the Regulations. However, the 10 µg/l limit did remain in the Private Drinking Water Regulations 1991 until their revision at the end of 2009.

In the absence of a prescribed concentration for drinking water, many Environment Agency officers continue to use the superseded value. This is perhaps because petroleum hydrocarbons are a hazardous substance (former List 1) under the WFD. There is, however, no clear UK policy on hydrocarbon contamination of controlled waters. This is partly because analyses for 'petroleum hydrocarbons' are fraught with complications concerning false positives, the results being method dependent and not restricted to petroleum products.

Guidance written by the Environment Agency on risk assessment of hydrocarbons in groundwater is dated 2009 but has never been officially released through the Agency's website, although the dissemination status of the document is given as publicly available. This gives a table of water quality targets for hydrocarbons and lists "TPH (dissolved or emulsified hydrocarbons)". No minimum reporting value (MRV) is quoted, the value that would equate to a *de minimus* concentration under the prevention objective. The target of 10 µg/l is given and this is described as coming from the "Private Water Supply Regulations 1991 No. 2790 (due to be updated in 2009)". As mentioned above, the 2009 Regulations no longer list dissolved hydrocarbons.

Furthermore, the guidance also states that in cases where petroleum hydrocarbons have already entered the water, the Agency will regulate under its limit objective, rather than the prevention objective. This means that EQS or DWS will be appropriate. However, none exist.

In the absence of definitive guidance on petroleum hydrocarbons in water Hydrock recognises that it is not possible to provide EQS and so regulation with respect to aquatic ecosystems is impossible. However, it is possible to extend the use of DWS by calculating screening criteria for the speciated TPH fractions. This provides a rational, transparent and risk-based approach using established scientific principles, rather than simply adopting a withdrawn standard.

Whilst not strictly applicable to aquatic ecosystems, at least this approach can help inform the judgement as to the degree of degradation of a water body.

Accordingly Hydrock has calculated guidelines for drinking water quality based on the methodology proposed by the World Health Organisation (WHO, 2005). This is based on an adult consuming 2 litres of water per day. Whereas the WHO document assumes a body weight of 60kg, Hydrock has assumed 70kg in keeping with the UK Contaminated Land CLEA methodology.

A conservative allocation of 10% of the oral Tolerable Daily Intake (TDI) has been attributed to intake from drinking water. It is noted by the WHO (2005) that exposure from other sources would be expected to be very small and that it would be possible to allocate a greater percentage to drinking water if required. In other words, this approach is very conservative and is appropriate as an initial screening value and allows for potential additive toxicity and simultaneous exposure from other sources.

The TDIs used are the same as those used in the derivation of soil GACs and are listed in Table 3.10 along with the calculated health-based water quality targets for drinking water. Note, however, that the Environment Agency (2009d) states that when considering carbon bands, one does not know the range of toxicities and health effects of the individual chemicals, and it is precautionary to assume that the toxicological effects are additive when setting water quality targets even though the toxic endpoints and modes of action might in reality be quite different. The recommendation is to adopt a precautionary approach whereby the water quality target for each band is divided by the number of bands with detected concentrations.

Table 3.10: Calculated Water Quality Targets for Petroleum Hydrocarbons in Drinking Water

Determinand	TDI (µg/kg/day)	Solubility (µg/l)	Water Quality Target (see Note 1) (µg/l)	Notes
Ali EC5-EC6	5000	35900	**17500**[1]	
Ali >EC6-EC8	5000	5370	**17500**[1]	This concentration would be significantly above the solubility in water.
Ali >EC8-EC10	100	427	**350**[1]	
Ali >EC10-EC12	100	33.9	**350**[1]	This concentration would be significantly above the solubility in water.
Ali >EC12-EC16	100	0.759	**350**[1]	This concentration would be significantly above the solubility in water.
Ali >EC16-EC44	2000	0.00254	**7000**[1]	This concentration would be significantly above the solubility in water.
Aro EC5-EC7	223	1780000	**1**[1]	Based on the TDI for toluene as recommended by Environment Agency (2005) P5-080/TR3 gives 780. In reality the UK DWS for benzene = **1** takes precedence.
Aro >EC7-EC8	223	590000	**700**[1]	Calculated as 780, WHO DWS = **700** takes precedence.
Aro >EC8-EC10	40	64600	**140**[1]	
Aro >EC10-EC12	40	24500	**140**[1]	
Aro > EC12-EC16	40	5750	**140**[1]	
Aro >EC16-EC21	30	653	**105**[1]	
Aro >EC21-EC44	30	6.61	**105**[1]	This concentration would be significantly above the solubility in water.
Benzene	n/a	1780000	**1**	Calculation not possible as non-threshold substance, UK DWS = **1** takes precedence.
Toluene	223	590000	**700**	Calculated as 780, WHO DWS = **700** takes precedence.
Ethylbenzene	100	180000	**300**	Calculated as 350, WHO DWS = **300** takes precedence.
Xylene	180	200000	**500**	Calculated as 630, WHO DWS = **500** takes precedence.
MTBE	300	48000000	**15**	Calculated as 1050 so the odour threshold = **15** is adopted.

Determinand	TDI (µg/kg/day)	Solubility (µg/l)	Water Quality Target (see Note 1) (µg/l)	Notes
Note 1: The value to be used in a risk assessment (for carbon bands) is the value in the table divided by the number of bands with detected concentrations. Last updated 29/06/10				

In instances where a simple 'total' TPH is reported for water samples this should be considered indicative only. This is particularly the case if groundwater or surface water samples were not available and an indication of pore water quality has been derived by subjecting soil samples to a standard leaching procedure or calculation.

Where petroleum hydrocarbon contamination of Controlled Waters is suspected, Hydrock recommends that discussion with the Environment Agency is entered into at the earliest opportunity.

3.15 Statistical Tests of Soil Contamination Results

As discussed above, the sample analyses are divided into representative data sets for the assessment, based on the conceptual site model, and are referred to as 'averaging areas'. In this case it has been chosen to characterize materials that are likely to form the ground cover in critical receptor areas (e.g. gardens), on a material by material basis. The critical part of the soil column is the upper metre in terms of contact with end users of a development site.

Under the **land use planning system** where the aim is to demonstrate 'suitability for use' the key question will usually be "can we say confidently that the level of contamination of this land is low relative to some appropriate measure of risk, sometimes referred to as the critical concentration?" The critical concentration can be, for example, the relevant GAC.

It is necessary to demonstrate that (for each contaminant) the mean concentration on the site is **below** the critical concentration. The true mean concentration of a contaminant is not known because all the site soil has not been tested. An estimation of the true mean can be obtained from the samples tested during the investigation. The greater the number of samples tested, the closer the mean of these values is to the true mean.

In practice, this involves calculation of a quantity known as the 95th Upper Confidence Limit (UCL) of the true population mean, also known as the US_{95}. This is the estimate of the true mean at a 95% level of confidence (i.e. there is a 95% probability that the true mean will not be greater than this, given the values obtained from the investigation sample testing).

The statistical test that is carried out, therefore, is used to demonstrate that there is a 95% probability that the true mean falls below critical concentration (typically the GAC in a screening exercise).

In statistical language, a **null hypothesis** is stated; that the level of contamination is the same as, or higher than, the critical concentration. The **alternative hypothesis** is that the level of contamination is lower than the critical concentration. The statistical test is used to decide whether or not the null hypothesis is rejected.

If it is rejected, the assessor can conclude that the alternative hypothesis is more likely to be true, i.e. that contaminant concentrations are low relative to the critical concentration and that, potentially, the land is suitable for use. Conversely, if the null hypothesis is not rejected, the assessor should conclude that contaminant concentrations may be the same as, or higher than, the critical concentration and further measures may be needed.

A useful summary of the methodology is provided by CIEH & CL:AIRE (May 2008), which forms the basis for the approach adopted by Hydrock, and is described below. Appendix I of the C4SL report SP1010 (CL:AIRE, December 2013) contains a review of this methodology.

Firstly, the data set is assessed for outliers and normality. This is mainly a visual exercise rather than following a particular statistical method. Two graphs are considered, the data frequency histogram with a normal 'bell curve' for comparison and a quantlie-quantile (q-q) plot. The closer the data points lie to the 45° line, the closer they are to a normal distribution. Kinks in the q-q plot are indicative of more than one data set. Individual points away from the 45° line are indicative of outliers.

Additional evidence of outliers is obtained through a simple method of robust statistics advocated by the Royal Society of Chemistry (2001) and others. The measure of the mean is taken to be the median value because this is less susceptible to outliers and non-normal data sets. A value known as the mean absolute deviation (MAD) is calculated and from this can be calculated a robust standard deviation estimate by multiplying by 1.483.

A z-score can then be calculated, which is the absolute value of the data value minus the median, divided by the robust standard deviation. This is then compared with a critical value which, if exceeded, suggests a possible outlier. The critical value represents the number of standard deviations from the mean (or in this case the median). A critical value of 3 to 3.5 is generally considered appropriate. The attraction of this approach is that it is a robust, non-parametric method suitable for all data sets. It is not considered as definitive, but merely a tool to aid decision making.

If a potential outlier is identified it could be a laboratory or typographic error. If this is not the case it could be representative of a different contaminative incident and, therefore, be a hot-spot. However, it could also be simply the result of heterogeneous ground conditions and a relatively low number of sampling points. The initial review of the data is then coupled to a knowledge of the conceptual site model before an outlier is removed from the data set. A good reason is required to justify the removal of outliers and this will be reported in the text.

The second stage of the assessment is to carry out the statistical test as described previously. Two alternative methods are highlighted in the CIEH/CL:AIRE document. The one-sample t-test is said to be appropriate for normally distributed data (it is a parametric test) but is not sensitive to moderate departures from normality. The Chebychev Theorem is a non-parametric test which is said to be suitable for all data distributions. It is a less powerful test (statistically) and gives a more cautious result than the t-test because there is less certainty about the shape of the distribution.

The CL:AIRE review of 2013 considers the use of the t-test in more detail and states that if enough samples have been taken the distribution that describes the uncertainty about the mean depends only on the mean concentration and the size of between-location variation (as measured by the observed standard deviation, not the shape of the variation. The review goes on to say that in certain circumstances, the use of the Chebychev Theorem may be unsound and suggests the use of statistical tests not based on the null hypothesis test.

The method of determining when there are enough samples to be able to use the t-test is based on the condition that the relative standard error (RSE) is less than 0.25. The RSE is calculated from the relative standard deviation (RSD) by dividing my the square root of the number of samples. The RSD is the standard deviation divided by the mean. The number of samples required for an unbiased estimate of the average concentration are listed in Table 2 of Appendix I of SP1010, for various values of RSD and based on RSE of 0.25. The number of samples required and the RSE are calculated for each chemical on the Hydrock statistics spreadsheet and a note appears as to whether or not the t-test is applicable on this basis.

The risk assessor ultimately decides, based on all the evidence, whether to use the t-test (by selecting the data as being treated as normally distributed) or the Chebychev Theorem (data treated as non-normal). The chosen method is applied and the outcome recorded with respect to whether or not the null hypothesis is rejected and the site is potentially suitable for use.

Please note that under certain circumstances a ‘divided by 0’ error can occur in the spreadsheets used in the statistical analyses. This happens when all the data points are the same integer value, for example where all results are <3 mg/kg and they have been assumed to be 3 mg/kg. To prevent this error, one of the results can be altered by a small amount (e.g. 3 becomes 2.99999). This allows the statistical tests to be carried out but makes no difference to the outcome. However, it does mean that the q-q and histogram plots show a spurious point, which should be ignored.

It should be noted that a similar, but opposite, set of propositions applies in the case of a potential Part 2A determination where the level of contamination must be higher than some appropriate level of risk (critical concentration) (e.g. that indicative of SPOSH). In this case, however, a lower standard of proof may be accepted and the guidance suggests that if the statistical test of significance at the 95% confidence level does not indicate rejection of the null hypothesis, then the test should be repeated at the 51% level to see if there is evidence to suggest the null hypothesis be rejected on the balance of probabilities. Where no SPOSH concentrations are available and, say C4SLs, are being used as a low-level screen under Part 2A, the same approach as for the planning regime is appropriate.

When considering potential Part 2A sites, updated guidance published by Barnes *et al* (2010) recommends the t-test for all data sets where exceedance of a critical concentration is being tested (unless the data are negatively skewed, something these authors have never seen in contaminated land data sets).

3.15.1 Note on Clustered Data Sets

The assumption behind the statistical tests is that each sample represents an equal fraction of the averaging area (Nathanail, 2004). If the data are clustered, i.e. the sampling points are not equally spaced, the calculated US_{95} would be too high if targeted sampling has taken place around suspected high concentration areas to determine the extent of the high contamination. Conversely, the calculated US_{95} would be too low if there is a high density of sampling in an area of low contaminant concentration.

The sampling pattern used in this report has been reviewed to determine if clustering of data points is likely to affect the statistical tests significantly. In cases where the area represented by each sample is judged to be similar, the tests have been carried out without modification. The error in this approach is likely to be conservative to human health because the Hydrock approach to targeted sampling is more likely to produce more closely spaced higher concentrations than more closely spaced lower concentrations.

Erring on the conservative side is, however, counter-productive when it would indicate unnecessary remediation, i.e. remediation triggered by a US_{95} which is skewed by clustered data. This is taken into consideration in the risk evaluation part of the risk assessment exercise and can take the form of professional judgement, the modification of the averaging area datasets to decluster them, or the weighting of sample results to decluster the data set. The latter method involves weighting the measured concentrations according the proportion of the area they represent, giving greater weight to samples representative of a larger area.

3.15.2 Statistical Tests and Risk to Controlled Waters

Where only a few water quality tests are available, the maximum concentrations are compared with the standards because the 95 percentile will be close to the maximum value. However, where a larger population is available, the 95 percentile is compared with the standards, as recommended by the Environment Agency.

3.16 Ground Gas Risk Assessment

The permanent ground gases methane (CH_4) and carbon dioxide (CO_2) are monitored in accordance with the principles of BS 8576:2013 and the site records are reported in an appendix. Instrument calibration records are kept in accordance with Hydrock's in-house protocol for ground gas monitoring.

The risks associated with the methane and carbon dioxide are assessed using BS 8485:2015 and guidelines from CIRIA (Wilson *et al* 2007), the NHBC (Boyle and Witherington 2007) and CL:AIRE RB17 (Card *et al* 2012).

In the above guidance, 'Situation B' is defined as the specific development of low-rise (1 or 2 storey) housing with beam and block floors, vented sub-floor void and gardens. Initial risk classification can be made according to NHBC Table 8.1. This determines the appropriate risk strategy for protection, including the need to progress to generic quantitative risk assessment (GQRA). Even where no risk assessment is recommended by this table, one may be carried out if so desired. The GQRA is known as the 'NHBC traffic light classification' as it uses red, amber and green designations to portray levels of risk.

'Situation A' covers all other forms of development. This uses a modified version of the Wilson and Card (1999) methodology.

The idealised frequency of monitoring is suggested in CIRIA Tables 5.5a and 5.5b. These tables are adapted from Wilson and Haines (2005) Table 3 which gives examples of ground conditions with the various gas generation potentials, ranging from inert Made Ground (very low potential) to post 1960s domestic landfill (very high potential).

The report does not constitute a design for gas protection measures, but lists the recommendations given by the above-mentioned guidance for the particular "Situation" considered relevant. Reference should be made to BS 8485:2015 which provides guidance for the design, based on a system of scoring depending on the type of building, the type of structural barrier, ventilation protection measures and the gas membrane. The design of gas protection measures according to BS 8485:2015 requires the building(s), or different parts thereof, to be categorized into one of four building types: Type A, Type B, Type C or Type D. This is because the construction and use of the building, together with the control of future structural changes to the building and its maintenance (the building's management) should be assessed, since potential risks posed by ground gases are strongly influenced by these factors. Note that if a membrane is installed it must be verified in accordance with CIRIA C735 (Mallet *et al* 2014) or it will score zero points and will not be deemed to afford any protection.

CL:AIRE RB17 (Card *et al* 2012) is a pragmatic approach to ground gas risk assessment and was developed because gas concentration, pressure and flow rate measured in a well headspace may not be representative of the conditions in the surrounding formation. This approach is endorsed in BS 8485:2015. This is particularly the case where landfill or mine gases are not present, but there is scope for gas generation from Made Ground or naturally occurring organic matter in the soil. If generation rates are low, relatively high concentrations may be present in the soil pores but there is no driving force to expel gases at sufficiently high fluxes so as to represent a risk by entering enclosed living spaces.

In these low risk situations, the approach is to use the conceptual site model and the estimation of the likely gas generation from a source to identify:

- where gas monitoring is required to better define the risks;
- where it may be appropriate to reduce the period of monitoring required (or avoid extra monitoring in response to anomalous results); or
- gas protection measures where the total organic content (TOC) is not greater than 6%.

In summary:

Natural soils only with no credible methane source:

- no action required (monitoring or gas protection measures) as this represents Characteristic Situation 1 (CS1).

Natural soils with peat/organic alluvium or Made Ground with low organic content and a radon barrier is being provided:

- no action required (monitoring or gas protection measures).

Natural soils with peat/organic alluvium or Made Ground with low organic content and a radon barrier is *not* being provided:

- no gas monitoring required;
- if peat/organic alluvium is present this represents CS2 (note Table A1 in RB17 reads CS3 and this is an error according to Wilson (pers. Comm.);

- if Made Ground is present, is less than 1 m thick and is inert material such as sub-base of mineral soils no gas protection is required as this represents CS1;
- if Made Ground is present, is less than 5 m (maximum) and less than 3 m (average) thick determine TOC and forensic description (Table 3.11) and Characteristic Situation (and hence gas protection measures) (Table 3.12);
- if Made Ground is present, is greater than 5 m thick (for example and 'old refuse tip' on the Ordnance Survey map) determine Characteristic Situation (and hence gas protection measures) from TOC with forensic description plus gas generation modelling and gas monitoring to provide a lines of evidence approach. The findings of the TOC and gas modelling may mean gas monitoring for a period shorter than recommended by CIRIA.

Table 3.11: TOC and Forensic Description

Made Ground Fraction	TOC (%)
Fine soil <10mm organic	Laboratory test for TOC
Fine soil <10mm inorganic	Zero (inert) or confirm TOC with lab test
Coarse inert – clinker, gravel, concrete, brick etc.	Zero (inert)
Wood, trees, branches etc.	57 (=IPCC (2006) DOC of 43% x 1.33 according to Hesse (1971))
Vegetable matter	27 (=IPCC (2006) DOC of 20% x 1.33 according to Hesse (1971))
Metal, glass, ceramic and other inert matter	Zero (inert)
Paper and card	53 (=IPCC (2006) DOC of 40% x 1.33 according to Hesse (1971))
Other degradable matter	Food: 20 (=IPCC (2006) DOC of 15% x 1.33 according to Hesse (1971) Nappies: 32 (=IPCC (2006) DOC of 24% x 1.33 according to Hesse (1971) Construction / demolition waste: 5 (=IPCC (2006) DOC of 4% x 1.33 according to Hesse (1971)
Cloth and leather	32 (=IPCC (2006) DOC of 24% x 1.33 according to Hesse (1971))
Total TOC for the sample	**Weighted average of above based on mass of fractions**

Table 3.12: Characteristic Situation Based on TOC of Made Ground Maximum 5 m Thick, Average 3 m Thick

Maximum TOC (%) Made Ground in Place for 20 years or Less	Maximum TOC (%) Made Ground in Place for More Than 20 years	Characteristic Situation (CIRIA C665)
≤ 1.0	≤ 1.0	CS1
≤ 1.5	≤ 3.0	CS2
≤ 4.0	≤ 6.0	CS3
Not applicable for >CS3. Gas monitoring required if TOC > 4% (or 6% in old Made Ground)		

In a scenario where Made Ground is greater than 5 m thick the gas generation potential can be calculated according to the equation on page 10 of RB17, but ignoring the summation as no iteration is required if no new Made Ground is placed every year (Wilson, pers. comm.). The equation comes from LTGN03 (Environment Agency 2004c) and was originally developed to calculate the gas generation potential of landfill sites based on iterations representing the amount of waste deposited year by year. The rate constants (half-life) Hydrock uses as default are the fast, medium and slow degradation waste types from LTGN03 (viz 0.185/yr, 0.1/yr and 0.03/yr, respectively).

The result of the above calculation is assumed to represent the surface emission rate from a given area and mass of degradable Made Ground. This can be converted into a borehole emission rate (rounded up to the nearest 0.5%) for comparison with CIRIA C665 by assuming one borehole is equivalent to 10 m^2 of ground surface (Pecksen 1986).

Furthermore, the above calculated surface emission rate can be used with the equations from the NHBC Appendix F (Boyle and Witherington 2007) to estimate gas content in as house and compare this with the permissible concentrations.

4.0 WATER SUPPLY PIPES

The current guidance on selection of materials for potable water supply pipes to be laid in contaminated land is contained in a document published jointly by Water UK and the Home Builders Federation (Water UK HBF 2014). The protocols in that document are for guidance and are not subject to enforcement by Water UK or any agency, but have been adopted by Water UK and by HBF as best practice for their members. It has been produced to replace the guidance published by UK Water Industry Research (UKWIR) (Report 10/WM/03/02 and reissued in 2010), which came under criticism from contaminated land specialists. Accordingly this guidance is used in the following assessment.

The contaminants are divided into a number of 'parameter groups'. Threshold values for a selection of organic contaminants that may have a detrimental effect on pipes and fittings, together with threshold values for certain parameters that could cause corrosion of metal pipes, are presented.

It is generally accepted that the UKWIR document contains a number of technical errors and inconsistencies and was not universally accepted (AGS June 2014). The Water UK guidance document states that UKWIR Tables 3.1 and G1 are "not considered a definitive guide" and replaces these with its own Table 1 which clarifies the guidance. This is reproduced as within Table 4.1 below and although not stated in the document, it is assumed the units are mg/kg.

With respect to VOCs it is not clear whether or not BTEX and MTBE are to be included within the total VOC category. They appear in the USEPA method 8260C list of priority pollutants, but the text does not say to exclude them from the VOC total even though there is a separate group for BTEX and MTBE. The text does specifically exclude certain sub-sets of the SVOC list and so Hydrock has taken the guidance at face value and includes BTEX and MTBE in the VOC total.

Table 4.1: Water UK Threshold Values for Water Pipes

Parameter Group	Testing Required?	PE Pipe Threshold (mg/kg)	Metal or Barrier Pipe Threshold
Total VOC Sum of all USEPA 8260C VOC >10ug/kg and TIC >20ug/kg	Where preliminary risk assessment has identified land potentially affected by contamination	0.5	No limit
Total BTEX and MTBE		0.1	No limit
Total SVOC Sum of all USEPA 8270D SVOC >10ug/kg and TIC >20ug/kg but excluding PAH and those substances marked with an asterisk below.		2	No limit
TPH >EC5-EC10		2	No limit

Parameter Group	Testing Required?	PE Pipe Threshold (mg/kg)	Metal or Barrier Pipe Threshold
TPH >EC10-EC16		10	No limit
TPH >EC16-EC40		500	No limit
Phenols* from SVOC analysis		2	No limit
Cresols* and chlorinated phenols* from SVOC analysis		2	No limit
Ethers*		0.5	No limit
Nitrobenzene*		0.5	No limit
Ketones*	Only where identified from former land use	0.5	No limit
Aldehydes*		0.5	No limit
Amines*		Nothing >LoD	No limit
Corrosive indicators, pH, conductivity EC and redox potential Eh	Where metal pipes are contemplated	No limit	Wrapped steel: corrosive if pH<7 and EC>400uS/cm. Wrapped ductile iron corrosive if pH<5, Eh not neutral and EC>400uS/cm. Copper: corrosive if pH<5 or >* and Eh positive.
Presence of liquid free phase hydrocarbons	Observation	None allowed	None allowed

Within the guidance the soil tested must be representative of that in which the pipes will be laid, be it existing ground, remediated ground or imported soil, and should be sampled to at least 0.5 m below the underside of the pipe and along the pipe runs with sufficient number of samples to satisfy sampling strategies set out in CLR 4, CRL 11 and P5-066/TR. Following this, the data are to be incorporated into a specified risk assessment methodology.

Note that, unless stated otherwise, the Hydrock report does not constitute a formal water pipe risk assessment. Rather, the findings of the standard site investigation are screened against the threshold values in Table 4.1 insofar as is practicable given the data availability to give an indication of the possible restrictions to the use of plastic water pipes.

Note that the use of barrier pipe (PE-Al-PE) is applicable for all brownfield sites according to the guidelines, unless there are liquid free phase hydrocarbons present.

Note also that the Water UK guidance also includes greenfield sites where the preliminary risk assessment indicates there is a potential for contamination to be present.

The Water UK guidance above concentrates on direct contact of pipes with contaminated soil. It also refers to contact with excessive vapour phase and contaminated groundwater, but does not define either of these nor give any threshold concentrations.

The guidance also cautions against the creation of new pathways during construction, mainly the ability of contaminated groundwater to flow into granular pipe bedding.

It is **strongly recommended** that site-specific approval of the materials for underground pipes to be used for water supply be obtained from the water company that will be supplying this site and/or adopting the pipe work.

5.0 FLOOD RISK

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6.0 WASTE MANAGEMENT

6.1 Introduction

Any material excavated on site may be classified as waste and it is the responsibility of the holder of a material to form their own view on whether or not it is waste. This includes determining when waste that has been treated in some way can cease to be classed as waste for a particular purpose.

One of the ways this can be achieved is set out in the Development Industry Code of Practice (CoP) (CL:AIRE, March 2011). This builds on the Environment Agency guidance document Definition of waste: developing greenfield and brownfield sites (2006b).

The handling, re-use or disposal of waste is regulated by the Environment Agency. The Agency will take into account the use of the CoP in deciding whether to regulate materials as waste. If materials are dealt with in accordance with the CoP, the Agency considers that those materials are unlikely to be waste at the point when they are to be used for the purpose of land development. This may be because the materials were never discarded in the first place, or because they have been submitted to a recovery operation and have been completely recovered so that they have ceased to be waste.

Further details are provided in the CoP.

The chemical analyses in this report were scheduled for the purposes of risk assessment with respect to human health, plant life and controlled waters as discussed in the report. Whilst the results may be useful in applying the Hazardous Waste Assessment Methodology given in Environment Agency Technical Guidance WM3, they are not primarily intended for that purpose and additional analysis may be required should waste classification be required for consideration of off-site disposal of contaminated soils. As part of the report, Hydrock may have undertaken a preliminary exercise to characterise the soils encountered in the investigation in order to inform the waste characterisation process. This has been undertaken using a proprietary web-based tool and in not necessarily identical to the assessment that could be made by a particular landfill operator.

Separate analyses are required to meet the Waste Acceptance Criteria for specific landfill sites.

6.2 Classification of Materials for Off-Site Disposal Purposes

With respect to the possible waste streams from a site, it is recommended that a phased approach is implemented. This phased approach comprises Waste Characterisation and Waste Acceptance Criteria.

6.2.1 Waste Characterisation

Background

All wastes going to landfill must be classified as ‘inert’, ‘non-hazardous’ or ‘hazardous’, with a sub-category of hazardous waste known as ‘stable non-reactive hazardous waste’. Individual landfill sites must operate in accordance with their Environmental Permits.

Basic Characterisation

The first step is to determine if a waste is hazardous or non-hazardous.

Contaminated soil is a 'mirror entry' in the Consolidated European Waste Catalogue, and is not necessarily a hazardous waste. It is only classified as hazardous if it contains dangerous substances above certain threshold concentrations. The Environment Agency document *Waste Sampling and Testing for Disposal to Landfill* (March 2013) suggests that waste holders should use the information collected as part of the contaminated land risk assessment to inform decisions as to the concentrations that might reasonably be expected to be present in the contaminated soil, given the past and current uses of the site.

The waste must be assessed against all the appropriate hazards in accordance with the Environment Agency Technical Guidance WM3. This makes certain worst case assumptions about the chemical composition if specific compounds are not analysed for.

The classification of the soils as waste in England and Wales is undertaken in accordance with the revised Waste Framework Directive (WFD) (2008/98/EC).

Defining the class of waste is carried out on the actual waste being disposed of and the destination landfill site will have the final decision on acceptability of the waste. Therefore, it is recommended that if soils are to be removed from the site, the appointed contractor should approach a landfill site with the available chemical data and seek a formal waste characterisation.

The waste characterisation in this report is for information purposes only and should be considered in the light of the final decision made by the landfill site.

6.2.2 Waste Acceptance Criteria

If the waste is destined for landfill, the second step is Waste Acceptance Criteria (WAC) testing to determine if the receiving landfill can accept the waste. Further sampling and testing may be required.

WAC testing must be carried out on waste classified as non-hazardous to check if it can be disposed of at an inert landfill. Otherwise, it can be disposed of at a non-hazardous landfill without WAC testing.

WAC testing must be carried out on waste classified as hazardous to check if it can be disposed of at a hazardous landfill (or in a special stable non-reactive hazardous waste landfill site/cell).

The WAC are a list of limit values for certain parameters obtained from total content tests and standard leaching tests. If the limit values are exceeded, the waste is not suitable for disposal at that class of landfill site and alternative disposal methods have to be found.

Maximum permissible limit values are determined by the EU (part of what is known as 'full waste acceptance criteria') but individual landfills may have more stringent values to take into account the environmental setting, liner system or additional nature of specific waste streams.

WAC tests should be performed on the soils leaving the site and is not normally part of a site investigation exercise.

6.3 Materials Management

Any material excavated on site may be classified as waste and it is the responsibility of the holder of a material to form their own view on whether or not it is waste. This includes determining when waste that has been treated in some way can cease to be classed as waste for a particular purpose. One of the ways this can be achieved is set out in the Development Industry Code of Practice (CoP) (CL:AIRE, March 2011).

The handling, re-use or disposal of waste is regulated by the Environment Agency. The Agency will take into account the use of the CoP in deciding whether to regulate materials as waste. If materials are dealt with in accordance with the CoP, the Agency considers that those materials are unlikely to be waste at the point when they are to be used for the purpose of land development. The MMP must be signed off by a Qualified Person as defined in the CoP.

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Appendix E

Hydrock Methodology

Hydrock desk study report appendix on Hydrock Methodology, version 03 updated 17-08-15 applies to this report.

This appendix may not be included in the printed report to reduce the document size.

It is presented in the PDF version of the report on the CD enclosed with the printed report. Alternatively, it can be supplied on request by quoting the version number and date.