

**GEOTECHNICAL AND GEO-ENVIRONMENTAL
SITE INVESTIGATION REPORT**

BLYTHE STREET, WOMBWELL

FOR

GLEESON DEVELOPMENTS LTD

ISSUE 3



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1.0 EXECUTIVE SUMMARY

1. The approximately 1.1 hectare site comprises open land, mainly covered with scrub grass.
2. Historical maps indicate that the site was formerly occupied by a school which was demolished in the early 1990s when the site was developed with Highfield Grange Residential Home. This was demolished recently.
3. The majority of the site, where the former buildings were located, is relatively level. There is a steep slope in the south of the site, with the southern area being at the higher level, suggesting that regrading of the site took place to accommodate the former developments. The site is also elevated in the north eastern corner.
4. The geological map shows that the site is underlain by the Oaks Rock Formation sandstone.
5. The geology is classed as a Secondary A Aquifer and the site does not lie within a Groundwater Source Protection Zone.
6. Precautions against the effects of coal mining are not considered necessary.
7. There are no registered landfills within 500 m of the site.
8. No radon precautions are required.
9. The ground conditions generally comprised made ground to depths of between 0.5 m and 1.8 m, but locally up to 2.1 m. The underlying natural ground generally comprised clayey gravelly sand, over sandstone. Clay was locally found in the central north western part of the site.
10. No groundwater was encountered within the trial pits.
11. Consideration will need to be given to the slopes within the site, with regrading and/or retaining required.
12. Conventional strip or trench fill footings onto the natural ground at a minimum depth of 750 mm are proposed. Where in clay, a minimum depth of 900 mm, below existing or finished ground level whichever is the lower, should apply. All foundations need to be extended through made ground and any soft material to competent natural ground. A safe bearing capacity of 150 kN/m² is considered can be assumed for the clayey gravelly sand, however this will increase significantly on the underlying sandstone bedrock. A safe bearing capacity of 125 kN/m² is considered can be assumed for the natural clay found locally.

Foundations within the clay will need to be deepened and constructed in accordance with the NHBC Standards.

13. Infiltration tests suggest soakaways are unlikely to be a viable solution for surface water drainage.
14. DS2, AC2 sulphate precautions are considered appropriate for concrete in contact with the made ground.
15. Elevated polycyclic aromatic hydrocarbons (PAHs) were recorded within the thin layer of topsoil over the made ground in TP1, in the northern part of the site. Further testing did not record elevated concentrations in the vicinity of TP1. Modified means for the elevated contaminants do not exceed their generic assessment concentrations and therefore the topsoil in the northern area is considered to be suitable for reuse. The remaining samples of topsoil, which were from the south and western parts of the site, did not record any elevated concentrations of contaminants and this topsoil is also considered to be suitable. Stripping of the topsoil should be precise and the topsoil should not be mixed with the underlying made ground.
16. Elevated PAHs, copper and lead were recorded in the made ground. The modified means only exceed the generic assessment concentration for two of the PAH compounds and then by less than twice the assessment value. A clean capping, a minimum of 300 mm thick, including at least 100 mm of topsoil, is therefore proposed in gardens and areas of soft landscaping located over made ground.
17. The conclusions made in this report in relation to contamination are subject to agreement by the approving bodies such as the Local Authority and your warranty provider.

2.0 INTRODUCTION

2.1 Terms of Reference

This report presents the findings of a geotechnical and geo-environmental site investigation carried out by Eastwood & Partners (Consulting Engineers) Ltd for, and on the behalf of, Gleeson Developments Ltd. Any other parties using the information in this report do so at their own risk and any duty of care is excluded.

2.2 Context

We have not been made aware of any previous site investigation reports undertaken for this site.

2.3 Aims and Objectives

The aims and objectives of this investigation were as follows:

- Assimilate phase 1 data to derive an outline conceptual model identifying potential contaminants, pathways and receptors, as well as possible linkages between these;
- Obtain information enabling refinement and subsequent testing of the conceptual model;
- Carry out tiered risk assessment to establish the likely risks to future receptors, involving the use of generic assessment criteria and where unacceptable risks are identified, site specific assessment criteria within a detailed quantitative risk assessment;
- Identify feasible remediation options if unacceptable risks are highlighted;
- Develop an appropriate remediation strategy where remediation is required; and
- Detail the ground conditions and their geotechnical properties enabling outline foundation proposals to be made.

2.4 Scope of Investigation

This document is split into two sections. These constitute the findings of the Phase 1 and Phase 2 investigations, consecutively.

2.4.1 Phase 1

The Phase 1 investigation involved a review of information extracted from published documentation as well as that obtained from a site reconnaissance. Information regarding the current and former land uses both on and surrounding the site, as well as the environmental sensitivity of the site

location as determined by factors including geology, hydrogeology and hydrology have been examined.

Information analysed in this section of the report has been obtained from a variety of sources and included the following:

- A Landmark Envirocheck report. This includes historical Ordnance Survey maps, as well as information regarding environmental issues such as abstraction licenses, pollution incidences and waste facilities;
- British Geological Survey maps and memoirs; and
- A Coal Authority mining report

The results of the Phase 1 investigation were used to derive an outline conceptual model from which a preliminary risk assessment was made.

2.4.2 Phase 2

This part of the investigation consisted of intrusive works and laboratory analysis. The findings were used to test the conceptual model and produce a final risk assessment.

The intrusive works comprised trial pits which were excavated to enable:

- Examination of the upper few metres of ground;
- In situ description of soils, enabling any localised lateral and vertical changes in soil conditions to be logged;
- Assessment of any contamination identified using visual and olfactory methods;
- Collection of soil samples for geotechnical and chemical testing; and
- Infiltration tests to be undertaken

2.5 Limitations of Investigation

This report is based on the assumption that the site will be developed with houses, up to three storeys in height, which will be of conventional construction, and that existing ground levels will not alter significantly. If this is not the case, then the advice given in this report may not be appropriate.

Where assessments of site areas affected in particular ways are given, these are approximate. All information, comments and opinions given in this report are based on the ground conditions

encountered during the site work, on the results of laboratory testing carried out as part of the investigation and information gained from a historical, geological and environmental desk study. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata and water conditions between or below investigation points. It should be noted that groundwater and gas levels vary due to seasonal or other effects, and may at times differ from those measured during the investigation.

3.0 THE SITE

3.1 Description

The site has an area of approximately 1.1 hectares and is located at Blythe Street, Wombwell. The site is centred around grid reference 439160, 403510.

The site currently comprises open land and it is mainly covered with scrub grass in the position of the former building of Highfield Grange Residential Home. Limited tarmacadam hardstanding is present in the north western part of the site. The eastern and southern parts of the site are covered with a limited amount of topsoil at the surface.

The majority of the site, where the former buildings were located, is relatively level. There is a steep slope in the south of the site, with the southern area being at the higher level, suggesting that regrading of the site took place to accommodate the former developments. The site is also elevated in the north eastern corner.

Several former and live services are present on site.

The '*Exploratory Hole Location Plan*', drawing 38506/001/B in Appendix 1, shows the features described. Some photographs are also provided in Appendix 1.

3.2 History

Historical maps, obtained as part of the Envirocheck report, have been reviewed to assess the previous use of the site and surrounding area. Copies of the maps are presented in Appendix 2.

3.2.1 The Site

The earliest map reviewed dates from 1854. This shows the site to comprise part of a larger field.

By 1948, a school, later labelled the Wombwell Day Special School, has been developed in the southern part of the site. A small mound is shown in the west of the site on the 1962 map, it is not present on any subsequent maps. The school remains until between 1989 and 1993 when it is demolished and the site is developed with Highfield Grange Residential Home. The home is present on all maps, dated up to 2015, and it is therefore assumed that demolition has recently been undertaken.

3.2.2 The Surrounding Area

The earliest map dated 1854-1855, shows the surrounding area to predominately comprise agricultural land. The Dearne and Dove canal is located approximately 300 m north east of the site

and a railway line is present beyond this, around 450 m from the site. The Wombwell Main Colliery is located approximately 750 m south west of the site.

By 1894 Mitchel Main Colliery, with associated railway lines is shown about 600 m north of the site and Darfield Main Colliery is located approximately 900 m north east of the site. Residential development of the wider surrounding area has also begun, mainly to the south east of the site. This development continues and during the early 1900's, residential development has occurred within 50 m east of the site.

The residential development continues, predominantly to the south and south east of the site and by 1966, the area immediately surrounding the site has been developed residentially. Mitchell Main Colliery is no longer shown at this point. By 1980, residential development has continued to the west and north of the site and Wombwell Main Colliery is no longer shown. The Darfield Main Colliery is demolished between 1989 and 2006.

No major changes have occurred in the surrounding area during the subsequent years.

3.3 Geology

The geological map SE 275 SW (1:10,560 scale) covers the area. The geology beneath the site comprises the Oaks Rock formation, which is indicated to comprise sandstone. No superficial deposits are shown beneath the site.

No faults or other lines of weakness are indicated to cross the site.

The British Geological Survey holds records of trial pits excavated in the local area. Trial pits located about 280 m south east of the site and excavated in the same geological strata, have recorded sand to an approximate depth of 1 m over weathered sandstone.

3.4 Hydrogeology

3.4.1 Groundwater Vulnerability

The Envirocheck report shows the bedrock to comprise a Secondary A aquifer. This is defined as permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flow to rivers.

According to the Envirocheck report, the site is not located within a Groundwater Source Protection Zone.

3.4.2 Water Abstractions

The Envirocheck report does not record any water abstractions within 500 m of the site.

3.5 Hydrology

The Envirocheck report states that the nearest surface water feature is located around 360 m north-east of the site. This is labelled as Bulling Dike.

3.6 Mining

Coal

The site lies within the Oaks Rock Formation which comprises sandstone. The shallowest coal seam possibly underlying the site is the Swinton Pottery Coal, around 3.5 m below the Oaks Rock. This seam is indicated as thin in the geological maps and it is also shown in the generalised section as not being consistently present in the area. According to the memoir the thickness of the seam has been reported in many cases as being about 1 foot thick (0.3 m).

The Newhill Coal is anticipated to lie at about 28 m beneath the base of the Oaks Rock Formation. The geological maps indicate the thickness of this seam to range between 0.61 m and 1.4 m. The seam was found to be workable in places, however, according to the relevant geological memoir, near Wombwell, the Newhill Coal is a poor seam only 12 in (0.3 m) thick. Even if worked, this seam would not be expected to impact the site.

A Coal Authority mining report has been obtained for the site. According to the report, the site is within the zone of likely physical influence on the surface from workings in nine seams of coal at depths ranging from 110 m to 600 m and last worked in 1981. It also states that any movement from these workings should have stopped by now. Any workings at these depths are therefore not anticipated to affect development at the surface. No reference is made to any coal potentially being present at shallow depth.

There are no known coal mine entries on or within 20 m of the boundaries of the site. The site is not in the zone of influence of any present underground workings and it is not in an area that is likely to be affected at surface from any currently proposed workings. The site is not within the boundary of an opencast site from which coal has been removed by opencast methods. It is also not in an area for which a licence has been granted to remove or otherwise work coal using underground or opencast methods.

There is no record of a mine gas emission requiring action by the Coal Authority within the boundary of the property, and no claims for mining related subsidence have been made on the site. The Coal

Authority states that reserves of coal exist in the local area, which could be worked in the future. However, we consider this unlikely due to the demise of the coal mining industry.

Precautions against the effects of coal mining are not considered necessary.

3.7 Ground Gas

Information obtained from the Envirocheck report indicates that the site lies within an intermediate radon affected area. However, it is stated that no radon precautions are required for the construction of new dwellings.

There are no historical or active landfills within 500 m of the site.

Made ground is anticipated to be locally present on site. This is not expected to be of significant thickness at this stage.

3.8 Pollution Incidents to Controlled Waters

The Envirocheck report does not record any pollution incidents within 250 m of the site.

3.9 Discharge Consents

The Envirocheck report does not record any discharge consents within 250 m of the site.

3.10 Flooding

The Envirocheck report indicates that the site is not within 250 m of a flood plain.

4.0 OUTLINE CONCEPTUAL MODEL

Historical maps indicate that the site was formerly developed with a school. This was later demolished and Highfield Grange Residential Home occupied the site until it was demolished recently.

The following table details the possible sources and associated contaminants of concern, pathways and receptors, highlighted by the Phase 1 investigation as potentially present.

Potential Contaminants	Pathway	Receptor
Heavy metals/metalloids and polycyclic aromatic hydrocarbons (PAHs) in made ground and any topsoil.	Ingestion, inhalation, direct contact	Site workers, future residents, plants
	Migration through ground	Secondary A aquifer
Naturally elevated levels of heavy metals/metalloids in the natural ground	Ingestion, inhalation, direct contact	Site workers, future residents, plants
Sulphates in made ground and the natural ground	Direct contact	Below ground concrete
PAHs in made ground and any topsoil	Direct contact	Water supply pipes
Asbestos fibres within the made ground	Inhalation	Site workers, future residents

5.0 GROUND INVESTIGATION

5.1 Site Works

We visited site on 28 May 2015 and excavated ten trial pits, TP1 to TP10, using a JCB 3CX type mechanical backhoe excavator to determine the underlying ground conditions. These reached depths of between 1.2 and 2.95 m below ground level (bgl).

A second visit was made on 20 and 21 August 2015, to conduct additional infiltration tests and further sampling of the topsoil and made ground. Eight further pits were excavated and multiple soakaway tests carried out.

A trial pit was also excavated beneath the tarmacadam in the north western section of the site.

Copies of the trial pit logs are presented in Appendix 3, and the positions of the trial pits and soakaway pits are plotted on the Exploratory Hole Location Plan, Drawing number 38506/001, revision B, in Appendix 1.

5.2 Laboratory Testing

Six samples of topsoil, six samples of made ground and four samples of natural ground were dispatched for chemical testing after the first visit. Following the second visit, the following samples were sent for chemical testing:

- Five samples of topsoil around TP1, together with two more samples of topsoil from the northern part of the site;
- Five samples of made ground from around TP3 and five samples of made ground in the vicinity of TP6, where elevated concentrations were recorded in the samples from the first visit;
- One sample of made ground from beneath the tarmacadam in the north western part of the site; and
- Three samples of the topsoil present in the southern part of the site.

Soil samples were taken in 500 g plastic tubs and 250 ml amber glass jars. All samples were analysed at Chemtech Laboratories, using MCERTs accredited methodologies where available.

One sample of the limited intermittent pockets of silty clay encountered was also sent to Professional Soils Laboratory for geotechnical testing.

The chemical test results are presented in Appendix 5 and discussed further in Sections 8 and 9. The geotechnical test results are presented in Appendix 4 and discussed further in Section 7.

6.0 GROUND CONDITIONS

6.1 Surface Covering

A thin layer of surface topsoil, in most cases over made ground, was encountered in a number of pits, located predominantly around the footprint of the former central building. The topsoil occasionally contained bricks or concrete fragments. Tarmacadam covers the surface in the north western part of the site.

6.2 Made Ground

Made ground was recorded in the majority of the trial pits at the surface, or directly below the thin layer of topsoil. The made ground predominantly comprised gravelly slightly clayey sand, with the gravel being of mixed lithology, bricks, concrete and occasionally metal and plastic fragments. Reworked clay was encountered in the south western part of the site.

The made ground extended in most cases to depths of between 0.5 m and 1.8 m bgl. Two pits were excavated in the elevated area in the southern part of the site, where made ground was encountered to depths of between 1 m and 1.8 m bgl. One pit excavated in the elevated area in the northern part of the site recorded made ground to a depth of 2.1 m bgl.

6.3 Natural Ground

The natural ground generally comprised brown fine to coarse clayey gravelly sand, over sandstone, recovered as fine to coarse gravel and frequently, cobbles. Intermittent patches of sandy clay were recorded in the northern part of the site. The natural ground was encountered at depths of between 0.35 m and 2.1 m bgl. Strong sandstone was recorded at depths of between 1.3 m and 2.95 m bgl, within the trial pits.

Natural clay was found locally to a depth of 2 m bgl in the central north western part of the site, beneath the tarmacadam (TP11), during the further site works.

6.4 Obstructions

No significant obstructions, other than the strong sandstone, were encountered. Some bricks and concrete from the former development are present within the made ground. Several networks of former underground services are also present.

6.5 Groundwater

No groundwater was encountered within the trial pits.

6.6 Evidence of Contamination

No visual or olfactory evidence of significant contamination was identified in any of the exploratory holes.

7.0 GEOTECHNICAL APPRAISAL

7.1 General

The ground conditions over the majority of the site generally comprised made ground to depths of between 0.5 m and 1.8 m bgl. Locally deeper made ground was recorded within the elevated area in the north of the site, where the natural ground was encountered at 2.1 m bgl.

The natural ground generally comprised clayey gravelly sand, over sandstone, recovered as fine to coarse gravel and frequently, cobbles. Intermittent patches of sandy clay were recorded in the northern part of the site. Natural clay was also found locally to a depth of 2 m bgl in the central north western part of the site, beneath the tarmacadam (TP11), during the further site works.

Plasticity tests were carried out on one sample of the sandy clay. The material was found to be non-plastic.

Consideration will need to be given to the slopes within the site, with regrading and/or retaining required.

7.2 Foundations

For a low rise housing scheme, the most suitable foundations are considered to be strip or trench fill footings at a minimum depth of 750 mm below existing or proposed ground level, whichever is the lowest. This means that they may reach the hard sandstone bedrock. Where competent sandstone is encountered above 750 mm bgl, foundations may not need to be deepened further. A safe bearing capacity of 150 kN/m² is considered can be assumed for foundations within the clayey gravelly sand, however this will increase significantly on the underlying sandstone bedrock.

Natural clay was also found locally to a depth of 2 m bgl in the central north western part of the site. This clay is considered can be classified as being of medium volume change potential. A safe bearing capacity of 125 kN/m² is considered suitable for foundations within this material. If any plots are to be built within this area and founded in this clay, they should be taken at a minimum depth of 900 mm below existing or proposed ground level, whichever is the lowest. The footings will need to be deepened in accordance with NHBC Standards, Chapter 4.2, where they are within clay soils, and where existing or proposed trees are within influencing distance. Heave precautions will be required if the footings need to be deepened more than 1500 mm due to existing or removed trees.

The foundations need to be extended through the made ground and any soft material to competent natural ground. Made ground was found to depths of up to 2.1 m bgl. Trench fill foundations are considered to be suitable for the areas of deep made ground, based on the current surface levels.

The majority of the ground conditions were found to comprise sand, however some pockets of clay were noted. If the footings are to span between different materials, e.g. sand and clay, it is considered prudent to allow for the foundations to be reinforced. This is not however, expected to affect a large number of plots at the site.

7.3 Ground Slabs

A ground bearing slab may be considered where there is less than 600 mm of made ground and the natural ground is well compacted granular material. Otherwise a reinforced suspended or precast concrete floor should be used.

If heave precautions are required, a precast concrete floor with a minimum 250 mm high ventilated void beneath would be required.

7.4 Superstructure Precautions

Additional superstructure precautions are not considered to be required in the proposed development as a result of the ground conditions encountered within the trial pits.

7.5 Excavation Problems

Made ground was encountered across the site. The sides of trenches and excavations are likely to be unstable and temporary support may be required in some areas.

Where excavations which workers are required to enter are over 1.2 m deep, or less where there is a risk of harm from collapse of the sides of the excavation, the sides should be supported or battered back to make them safe.

7.6 Roads

A CBR value of at least 2% is likely to be appropriate for road design. The ground should be assumed to be frost susceptible and a minimum capping thickness of 450 mm will therefore apply.

It is recommended that CBR tests are undertaken along any proposed roads prior to construction so that more accurate CBR values can be obtained.

7.7 Surface Water Drainage

Infiltration tests were completed in four of the trial pits (SA1 to SA4) during the initial site investigation in May. A repeat test was undertaken in one location.

Further soakaway tests were carried out in eight additional positions (SA5 to SA12). Repeat tests were undertaken in all positions, between two and five times. The table below summarises all the infiltration rates recorded.

	Infiltration Rate ($\times 10^{-06}$ m/sec)									
	Test 1		Test 2		Test 3		Test 4		Test 5	
	BR365	Average	BR365	Average	BR365	Average	BR365	Average	BR365	Average
SA1	620	320								
SA2	110	110	980	980						
SA3	66	63								
SA4	1100	640								
SA5	380	120	150	180	72	76				
SA6	44	38	30	28	N/A	23				
SA7	410	510	860	340	190	200	110	140		
SA8	270	330	270	290	100	130				
SA9	17	23	15	14						
SA10	130	100	120	88	90	74	95	77	98	89
SA11	16	16	N/A	9						
SA12	43	50	27	32	N/A	36				

A copy of the test results is included in Appendix 4.

Rates of 16 to 1100 $\times 10^{-06}$ m/sec were recorded in the first test at each of the twelve positions. The rates are therefore very variable with the vast majority at the lower end of this range. Repeat tests were undertaken and the infiltration rates reduced significantly over these indicating that soakaways would silt up over time reducing their effectiveness. In summary, therefore we consider that soakaways are not a viable solution for this site.

8.0 REFINEMENT OF OUTLINE CONCEPTUAL MODEL

8.1 Source Characterisation

An outline conceptual model, detailing the possible sources and associated contaminants of concern, potential pathways and receptors identified in the Phase 1 study, is set out in Section 4.

This section of the report documents the works undertaken to obtain information to test and refine this model enabling a risk assessment to be produced and, where significant risks are expected, remediation recommendations.

8.2 Gas Precautions

No radon precautions are required.

No historical or active landfills are recorded within 250 m of the site.

Made ground is present on site. Made ground extended in most cases to depths of between 0.5 m and 1.8 m bgl. One pit excavated in the elevated area in the northern part of the site, recorded made ground to a depth of 2.1 m bgl. The made ground predominantly comprised gravelly slightly clayey sand, with the gravel being of mixed lithology, bricks, concrete and occasionally metal and plastic fragments, associated with the former buildings on site. Significant quantities of organic or biodegradable material were not present within the made ground, it is therefore not considered to comprise a significant source of ground gas.

8.3 Unexpected Contamination

No visual or olfactory evidence of significant contamination was identified during the site investigation.

8.4 Chemical Testing

Initial Site Investigation

Six samples of topsoil, six samples of made ground and four samples of natural ground were dispatched for chemical testing. Each of the samples was analysed for the suite of contaminants listed in the table overleaf:

Contaminant Type	Actual Contaminants
Metals/Metalloids	Arsenic, cadmium, chromium (III and VI), lead, mercury, nickel, selenium, copper and zinc
pH	pH
PAHs	Speciated Polycyclic Aromatic Hydrocarbons
Sulphates*	Water soluble sulphate, acid soluble sulphate and sulphur
Asbestos presence**	

*Made ground and natural ground only ** Three samples of made ground

Additional Site Investigation

Following the second visit the following samples were sent for chemical testing:

- Five samples of topsoil around TP1, together with two more samples of topsoil from the northern part of the site;
- Five samples of made ground from around TP3 and five samples of made ground in the vicinity of TP6, where elevated concentrations were recorded in the samples from the first visit;
- One sample of made ground from beneath the tarmacadam in the north western part of the site; and
- Three samples of the topsoil present in the southern part of the site.

8.5 Assessment Criteria

The proposed development of the site is for residential properties with private gardens. Therefore the assessment criteria relating to a residential end use have been used. Tables detailing the relevant assessment concentrations used are included in Appendix 5.

8.6 Chemical Test Results

8.6.1 Made ground

Initial Site Investigation

Six samples of made ground were tested. The table overleaf shows the elevated concentrations recorded.

	Assessment Value (mg/kg)	Concentration (mg/kg)
Benzo(b)fluoranthene	2.6	4.8 (TP3), 5.1 (TP6)
Benzo(a)pyrene	5	5.1 (TP3), 6.2 (TP6)
Dibenzo(a,h)anthracene	0.24	0.41 (TP3), 0.39 (TP6)
Copper	200 (PH>7)	260 (TP3)

No asbestos was detected within any of the samples tested.

Additional Site Investigation

Four samples of made ground around TP3 were tested for PAH and copper, while one sample was tested for a general suite of contaminants. Three samples of made ground in the vicinity of TP6 were also tested for PAH and two samples were tested for a general suite of contaminants. The locations of the samples taken can be seen on the Exploratory Hole location Plan, drawing 38506/001/B.

The table below shows the elevated concentrations recorded.

	Assessment Value (mg/kg)	Concentration (mg/kg)
Benzo(b)fluoranthene	2.6	8.1 (TP3A), 12 (TP3D), 3.2 (TP6E)
Benzo(a)pyrene	5	6.7 (TP3A), 10 (TP3D)
Dibenzo(a,h)anthracene	0.24	0.92 (TP3A), 1.3 (TP3D), 0.25 (TP6E)
Benzo(a)anthracene	7.2	9.8 (TP3D)
Copper	200 (PH>7)	460 (TP3A), 520 (TP3D)
Lead	200	270 (TP6D)

8.6.2. Topsoil

Initial Site Investigation

Five samples of the thin layer of surface topsoil were tested. In one sample, which was collected from the northern part of the site (TP1), the following elevated values of contaminants were recorded:

	Assessment Value (mg/kg)	Concentration (mg/kg)
Benzo(b)fluoranthene	2.6	5.1
Benzo(a)pyrene	5	6.4
Dibenzo(a,h)anthracene	0.24	0.4

Additional Site Investigation

Four samples of topsoil around TP1 were tested for PAH and one for a general suite of contaminants. Two additional topsoil samples from the limited area of topsoil in the northern part of the site were also tested. Finally, three samples of topsoil from across the southern part of the site were also tested for a general suite. No elevated concentrations of contaminants were recorded within the samples tested.

8.6.2. Natural Ground

No elevated concentrations of contaminants were recorded within the samples of natural ground tested.

8.6.4 Sulphates

The site has been taken as a brownfield location in relation to the Aggressive Chemical Environment for Concrete classifications.

The made ground samples recorded water soluble concentrations between 10 and 1300 mg/l, which indicate a Design Class of DS2. However, the total potential sulphate concentrations ranged between 0.09% and 0.87%. As there are between five and nine results, it is appropriate to derive a characteristic value of total potential sulphate. This is the mean of the two highest results which is calculated to be 0.68%. It is therefore considered that a Design Class of DS2 can be adopted for concrete in contact with the made ground. The recorded pH values indicate an ACEC class of AC-2.

The natural ground samples recorded water soluble concentrations of between 10 and 240 mg/l, which are lower than the upper limit for DS1 of 500 mg/l. Total potential sulphate concentrations of between 0.03 and 0.12% were recorded, with pH values between 7.7 and 8. A Design Class of DS1 with ACEC class of AC-1 is therefore suitable for concrete not in contact with the natural ground.

9.0 RISK ASSESSMENT

Risk assessments have been undertaken in this section following the results of the chemical testing undertaken.

9.1 Human Health – Construction Workers

Ground workers employed during the construction phase of the development are most at risk of harm due to them having direct contact with the affected soils. However, the contact is generally of short duration, and all competent ground workers will be aware of the potential risks associated with made ground. Therefore the overall risk to the health of construction workers is considered to be low.

All ground workers employed on the site should be made aware that elevated concentrations of PAHs are present, and normal site procedures such as the wearing of gloves when handling soils, and the washing of hands prior to eating should be implemented.

Any unusual, brightly coloured, ashy or odorous material encountered during construction should be brought to the attention of the site staff and investigated.

9.2 Human Health – Future Residents and Visitors

Topsoil

A limited amount of topsoil exists, mainly around the perimeter of site. Elevated concentrations of PAHs were initially recorded within the thin layer of topsoil which lies over the made ground in the northern part of the site, in trial pit TP1. Further testing of five samples was conducted at distances of 3 m and 8 m from TP1. Two additional samples from the northern area were also tested. No elevated concentrations of contaminants were recorded. It is therefore concluded that the slightly elevated values in TP1 are attributed to a 'hotspot'.

It is assumed that the topsoil will be stripped and stockpiled before being used. Modified means have therefore been calculated for the three elevated PAH, to account for the small size of the hotspot, i.e. the elevated concentrations were not recorded in samples taken 3 m from TP1, and because the topsoil and elevated concentrations within it should be mixed and therefore diluted. The modified means are:

- 2.56 mg/kg for benzo(b)fluoranthene, compared to the generic assessment concentration of 2.6 mg/kg;
- 2.8 mg/kg for benzo(a)pyrene compared to the assessment concentration of 5 mg/kg; and

- 0.21 mg/kg for dibenzo(a,h)anthracene compared to the generic assessment concentration of 0.24 mg/kg.

The arithmetic means were 1.6 mg/kg, 1.43 mg/kg and 0.14 mg/kg, respectively. The topsoil in the northern part of the site and within the vicinity of TP1 is therefore considered to be suitable for reuse in the proposed development. Copies of the calculations are included in Appendix 5.

Four samples that were initially collected from the western and southern parts of the site did not show elevated concentrations of contaminants. Three more samples were tested. No elevated concentrations of contaminants were identified. The topsoil elsewhere is therefore also considered to be suitable to be reused.

The topsoil is generally over made ground. Stripping of the topsoil should therefore be precise and the materials should not be mixed.

Made Ground

Elevated values of PAHs and copper were initially recorded in a number of samples of the made ground.

Further testing conducted in the vicinity of TP3 and TP6, showed elevated values of PAHs, as well as copper and lead. Modified means have been calculated for the contaminants found to be elevated within the made ground and are summarised below.

	Assessment Value (mg/kg)	No of samples of Made Ground	Modified Mean Concentration (mg/kg)
Benzo(b)fluoranthene	2.6	17	3.97
Benzo(a)pyrene	5	17	3.53
Dibenzo(a,h)anthracene	0.24	17	0.41
Benzo(a)anthracene	7.2	17	3.3
Copper	200 (PH>7)	14	189
Lead*	200	10	97

*Lead: Geometric mean used

Only the modified means for benzo(b)fluoranthene and dibenzo(a,h)anthracene exceed their respective generic assessment concentrations and by less than twice the assessment value. A clean capping, a minimum of 300 mm thick, including at least 100 mm of topsoil, is therefore proposed in gardens and areas of soft landscaping. This is considered to be in accordance with BR465 'Cover systems for land regeneration' where except in extreme circumstances, research

indicates that the mixed zone should be limited to the top 600 mm. Therefore, for concentrations to be below their respective generic assessment concentration throughout the upper 600 mm, the concentrations would need to be no more than twice their assessment concentration in the lower 300 mm.

Natural Ground

The natural ground is not anticipated to pose a risk to human health, since no elevated concentrations of any contaminants were recorded.

9.3 Plants

An elevated concentration of copper was recorded within the made ground in the central part of the site. The placement of the capping layer is considered should mitigate any potential risks to plants.

9.4 Concrete

It is considered that DS2 AC2 sulphate precautions are appropriate where concrete is in contact with the made ground. A Design Class of DS1 with ACEC class of AC-1 is suitable for concrete in contact with the natural ground.

9.5 Controlled Waters

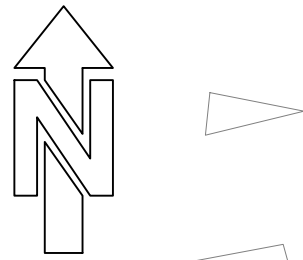
The elevated concentrations of PAHs were only recorded in the made ground or locally in topsoil and do not appear to be leaching or migrating down into the natural ground. Significant risks are therefore not expected to be posed to controlled waters.

10.0 CONTAMINATION - RECOMMENDATIONS AND APPROVALS

1. DS2, AC2 sulphate precautions are considered appropriate for concrete in contact with the made ground. A Design Class of DS1 with ACEC class of AC-1 is suitable for concrete in contact with the natural ground.
2. Elevated polycyclic aromatic hydrocarbons (PAHs) were recorded within the thin layer of topsoil over the made ground in TP1, in the northern part of the site. Further testing did not record elevated concentrations in the vicinity of TP1. Modified means for the elevated contaminants do not exceed their generic assessment concentrations and therefore the topsoil in the northern area is considered to be suitable for reuse. The remaining samples of topsoil, which were from the south and western parts of the site, did not record any elevated concentrations of contaminants and this topsoil is also considered to be suitable. Stripping of the topsoil should be precise and the topsoil should not be mixed with the underlying made ground.
3. Elevated PAHs, copper and lead were recorded in the made ground. The modified means only exceed the generic assessment concentration for two of the PAH compounds and then by less than twice the assessment value. A clean capping, a minimum of 300 mm thick, including at least 100 mm of topsoil, is therefore proposed in gardens and areas of soft landscaping located over made ground.
4. The conclusions made in this report in relation to contamination are subject to agreement by the approving bodies such as the Local Authority and your warranty provider.
5. A copy of this report should also be sent to the water supplier to review any requirement for protective water supply pipes.

Appendix 1

'Exploratory Hole Location Plan', Drawing Number 38506/001B
Photographs



INFORMATION WITHIN THIS DRAWING IS NOT NECESSARILY PRODUCED TO SCALE.
ALWAYS USE FIGURED DIMENSIONS AND CO-ORDINATES - IF IN DOUBT, ASK.

KEY:

- Site Boundary
- Approximate position of Electricity.
- Approximate position of BT.
- Approximate position of Water.
- Approximate position of Historical Building
- Approximate position of Former Highfield Grange Residential Home
- Approximate position of Trial Pits excavated by Eastwood & Partners on 26/05/15
- Approximate position of Soakaways excavated by Eastwood & Partners on 20-21/08/15.
- Approximate position of Topsoil Sample collected in the Southern part of the site by Eastwood & Partners on 20-21/08/15.
- Approximate position of Topsoil Sample collected in the Nothern part of the site by Eastwood & Partners on 20-21/08/15.
- Approximate position of Additional Samples of Made Ground collected on 20-21/08/15.

Eastwood & Partners
CONSULTING ENGINEERS



St. Andrew's House
23 Kingfield Road
Sheffield
S11 9AS
Tel 0114 255 4554
Fax 0114 255 4330

mail@eastwoodandpartners.com
www.eastwoodandpartners.com

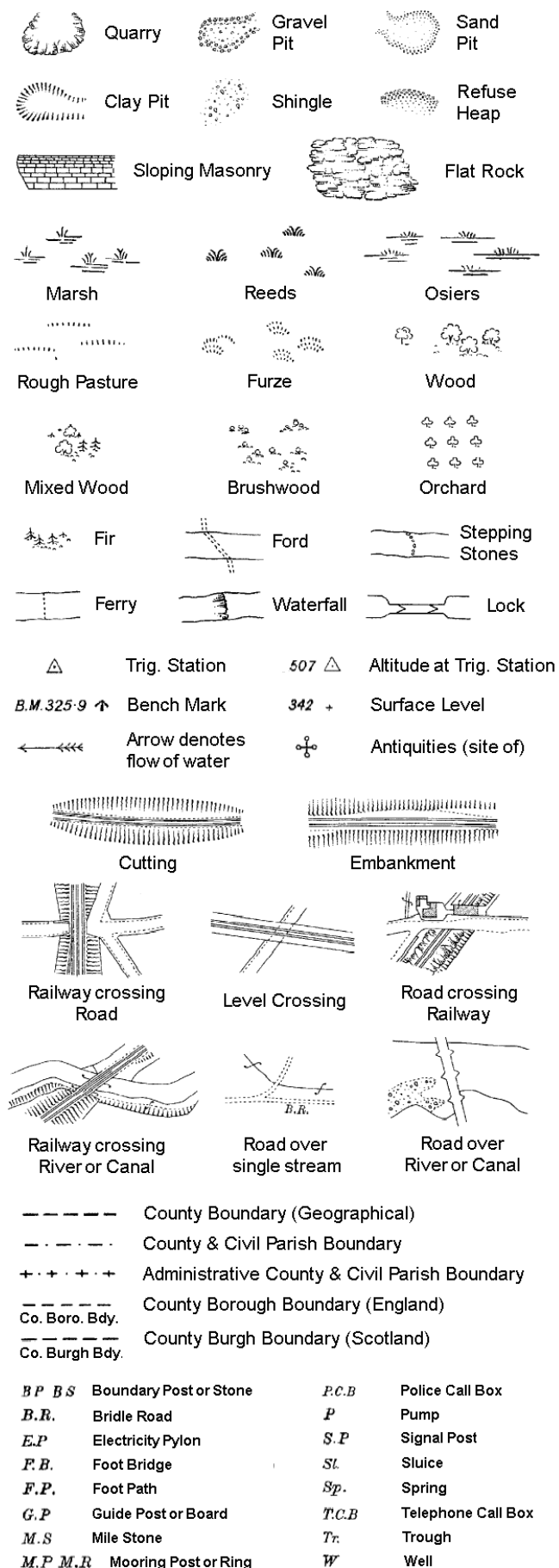
GLEESON DEVELOPMENTS LTD
BLYTHE STREET, WOMBWELL
EXPLORATORY HOLE LOCATION PLAN

B	SA5 to SA12, HT1 to HT4 & S1 & S2 added.	JL	MM	22.09.15
A	First Issue.			
REV	DESCRIPTION	SIG	CHK	DATE
SCALE WHEN PLOTTED AT A3 1:1000			DRAWING STATUS INFORMATION	
DRAWN JB	CHECKED MM	DATE 04.06.15	DRAWING NUMBER 38506/001	REV B

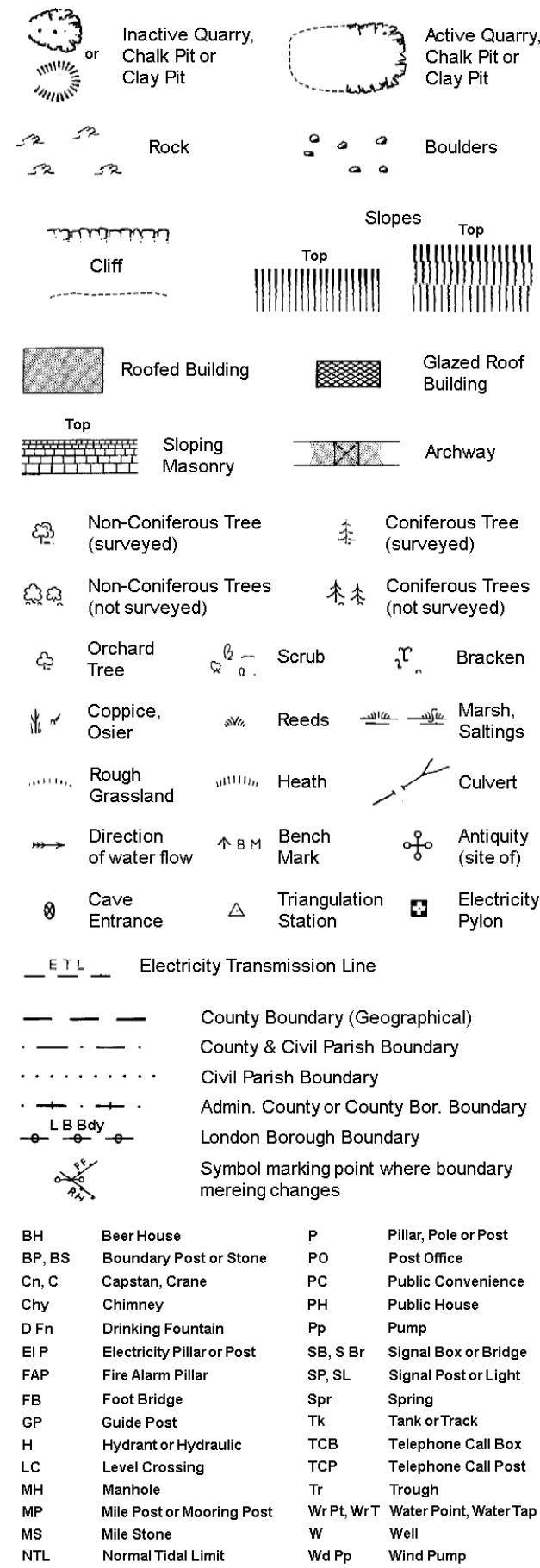
Appendix 2
Envirocheck Report
Coal Authority Mining Report

Historical Mapping Legends

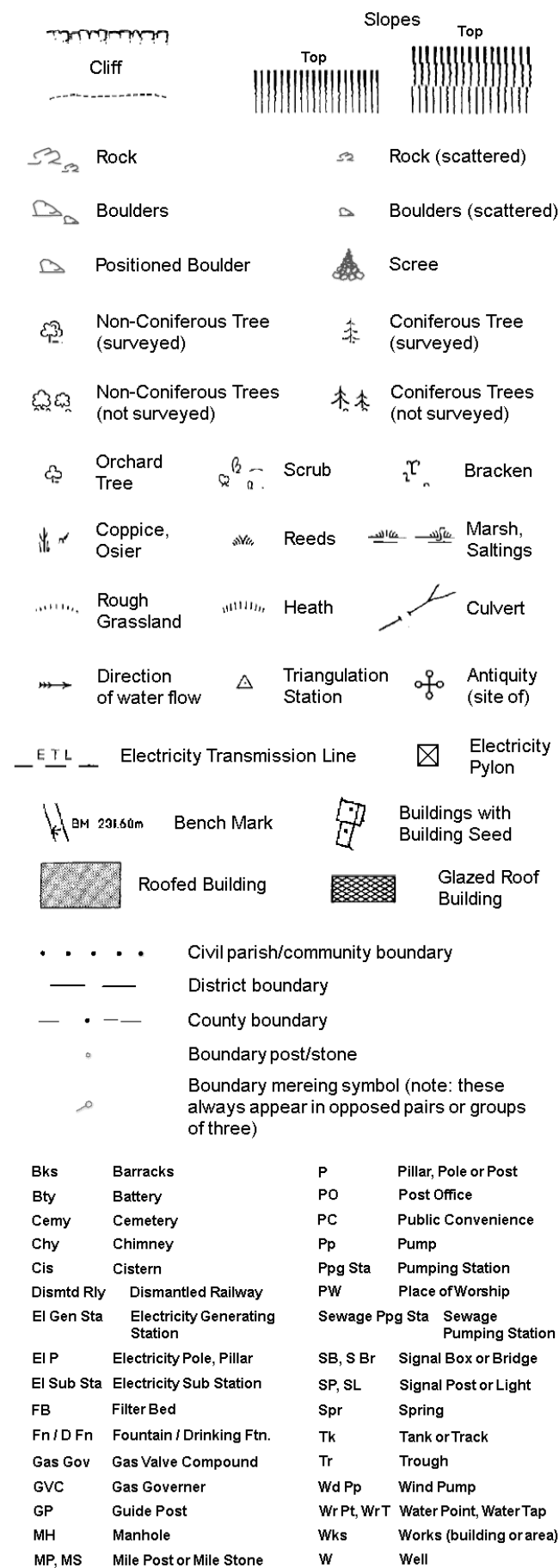
Ordnance Survey County Series and Ordnance Survey Plan 1:2,500



Ordnance Survey Plan, Additional SIMs and Supply of Unpublished Survey Information 1:2,500 and 1:1,250



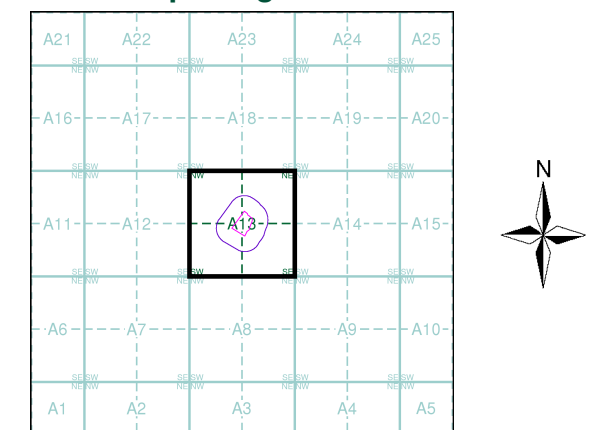
Large-Scale National Grid Data 1:2,500 and 1:1,250



Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Yorkshire	1:2,500	1892	2
Yorkshire	1:2,500	1906	3
Yorkshire	1:2,500	1931	4
Ordnance Survey Plan	1:2,500	1962	5
Ordnance Survey Plan	1:2,500	1971	6
Additional SIMs	1:2,500	1978	7
Ordnance Survey Plan	1:1,250	1982	8
Additional SIMs	1:2,500	1986	9
Large-Scale National Grid Data	1:1,250	1993	10
Large-Scale National Grid Data	1:1,250	1993	11
Large-Scale National Grid Data	1:1,250	1994	12

Historical Map - Segment A13



Order Details

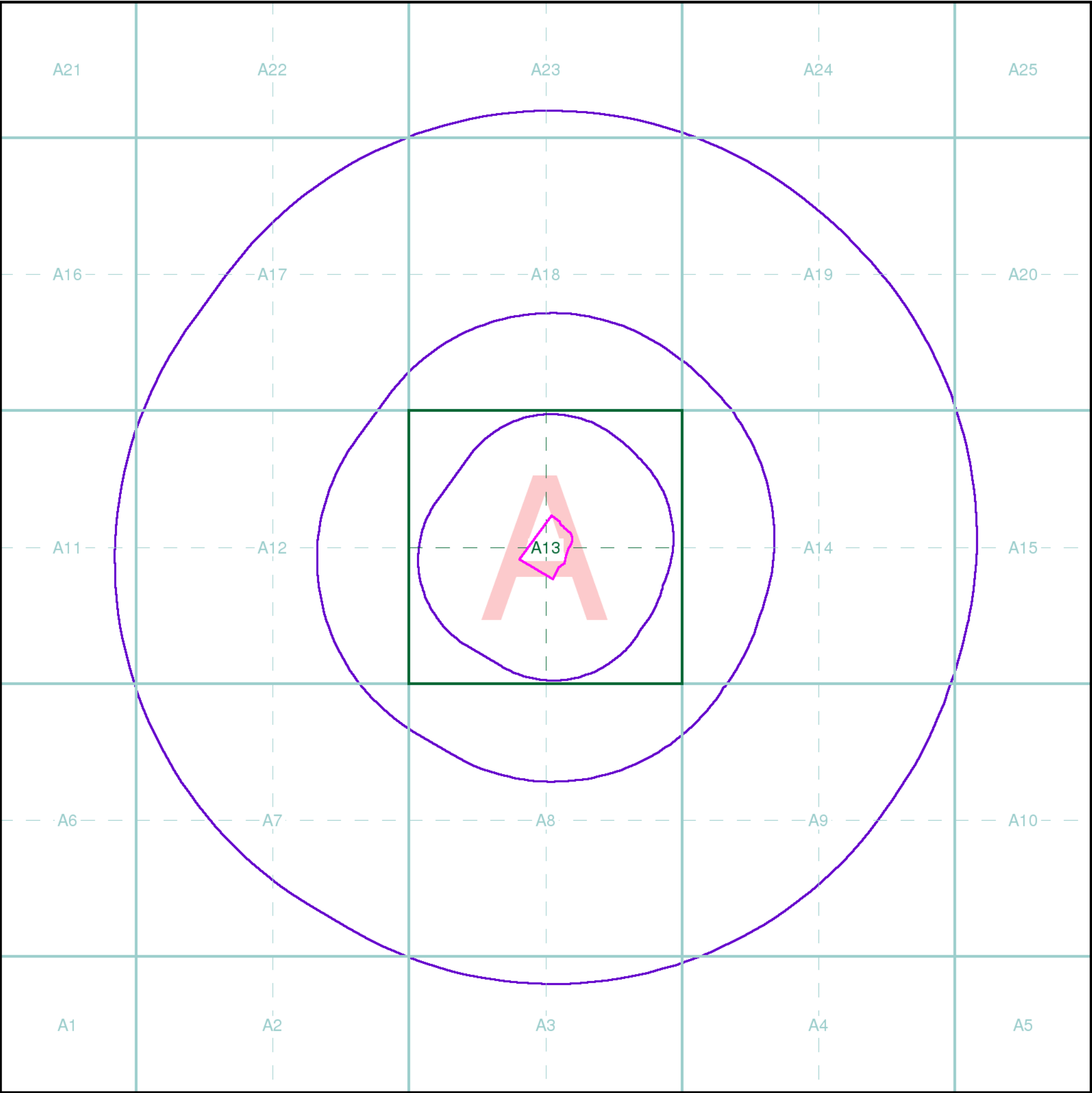
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Customer Ref: 38506 Blythe Street, Wombwell
National Grid Reference: 439160, 403510
Slice: A
Site Area (Ha): 1.11
Search Buffer (m): 100

Site Details

Blythe street, Wombwell



Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Index Map

For ease of identification, your site and buffer have been split into Slices, Segments and Quadrants. These are illustrated on the Index Map opposite and explained further below.

Slice

Each slice represents a 1:10,000 plot area (2.7km x 2.7km) for your site and buffer. A large site and buffer may be made up of several slices (represented by a red outline), that are referenced by letters of the alphabet, starting from the bottom left corner of the slice "grid". This grid does not relate to National Grid lines but is designed to give best fit over the site and buffer.

Segment

A segment represents a 1:2,500 plot area. Segments that have plot files associated with them are shown in dark green, others in light blue. These are numbered from the bottom left hand corner within each slice.

Quadrant

A quadrant is a quarter of a segment. These are labelled as NW, NE, SW, SE and are referenced in the datasheet to allow features to be quickly located on plots. Therefore a feature that has a quadrant reference of A7NW will be in Slice A, Segment 7 and the NW Quadrant.

A selection of organisations who provide data within this report:



Envirocheck reports are compiled from 136 different sources of data.

Client Details

Miss K Daddo-Langlois, Eastwood & Partners Ltd, St Andrews House, 23 Kingfield Road, Sheffield, S11 9AS

Order Details

Order Number: 67251901_1_1
Customer Ref: 38506 Blythe Street, Wombwell
National Grid Reference: 439160, 403510
Site Area (Ha): 1.11
Search Buffer (m): 1000

Site Details

Blythe street, Wombwell

Full Terms and Conditions can be found on the following link:
<http://www.landmarkinfo.co.uk/Terms/Show/515>



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Web: www.envirocheck.co.uk

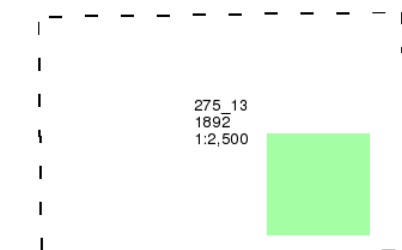
Yorkshire

Published 1892

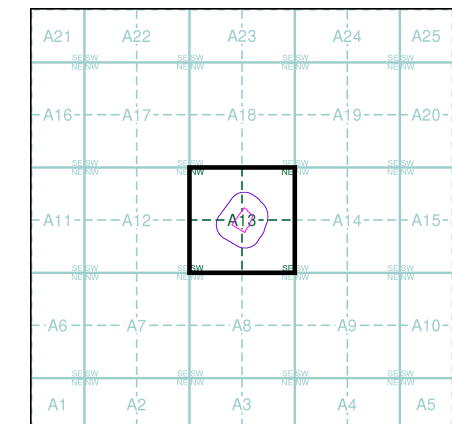
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The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13

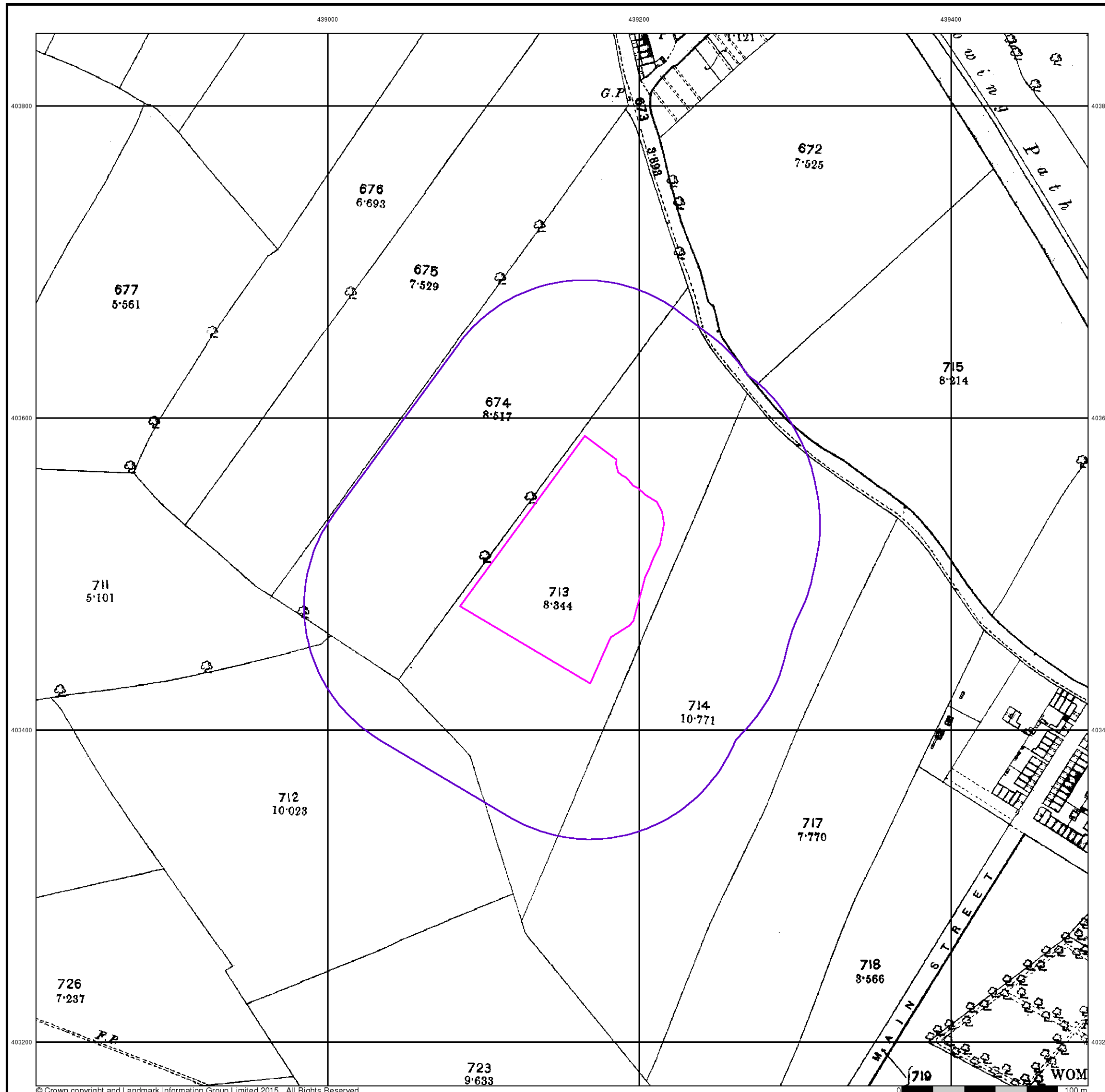


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Site Details

Blythe street, Wombwell



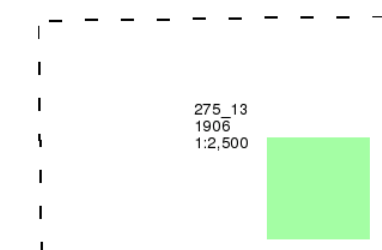
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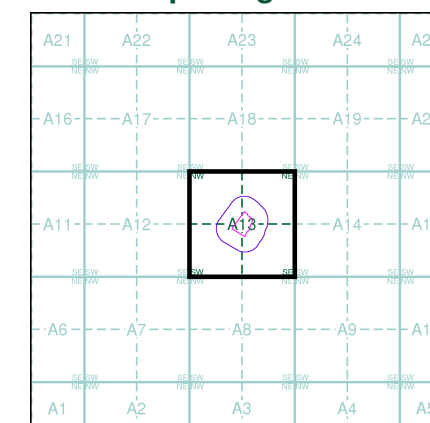
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Map Name(s) and Date(s)



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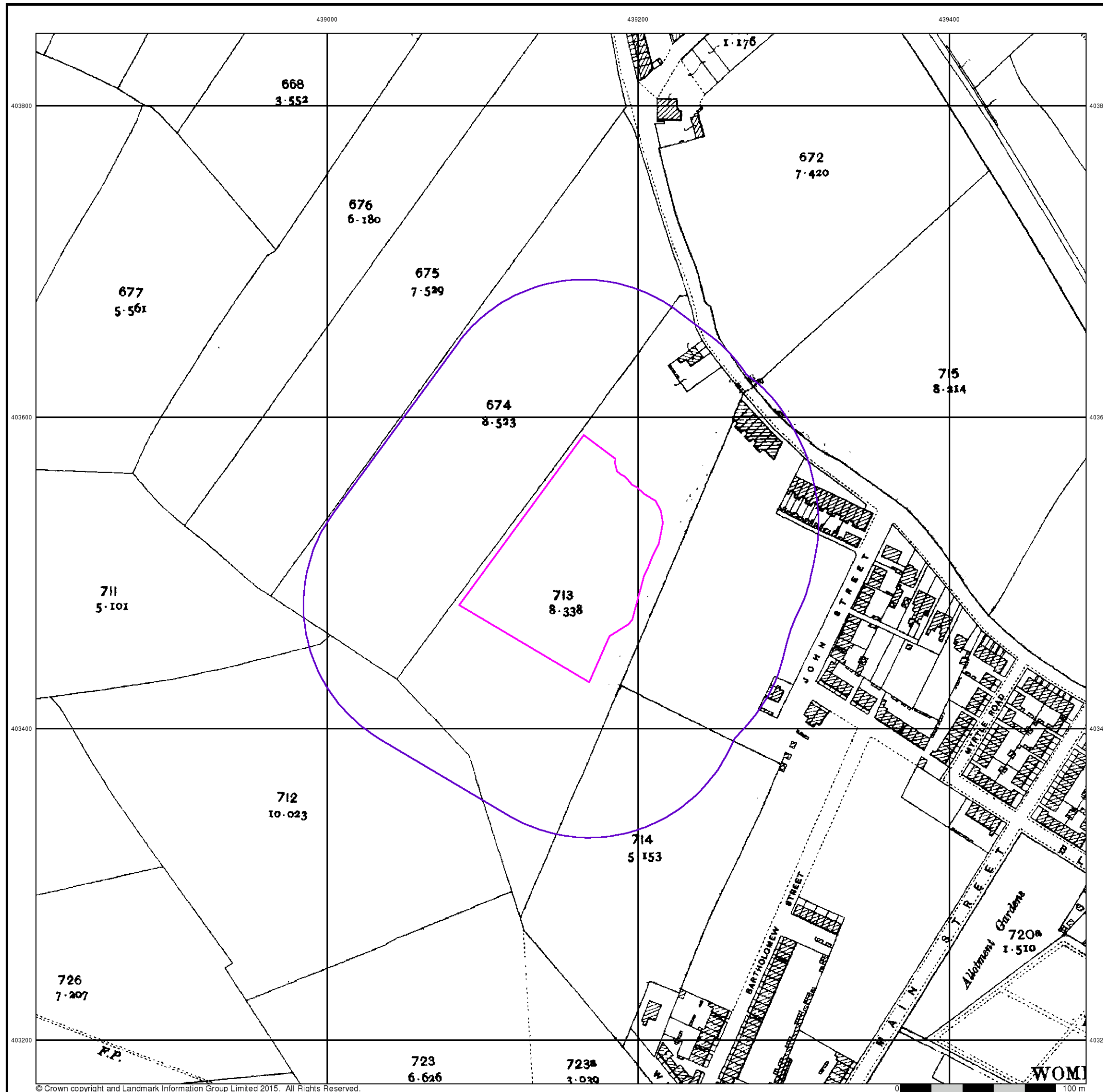


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Site Details

Blythe street, Wombwell



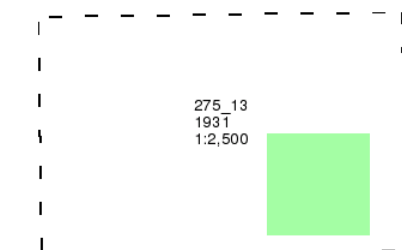
Yorkshire

Published 1931

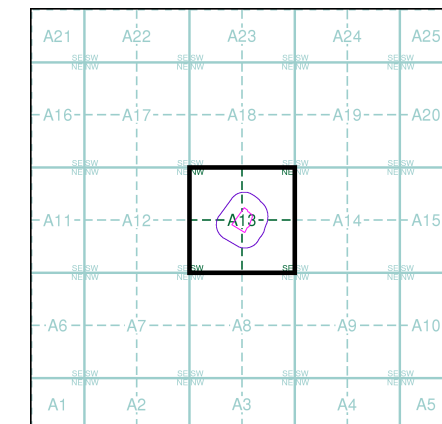
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Map Name(s) and Date(s)



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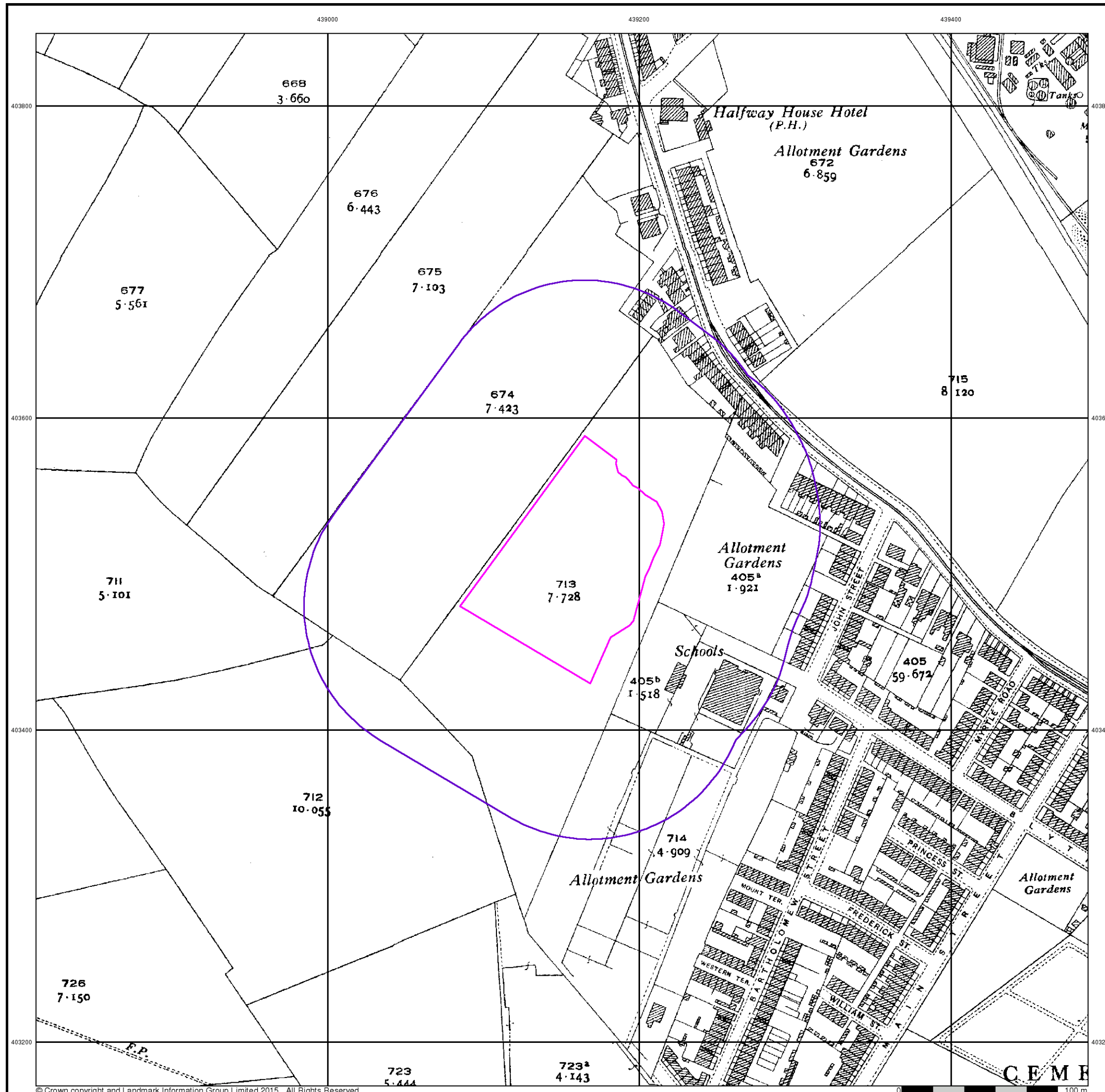


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Site Details

Blythe street, Wombwell



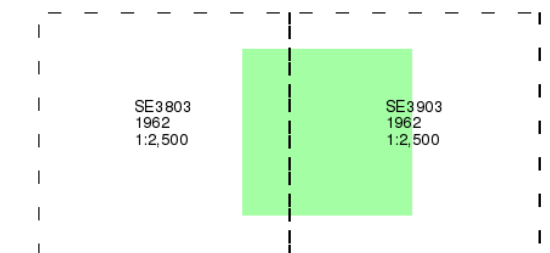
Ordnance Survey Plan

Published 1962

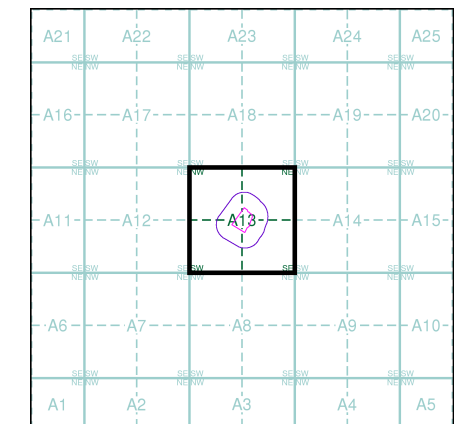
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Map Name(s) and Date(s)



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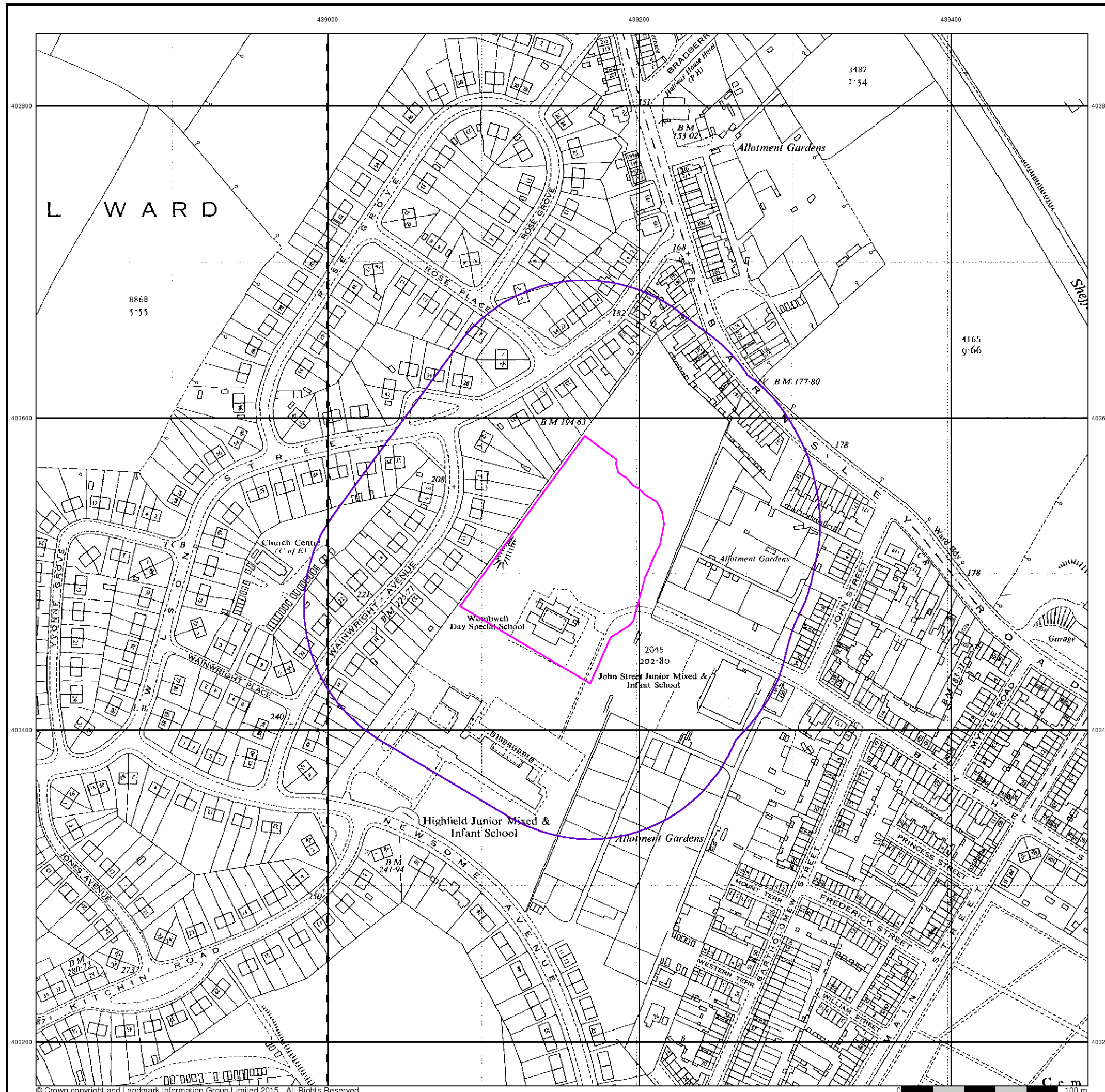


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Site Details

Blythe street, Wombwell



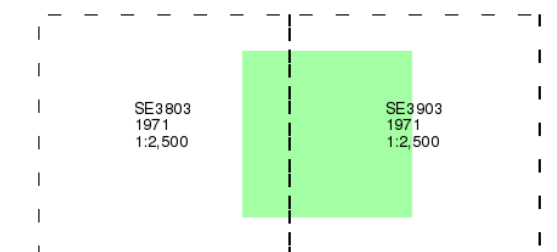
Ordnance Survey Plan

Published 1971

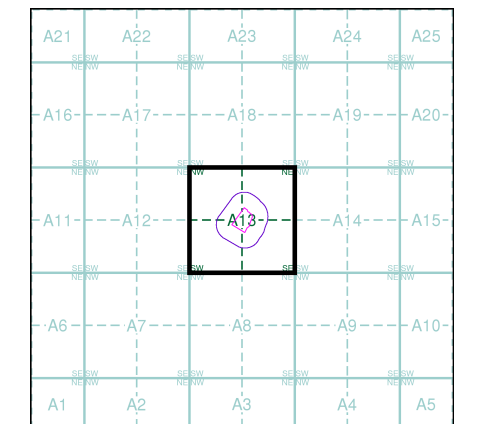
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Map Name(s) and Date(s)



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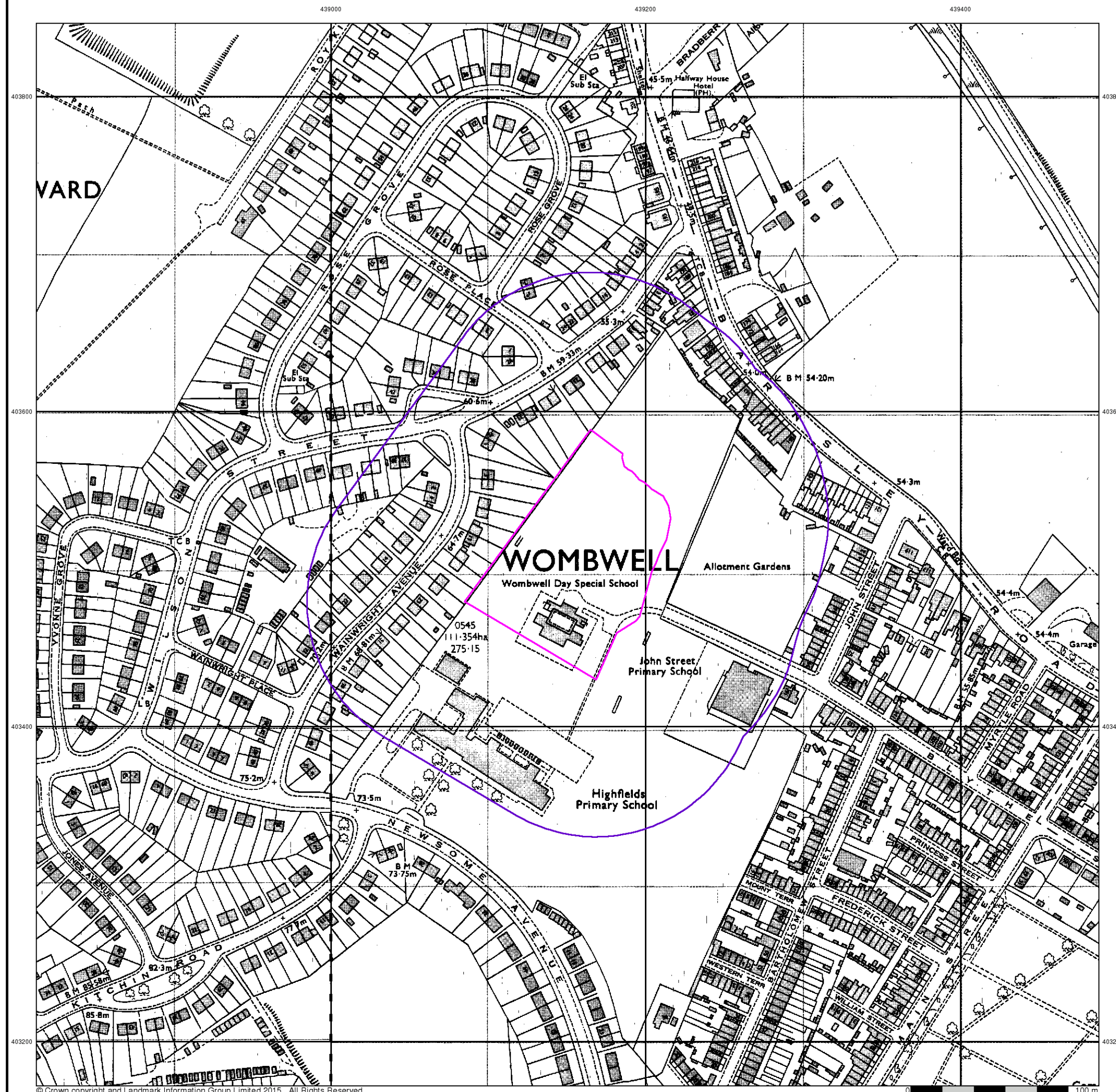


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Site Details

Blythe street, Wombwell



Ordnance Survey Plan

Published 1982

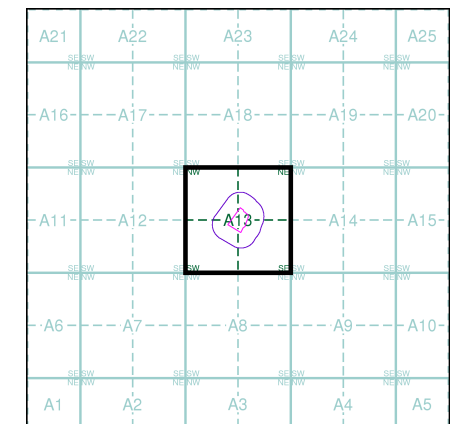
Source map scale - 1:1,250

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Map Name(s) and Date(s)

SE3803NE 1982 1:1,250	SE3903NW 1982 1:1,250
SE3803SE 1982 1:1,250	SE3903SW 1982 1:1,250

Historical Map - Segment A13

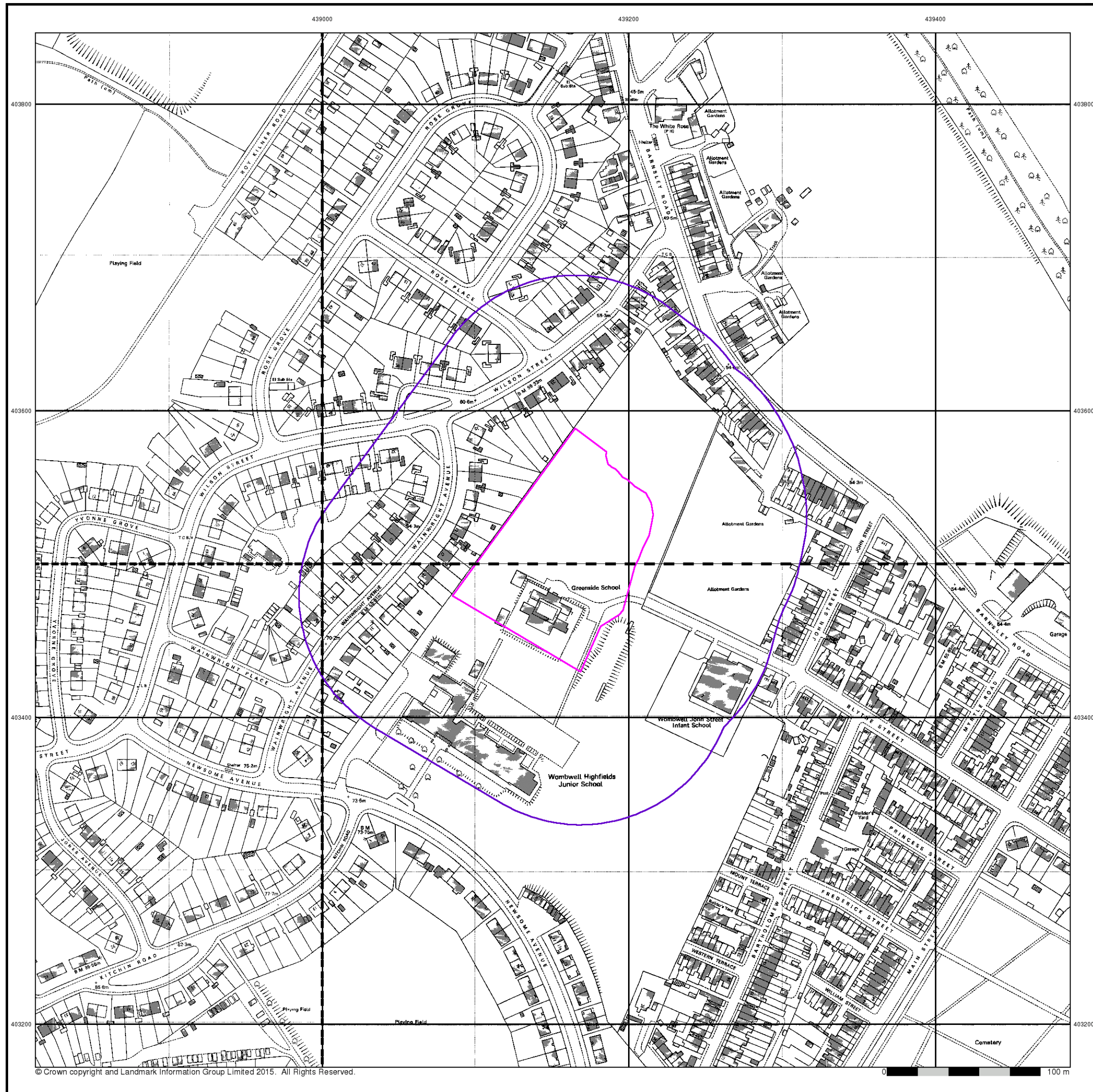


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Site Details

Blythe street, Wombwell



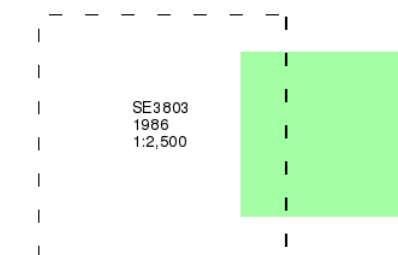
Additional SIMs

Published 1986

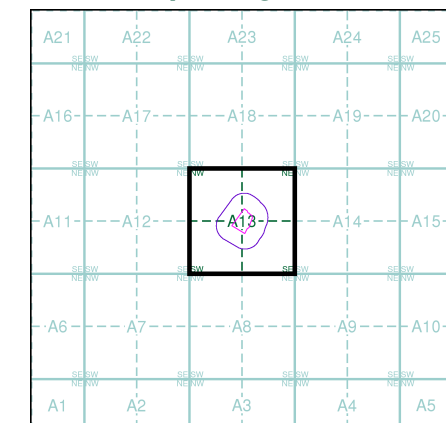
Source map scale - 1:2,500

The SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13

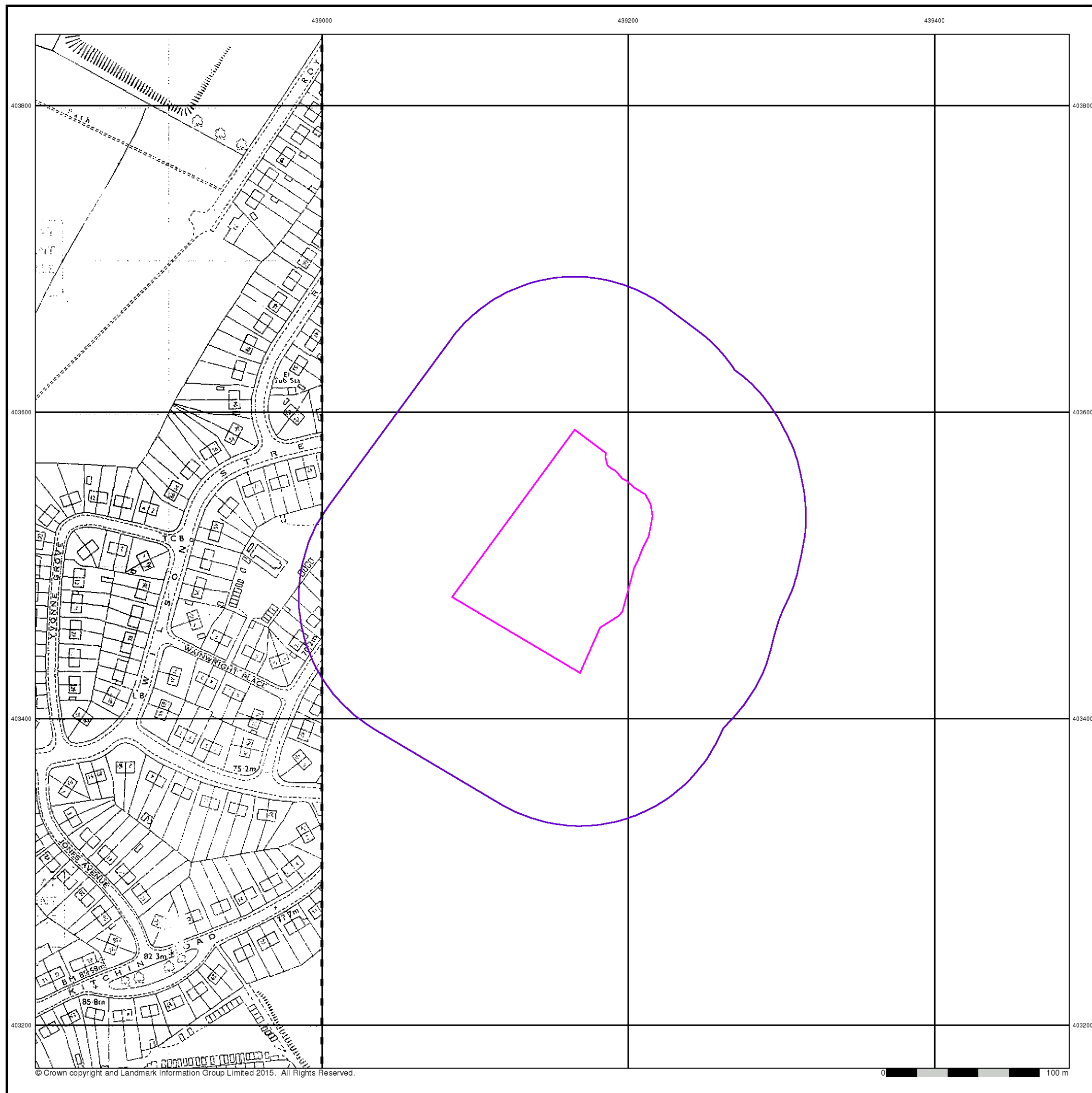


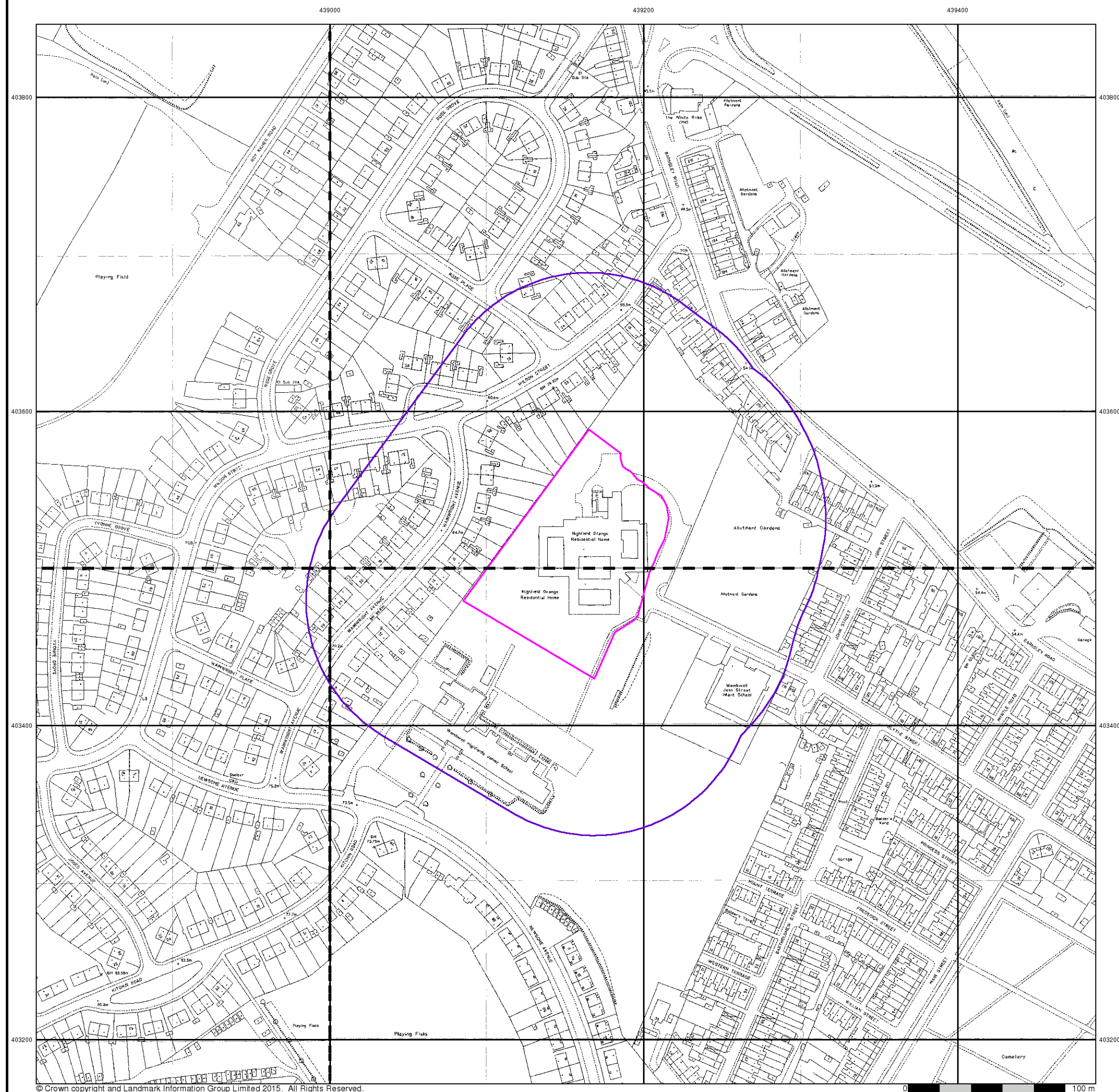
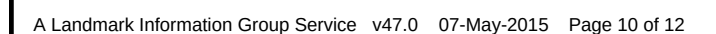
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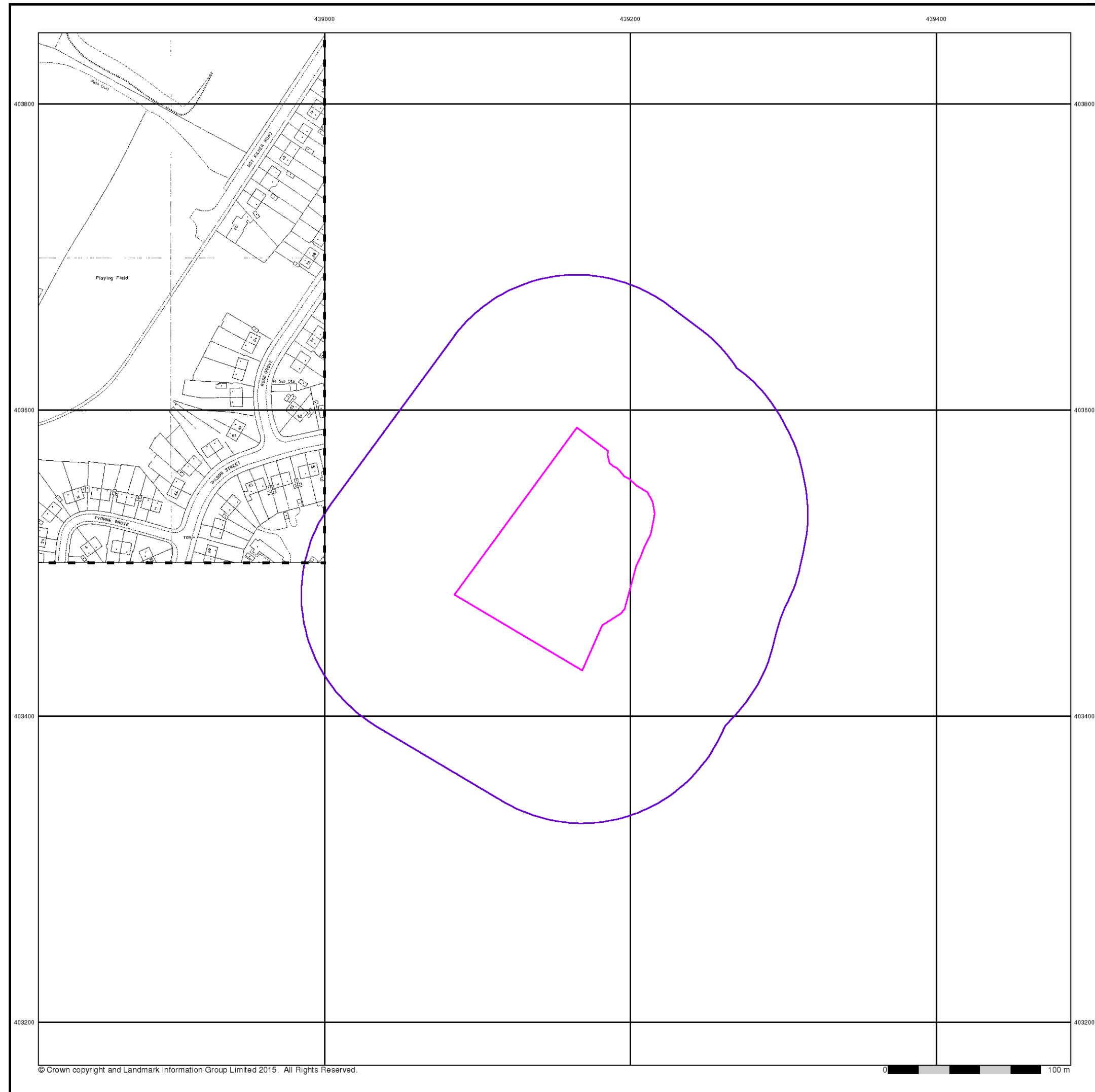
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 Search Buffer (m): 100

Site Details

Blythe street, Wombwell









Large-Scale National Grid Data

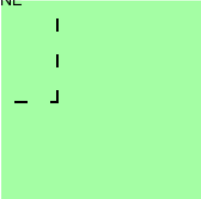
Published 1993

Source map scale - 1:1,250

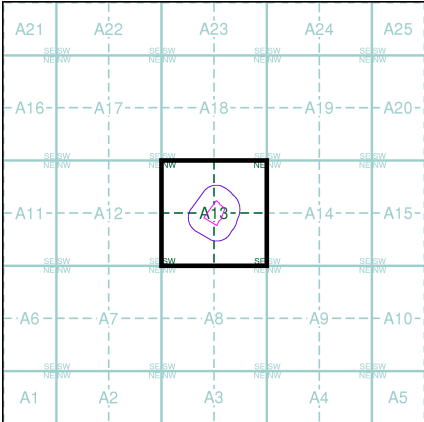
'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)

SE3803NE
1993
1:1,250



Historical Map - Segment A13



Order Details

Order Number:	67251901_1_1
Customer Ref:	38506 Blythe Street, Wombwell
National Grid Reference:	439160, 403510
Slice:	A
Site Area (Ha):	1.11
Search Buffer (m):	100

Site Details

Blythe street, Wombwell



Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

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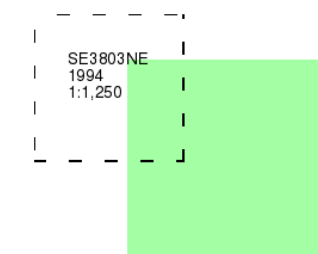
Large-Scale National Grid Data

Published 1994

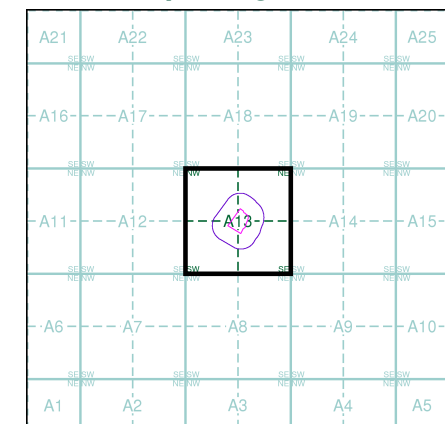
Source map scale - 1:1,250

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



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