GROUND ENGINEERING
Newark Road, Peterborough PE1 5UA
Tel: 01733 566566
Fax: 01733 315280

REPORT ON A SITE INVESTIGATION AT LAND BETWEEN 24 & 30 PLANK DROVE CROWLAND PETERBOROUGH

Report Reference C13802

On behalf of:

Switch Electrical Wholesale Ltd
Head Office
Unit 7, Titan Drive
Peterborough
PE1 5XN

May 2016

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SWITCH ELECTRICAL WHOLESALE LIMITED

STUDIO 11 ARCHITECTURE LIMITED

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Report Reference No. C13802 **May 2016**

INTRODUCTION

Ground Engineering Limited was instructed by the client, Switch Electrical Wholesale Limited, to carry out a site investigation in preparation for residential development of a plot of land located between 24 and 30 Plank Drove, Crowland, Peterborough.

The scope of the site investigation, which had been specified by Studio 11 Architecture Limited, comprised desk study research and an intrusive ground investigation. The ground investigation comprised a single 15m deep cable percussion borehole; four machine excavated trial pits with two soakaway tests; and geotechnical and chemical testing on recovered samples to determine the nature of the underlying soil.

This report provides the findings of the investigation, together with the results of laboratory testing and provides recommendations with respect to the design of foundations, the soakage potential of the ground and the risk of soil contamination being present beneath the site.

LOCATION, TOPOGRAPHY AND GEOLOGY OF THE SITE

The site lies within countryside on the outskirts of the village of Crowland some 10km to the north-east of Peterborough. The site lies on the south-western side of Crowland as shown in Figure 1 and comprised a 40m wide by 50m long field located between two dwellings, Nos 24 and 30, on the eastern side of Plank Drove. The approximate National Grid Reference at the centre of the site is TF 2325 0963.

Whilst there were no trees within the site, mature Leyland Cypress trees formed a low hedgerow along the northern boundary and a tall continuous screen along the south-eastern site boundary.

Plank Drove runs along an embankment which lies at about 3mOD. The site and surrounding fields are at a lower level between 1m and 2mOD and regionally the ground was flat and level. The surrounding fields are bounded by a system of drainage ditches which channel water to pumping stations which artificially control the level of groundwater in the area.

The 1984 geological map at 1:50,000 scale, Sheet 158 'Peterborough', indicates the site to be directly underlain by marine/estuarine sand and gravel (Abbey Gravels). The underlying solid geology is indicated to be the Oxford Clay Formation.

HISTORY OF THE SITE

Research into the site history involved reference to historical maps and plans and information obtained from the internet. The map extracts studied are presented in the desk study map section, Appendix 1, and are described below:

Map Extract Studied	*Description*
1886/87 Ordnance Survey County Series Scale: 1:10,560 **Figure A** **1887/88** Ordnance Survey County Series Scale: 1:2500 **Figure B**	The site is shown undeveloped within a field off Plank Drove and lies about 0.9km to the south-west of Crowland. The area immediately surrounding the site comprises a rectangular grid of drainage ditches and fields. Corporation Bank is located 300m to the north of the site. There are ponds situated some 150m and 300m to the south of the site.
1901/03 Ordnance Survey County Series Scale: 1:10,560 **Figure C** **1901/04** Ordnance Survey County Series Scale: 1:2500 **Figure D**	The site and immediate surrounds appear as shown in the previous maps. A Nursery is shown some 300m to the south-east of the site.
1950 Ordnance Survey County Series Scale: 1:10,560 **Figure E**	Apart from a neighbouring dwelling directly to the north, the undeveloped site and immediate surroundings appear as shown in the previous maps. The field to the north-west contains some small buildings about 150m distant.
1958 Ordnance Survey Sheet TF2309 Scale: 1:2500 **Figure F**	The site and immediate surrounds appear as shown in the previous maps.
1973 Ordnance Survey Sheet TF2309 Scale: 1:2500 **Figure G**	Whilst the site remains undeveloped as a field. Directly to the north, a dwelling called Sundown has been constructed, and also other dwellings are now shown about 35m to the south-west (Lawnwood) and 100m to the north-east along Plank Drove. Fields continue to surround the immediate area of the site and neighbouring dwellings. The field to the north-west contains a small building and a tank some 150m distant.

Map Extract Studied	*Description*
1978/79 Ordnance Survey Sheet TF20NW Scale: 1:10,000 **Figure H**	The site and immediate surrounds appear as shown in the previous maps. There is an area of landfill some 500m to the west.
1982 Ordnance Survey Sheet TF2309 Scale: 1:2500 **Figure I**	A neighbouring dwelling has been constructed directly to the south of the undeveloped site. There are three new buildings around the dwelling previously called Lawnwood, to the south-west of the site.
1995 Ordnance Survey Sheet TF2309 Scale: 1:2500 **Figure J**	The site and immediate surrounds appear as shown in the previous maps.
2002 Ordnance Survey Sheet TF20NW Scale: 1:10,000 **Figure K**	The site and immediate surrounds appear as shown in the previous maps. A new dwelling has been constructed about 10m to the north of the site on the western side of Plank Drove.
2014 GroundSure Aerial Photograph of Site	The site is shown to comprise a green field. The neighbouring dwellings remain unchanged.
2014 Ordnance Survey Sheet TF20NW Scale: 1:10,000 **Figure L**	The site remains undeveloped.

The site which lies within open land crossed with drainage ditches appears to have never been developed other than for agricultural usage. The neighbouring dwelling to the north became established before 1950, has been more recently extended and refurbished. The Dwelling to the south was constructed in the late 1970s/early 1980s.

SUMMARY OF ENVIRONMENTAL DATA

Appendix 2 contains information derived from Environmental Databases for a radius of up to 2000m from the site. The information covers data sets held by the Groundsure with contributors including the local authority, the Environment Agency, British Geological Survey, Ordnance Survey and the Coal Authority and the results, within a radius of 250m, are summarised below:

1. Historical Industrial Sites	**On Site**	**0 - 250m**
Potentially Contaminative Uses identified from 1:10,000 scale mapping	0	6
Historical Tanks	0	1
Historical Energy Features Database	0	0
Historical Petrol and Fuel Site Database	0	0
Historic Garage and Motor Vehicle Repair Database	0	0
Potentially Infilled Ground	0	5
2. Environmental Permits, Incidents and Registers	**On Site**	**0 - 250m**
Industrial Sites Holding Environmental Permits/Authorisations	0	1
Records of COMAH and NIHHS Sites	0	0
Environment Agency Recorded Pollution Incidents	0	0
Sites Determined as Contaminated Land under Part IIA EPA 1990	0	0
3. Landfill and Other Waste Sites	**On Site**	**0 - 250m**
Landfill Sites	0	1
Landfill and Other Waste Sites	0	0
4. Current Land Uses	**On Site**	**0 - 250m**
Current Industrial Sites Data	0	4
Records of Petrol and Fuel Sites	0	0
National Grid Underground Electricity Cables	0	0
National Grid Gas Transmission Pipelines	0	0
5. Geology	**Description**	
Artificial Ground or Made Ground records	No	
Superficial Ground and Drift Geology records	Yes	
6. Hydrogeology and Hydrology	**On Site**	**0 - 250m**
There are productive strata within superficial geology	Yes	
There are productive strata within solid geology	No	
Groundwater Abstraction Licences	0	0
Surface Water Abstraction Licences	0	0
Potable Water Abstraction Licences	0	0
Source Protection Zones	0	0
Groundwater Vulnerability and Soil Leaching Potential	1	1
River Quality Data	No	No
Detailed River Network Entries	0	0

Surface Water Features	No	Yes
7. Flooding	**On Site**	**0 - 250m**
Environment Agency indicative Zone 2 floodplains within 250m of site	Yes	
Environment Agency indicative Zone 3 floodplains within 250m of site	Yes	
What is risk of flooding from rivers and sea	Low	
Flood defences within 250m of site	Yes	
Any areas benefiting from flood defences within 250m of site	No	
Flood storage areas	Yes	
Maximum BGS groundwater flooding susceptibility within 50m of site	Potential at surface	
BGS confidence rating for groundwater susceptibility areas	Moderate	
8. Designated Environmentally Sensitive Sites	**On Site**	**0 - 250m**
Environmentally sensitive sites	1	0
9. Natural Hazards		
Hazard		
Shrinking or Swelling Clay	Moderate	
Landslide Ground Stability	Very Low	
Ground Dissolution (Soluble rocks)	Negligible	
Compressible Ground	Negligible	
Collapsible Ground	Very Low	
Running Sand	Very Low	
10. Mining		
Coal mining areas within 75m of site	No	
Risk of subsidence relating to shallow mining within 150m of site	No	
Brine affected areas within 75m of study site	No	
11. Radon		
The property is not in a Radon Affected Area, as less than 1% of properties are above the action level. No Radon Protective Measures are necessary.		

Database Summary

There are no historical contaminative uses recorded on the site and six historical records within a distance of 250m of the site. These relate to a horticultural nursery recorded between 1900 and 1958, and located about 225m to the south-east of the site.

There are five areas of potentially infilled land within 250m of the site. These relate to a pond (dating between 1886 and 1901) about 83m to 97m to the south; a water body (dating between 1950 and 1976) between 200m and 213m to the north-east and another pond (dating between 1896 and 1900) about 253m to the south.

There is a licensed discharge consent, 43m to the north-west, relating to a bungalow on Plank Drove.

A historic landfill, known as Corporation Bank Landfill, is indicated to be situated 20m to the north of the site and it is recorded that household waste was permitted. It is noted that there is no topographic record of this landfill on any of the historical maps studied in the previous section and a dwelling is located in the north-eastern corner the suspected landfill area in the 1983 map edition. Reference to Google Earth aerial images shows the suspected landfill area to be covered by a grass covered field between 1999 and 2016.

Four records of current industrial data are within 250m of the site. These relate to an industrial estate located between 173m and 243m to the south-east. Activities comprise vehicle repair and servicing, general purpose machinery (landscaping and turf care equipment), sheet metal fabrication and lifting and handling equipment.

No made ground is indicated beneath the site, which is indicated to be underlain by drift deposits comprising Abbey Sand and Gravel which is classified as a Secondary (A) Aquifer. The underlying solid geology of the Oxford Clay Formation is indicated to be classified as Unproductive in terms of aquifer classification.

There are no rivers within about 1000m of the site, however surface water drainage ditches direct water towards pumping stations. There is a low risk of flooding from rivers and potential at surface for groundwater flooding.

The site lies within an area where no Radon Protective Measures are necessary.

PRELIMINARY RISK ASSESSMENT

Potential sources of contamination present on or beneath the site would relate primarily to; the historical use of the site; possible damaged drainage; the presence of contaminated soil; and the potential presence of soil gas beneath the site.

In order to assess the risks associated with the presence of ground contamination the linkages between the sources and potential receptors to contamination need to be established and evaluated. This is in accordance with the Environmental Protection Act 1990, which provides a statutory definition of Contaminated Land. To fall within this definition it is necessary that, as a result of the condition of the land, substances may be present on or under the land such that

- *Significant harm is being caused or there is a significant possibility of such harm being caused; or*
- *Pollution of controlled waters is being, or is likely to be, caused*

There are three principal factors that are assessed whilst undertaking a qualitative risk assessment for any site. These are the presence of a contamination source, the existence of migration pathways and the presence of a sensitive target(s). It should be noted that it is necessary for each element of source, pathway and target to be present in order for exposure of a human or environmental receptor to occur.

UK Government guidance on the assessment of contaminated land, requires risk to human health and the environment to be reviewed using source – pathway – target relationships. If each of these elements is present, the linkage provides a potential risk to the identified targets.

Contaminants or ***potential pollutants*** identified as ***sources*** in relation to the identified previous uses are listed overleaf in Table 1.

Table 1: Identified Potential Contaminant Sources

Contaminant Source	*Comments*
Drainage	Effluent from leaking drains would provide a contaminant source.
Soil Beneath Site	Contamination may be present within any made ground materials on the site.
Soil Gas	Potential soil gas generated from any made ground present
Ground Contamination Outside Site Boundary	Ground contamination migrating from adjoining sites.

A ***Pathway*** is defined as one or more routes through which a receptor is being, or could be, exposed to, or affected by, a given contaminant.

Potential ***Target or Receptors*** fall within the categories of Human Health, Water Environment, Flora and Fauna, and Building Materials.

There are a number of possible pathways for the contaminants identified on the site to impact human and/or environmental receptors and these are summarised in Tables 2 and 3.

Table 2: Human Receptors and Pathways

Human Receptor-Mechanism	*Typical Exposure Pathway*
Human Inhalation	Breathing Dust and Fumes Breathing Gas emissions
Human Ingestion	Eating -contaminated soil, for example by small children -produce grown on contaminated soil Ingesting dust or soil on vegetables Drinking contaminated water
Human Contact	Direct skin contact with contamination Direct skin contact with contaminated liquids

Table 3: Water Receptors and Pathways

Receptor-Water Environment	*Typical Exposure Pathway*
The site is indicated to be underlain by drift deposits comprising Abbey Sand and Gravel which is classified as a Secondary (A) Aquifer. The underlying solid geology of the Oxford Clay Formation is classified as Unproductive.	Surface infiltration of atmospheric waters into the soils beneath the site could wash or dissolve potential contaminants and migrate to underlying groundwater. Contamination leads to restriction/prevention of use as a resource, for example, drinking water, and can have secondary impacts on other resources, which depend on it.
There are no watercourses within 250m of the site.	Surface infiltration of atmospheric waters into the soils beneath the site could wash or dissolve potential contaminants and laterally migrate. Contamination leads to a restriction/prevention of use: -as drinking water resource -for amenity use Effects on aquatic life

Preliminary Conceptual Model

Assessment of the potential linkage between ground contamination sources, human and environmental receptors have been assessed based on the desk study research documented in the preceding sections of this report.

A generalised preliminary conceptual model is presented below in Table 4.

Table 4: Preliminary Conceptual Model Relative to Residential Development

Receptors	Pathway	Estimated Potential for Linkage with Contaminant Sources			
		Drainage	Soil Beneath Site	Soil Gas	Ground Contamination Outside Site Boundary
Human Health – ground workers	Ingestion and Inhalation of contaminated Soil, Dust and Vapour	NA	Low likelihood	Low likelihood	Low likelihood
Human Health – users of completed development	Ingestion and Inhalation of contaminated Soil, Dust and Vapour	NA	Low likelihood	Low likelihood	Low likelihood
Water Environment	Migration through ground into surface water or surrounding groundwater	NA	Low likelihood	Low likelihood	Low likelihood
Flora	Vegetation on site growing on contaminated soil	NA	Low likelihood	Unlikely	Unlikely
Building Materials	Contact with contaminated soil	NA	Low likelihood	Unlikely	Unlikely

Key to Table 4 Estimated Potential for Linkage with Contaminant Source	Definition
High likelihood	There is a pollution 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 pollution 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 is not inevitable, but possible in the short term and likely over the long term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such an event would take place, and is less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.
NA	Not Applicable

SITE WORK

The site work was carried out on 23 March 2016 and comprised a single 15m deep cable percussion borehole (BH1), and four machine excavated trial pits (TP1 to TP4). The borehole and trial pit locations are shown in Figure 2.

The borehole and trial pit records have been produced in accordance with British Standard BS 5930:2015 'Code of Practice for Site Investigations', and are given in Appendix 3. The records provide the descriptions and depths of the various strata encountered and details of installations, samples taken and the groundwater conditions observed during excavation, boring and on completion.

Service plans were consulted and a cable avoidance tool (CAT) was used to check for the absence of buried services prior to boring.

Cable Percussion Borehole

Borehole BH1 was commenced initially by the excavation, using hand tools, of a service inspection pit to a depth of 1.20m in order to ensure the absence of buried services. Representative small disturbed samples of soil were taken from the starter pit. The borehole, BH1, was sunk to 15m depth using a standard cable percussive boring rig and advanced using weighted claycutter and shell tools working initially within 150mm diameter casing inserted to a depth of 3.50m.

Representative small and bulk disturbed samples of soil were taken from the boring tools at regular intervals throughout the depth of each borehole. Undisturbed samples 100mm in diameter were taken at regular intervals within the clay soils. The ends of the samples were capped to maintain them in as representative condition as possible during transit to the laboratory. Water samples were also recovered when sufficient water entered the borehole.

The standard penetration test (SPT) was carried out at regular intervals in order allow the assessment of the relative in-situ density or stiffness of the ground. The test was made

by driving a 60° apex cone, into the coarse soils or rock at the base of the borehole by means of an automatic trip hammer weighing 63.50kg falling freely through 760mm. The penetration resistance was determined as the number of blows required to drive the tool the final 300mm of a total penetration of 450mm into the soil ahead of the borehole. In fine grained soil the 60° apex cone (SPT(C)) was replaced by a split-barrel sampler (SPT(S)). The penetration resistance was determined as the number of blows required to drive the tool the final 300mm of a total penetration of 450mm into the soil ahead of the borehole.

A soil gas and groundwater monitoring installation was fitted into BH1 to depth of 10.00m. The borehole below 10.00m was backfilled with materials arising. The installation comprised a 50mm diameter perforated plastic pipe where the annulus between the pipe and the borehole was backfilled with silica gravel to a depth of 1.00m. A bentonite seal was inserted between 0.50m and 1.00m, above which the tube was sealed by a gas valve and a surface protective cover was fixed in concrete.

Trial Pits

The trial pits (TP1 to TP4) were excavated, to depths of 2.10m and 2.50m, using a JCB3CX machine. The exposed strata in the trial pits were sampled and logged by a geo-environmental engineer and representative disturbed and bulk samples were taken throughout the depth of each pit. Disturbed soil samples were sealed in polycarbonate pots and amber glass jars pending possible selection for contamination testing.

On completion each trial pit was backfilled with compacted layers of the arisings.

Soakaway Testing

In-situ soakaway tests were carried out in at two locations in general accordance with BRE Digest 365 in order to allow the assessment of the soil infiltration rate. Water for the tests was provided via hoses from a lorry water tanker. The tests were performed within TP1 and TP2, which were approximately 1.60m long by 0.60m wide with vertical sides trimmed square to

the base at 2.30m and 2.50m. The dimensions were accurately measured and recorded and the pit was then filled with clean water to levels of about 0.82m and 0.98m depth below the ground surface. The rate of water dissipation from each test pit was measured by recording the depth of water at frequent time intervals. The results of the tests are presented following the trial pit records in Appendix 3. Due to the slow rate of water dissipation the pits were only filled once and the results have been extrapolated.

Return Site Visits

Return visits to site were undertaken on 13, 20 and 27 April 2016 to monitor the standpipe installation in BH1 for depth to groundwater and the concentrations of methane, carbon dioxide and oxygen. Measurement was carried out using a Gasdata GFM430, which also recorded the atmospheric pressure and flow rate. The monitoring results are presented following the borehole records in Appendix 3 and the results of the groundwater monitoring have also been included on the borehole records.

GEOTECHNICAL LABORATORY TESTING

Samples recovered from the exploratory holes were tested in accordance with the recommendations of British Standard BS1377:1990 'Methods of Tests for Soils for Civil Engineering Purposes' and other industry standards. The results of testing are presented on Laboratory Summary Sheets in Appendix 4.

Soil Moisture Content

The moisture content of selected samples was determined and the results are reported as the percentage water content with respect to the dry mass of soil.

Atterberg Limit Tests

The liquid and plastic limits, and plasticity index, were determined for selected specimens for the purpose of engineering soil classification. The results are quoted as the percentage water with respect to the dry weight of soil.

Undrained Shear Strength

Single-stage (Q) compression tests were carried out to determine the undrained shear strength of selected undisturbed samples. The moisture content, bulk and dry densities of the specimens were also determined as part of the test procedure. A plot of measured undrained shear strength versus depth is presented in Appendix 4.

Sulphate and pH Testing

Selected soil samples were tested to determine their pH-values and aqueous sulphate contents in order to provide advice on assessing the aggressive chemical environment in relation to buried concrete.

CHEMICAL LABORATORY TESTING

Selected soil samples were submitted to a UKAS Accredited Laboratory who carried out a suite of tests which encompassed a wide range of potential contaminants outlined by the Environment Agency (EA) and National House Building Council (NHBC) document R&D 66; 2008 'Guidance for the Safe Development of Housing on Land Affected by Contamination'.

Tests were carried out to screen the soil samples for the following potential contaminants: total arsenic, total cadmium, total chromium, hexavalent chromium, total lead, total mercury, total selenium, water soluble boron, total copper, total nickel, total zinc, total cyanides, free cyanides, soluble sulphate, sulphides and pH-value, phenols and polyaromatic hydrocarbons (PAH), including benzo[a]pyrene. The results of chemical testing are presented in Appendix 5.

GROUND CONDITIONS

The strata encountered in the borehole (BH1) and trial pits (TP1 to TP4) comprised 0.30m to 0.60m thickness of made ground/topsoil over Abbey Gravel. In BH1 the Abbey Gravel was underlain at a depth of 3.00m by the Oxford Clay solid geology which was proved to at least 15.00m.

Made Ground and Topsoil

Made ground/topsoil was encountered with a thickness of 0.30m and 0.60m and comprised soft, dark brown, slightly sandy, slightly gravelly clay. Gravel of angular to sub-rounded flint, quartzite and brick.

Abbey Gravel

The Abbey Gravel was encountered underlying the made ground/topsoil at depths between 0.30m and 0.60m and comprised an interbedded sequence of soft and firm, grey and orange brown, slightly sandy, slightly gravelly clay; and silty sand and gravel. According to standard penetration test data the sand/gravel in BH1 was medium dense in relative density.

The trial pits TP1 to TP4 were completed within the Abbey Gravel at depth between 2.10m and 2.50m and the base of the Abbey Gravel was encountered at 3.00m in BH1.

Oxford Clay Formation

The Oxford Clay Formation was encountered in BH1 underlying the Abbey Gravel at a depth of 3.00m and comprised a sequence of stiff becoming very stiff, fissured, grey clay which contained bands of extremely weak, grey mudstone at depths between 10.00m and 11.50m; and 12.80m and 13.00m. Borehole BH1 was completed within very stiff, grey Oxford Clay at a depth of 15.00m.

Groundwater and Observations

Groundwater was encountered in the borehole and trial pits at depths between 1.40m and 1.80m. Standpipe water levels in BH1 were recorded at depths of 0.80m to 0.92m between 13 and 27 April 2016.

Live roots were observed to a depths of between 1.00m and 1.20m.

COMMENTS ON THE GROUND CONDITIONS IN RELATION TO FOUNDATION DESIGN AND CONSTRUCTION

The findings of this ground investigation indicate that the site is underlain by a sequence of superficial deposits, the Abbey Gravel, whose bearing properties were variably poor in nature such that traditional trench fill foundations would be considered unsuitable for the proposed dwelling. The proximity of the mature Leyland Cypress trees screen along the eastern site boundary and the presence of clay soil would mean that a raft foundation would also not be considered to be a foundation option at this site.

Consequently consideration should be given to piled foundations taken into the underlying solid geology of the Oxford Clay Formation.

Piled Foundations

The ground conditions are suitable for bored, CFA, or driven piles although vibrations during the installation of driven piles could damage nearby buildings and structures.

The ultimate load on a single bored pile located in the vicinity of borehole BH1 may be estimated for preliminary cost and design purposes using the pile bearing coefficients given below which are based on the following assumptions.

1. Ultimate shaft friction/adhesion within the made ground, soft clay Abbey Gravel are ignored.
2. The shaft friction values within the sand/gravel Abbey Gravel would be a function of the overburden pressure and SPT 'N' values.
3. The shaft adhesion would be a function of the average cohesion of the clay in which the pile is embedded. A value of 0.5 is considered to be an appropriate adhesion factor for the firm clay Abbey Gravel and stiff Oxford Clay encountered. A plot of apparent cohesion in the Oxford Clay is provided after the borehole records in Appendix 4.

4. The end-bearing load within the stiff and very stiff Oxford Clay would be nine times the average cohesion at the level of the pile toe. The end bearing values adopted for the extremely weak mudstone layers within the Oxford Clay are limited by the strength of the undelying very stiff Oxford Clay.
5. A factor of safety of at least 2.0 would be used to assess pile working loads. If test loading of selected piles were not practical, the factor of safety would be increased to at least 2.5.

Item	**Ultimate Pile Bearing Value kN/m² (Bored)**
Shaft adhesion/friction in made ground and soft clay (Abbey Gravel)	Nil
Average shaft resistance in firm clay (Abbey Gravel)	20
Average shaft resistance in Sand/Gravel (Abbey Gravel)	10
Average shaft resistance in stiff clay (Oxford Clay)	60
Average shaft resistance in very stiff clay (Oxford Clay)	100
End bearing in stiff Oxford Clay below 6m	1080
End bearing in very stiff Oxford Clay below 8m	1620
End bearing in Extremely weak mudstone and very stiff Oxford Clay below 10m	2700

As a preliminary guide to pile design, the following safe working loads could be expected respectively from 250mm and 450mm diameter bored piles, end bearing at depths of 6m and 10m within the Oxford Clay. The calculations incorporate a factor of safety of 2.5 on shaft adhesion and end bearing.

	Pile Length	**Working Load for bored pile**	
		250mm Diameter	450mm Diameter
BH1	6m	85kN	180kN
BH1	10m	230kN	490kN

Different pile lengths, or diameters, from those listed above would give different available working loads, which could be tailored to suit the working loads required. The working load obtained from a given pile will be highly dependent upon the method of installation and it is recommended that the final design of piles should be undertaken by a piling specialist.

Floor Slab

Ground bearing floor slabs should not be placed on the made ground or the Abbey Gravel which are considered geotechnically unsuitable. Consequently the building floor slab should be suspended off the piled foundations in order to avoid differential movements between the slab and the main structure and to avoid surcharge of the inferior soils.

Foundation Excavations and Groundwater

The stability of all soils beneath this site should not be relied upon to stand unsupported even in the short term. Safety precautions should not be neglected especially where personnel are to enter excavations, when close side support will be required in order to maintain excavation stability.

Groundwater was encountered as seepages in the borehole and trial pits at depths between 1.40m and 1.70m. Standpipe water levels in BH1 were recorded at depths of 0.80m to 0.92m between 13 and 27 April 2016. It is therefore likely that excavations would encounter water seepages which would be more prevalent following periods of wet weather due to surface infiltration. Within shallow excavations it is likely that water ingress could be controlled by screened sump pump techniques.

Buried Concrete

Tests on the samples of water and the Oxford Clay to determine the risk of sulphate attack on buried concrete indicate levels that fall into Class DS-1 and DS-2 categorisation as defined by Table C1 of BRE Special Digest 1, 2005. The pH results indicate slightly alkaline ground conditions with pH values ranging between 7.2 and 7.8.

For the purposes of design an Aggressive Chemical Environment for Concrete (ACEC) Class of AC-2 should be considered when specifying a Design Chemical Class (DC Class) for buried concrete on this site.

An extract of Table C1, Aggressive Chemical Environment for Concrete (ACEC) site classification, from BRE Special Digest 1, 2005 is presented in Appendix 6.

Soakaways and Comments on Soil Permeability

Soakaway tests were carried out in trial pits TP2 and TP3 at a respective depths of 1.70m and 1.80m to provide an indication of the soils permeability.

The results of the soakaway tests indicates an infiltration rates of 1.33×10^{-6} m/s (TP2) and 2.19×10^{-6} m/s (TP3) for the Abbey Gravel, which corresponds to a poor drainage potential in accordance with BS8004: 1986, Section Six Figure 6.

The combination of poor drainage potential and shallow groundwater, standing at depths of between 0.80m and 0.92m, would indicate that soakaways are unlikely to be effective at this site.

COMMENTS ON THE SOIL CHEMICAL TESTING

The results of the laboratory chemical testing on near surface soil samples have been compared to CLEA Soil Screening Values (SSVs) and Category 4 Screening Levels (C4SLs), which have been used as screening tools for use in the assessment of land affected by contamination.

Atkins Limited has derived ATRISKsoil SSVs based on the default assumptions provided in SR3, which have been used in the development of the Soil Guideline Values (SGVs) published by the Environment Agency in 2009. Atkins SSVs have been derived in line with the Environment Agency 2009 guidance (SR2, SR3, SR4, SR7) using the CLEA v1.04 and CLEA v1.06 software. These are provided under licence to Ground Engineering Limited, and respective toxicology reports and technical details on the derivation of the SSVs can be provided on request.

Following revised statutory guidance to support Part 2A of the Environment Protection Act (2012), Final Category 4 Screening Levels have recently been published (for arsenic, benzo(a)pyrene, cadmium, chromium VI and lead) by the Department for Environment Food and Rural Affairs in their document SP1010: 2014. With the exception of lead and chromium VI, the C4SLs are higher than the SSVs.

The following standard land uses form the basis of the assessment in relation to soils:

- Residential use with home grown produce
- Residential use without home grown produce
- Commercial and industrial usage

The intended purpose of the SSVs are as "intervention values" in the regulatory framework for assessment of human health risks in relation to land use. These values are not binding standards, but are intended to inform judgements about the need for action to ensure that a new use of land does not pose any unacceptable risks to the health of the intended users.

Table 5 compares the test results for the made ground with the SSVs, and C4SLs for lead and chromium VI in relation to the specified uses. The number of test results, which exceed these values, are also provided.

Table 5: Comparison of Chemical Test Results for Near Surface Soil with Soil Screening Criteria SSC

Determinand	Number of Samples	Min Value (mg/kg)	Max Value (mg/kg)	Number of Samples Exceeding SSC for:			Measured 95th Percentile (mg/kg)	Soil Screening Criteria SSC (1% SOM)			
				Residential with home grown produce	Residential without home grown produce	Commercial / Industrial		Assessment Method	Residential with home grown produce (mg/kg)	Residential without home grown produce (mg/kg)	Commercial/ Industrial (mg/kg)
Organic matter	2	9.0%	12%	-	-	-	-	-	-	-	-
Arsenic	2	19	31	0	0	0	-	SSV	32	35	640
Cadmium	2	0.25	0.34	0	0	0	-	SSV	10	83	230
Trivalent* Chromium	2	35	54	0	0	0	-	SSV	12,800	15,500	21,300
Hexavalent Chromium	2	<0.50	<0.50	0	0	0	-	C4SL#	21	21	49
Lead	2	35	74	0	0	0	-	C4SL#	200	310	2330
Mercury	2	0.12	0.24	0	0	0	-	SSV	6	7	66
Selenium	2	0.77	0.79	0	0	0	-	SSV	350	595	13,000
Nickel	2	23	37	0	0	0	-	SSV	130	130	1800
Phenols	2	<0.30	<0.30	0	0	0	-	SSV	162	262	686
Benzo[a]pyrene	2	<0.10	<0.10	0	0	0	-	SSV	0.8	0.9	14
Copper	2	19	30	0	0	0	-	SSV	3970	8370	109,000
Zinc	2	67	100	0	0	0	-	SSV	16,900	46,800	917,000
Free Cyanide	2	<0.50	<0.50	0	0	0	-	SSV	34	34	34

Notes

*The concentration of Trivalent Chromium is assumed to be equivalent to the Total Chromium concentration.
This is because most naturally occurring chromium is in the trivalent (chromic) state.

#C4SL at 6% SOM

Discussion of Results

None of the determinands exceeded the SSC for the proposed residential usage.

UPDATED CONCEPTUAL MODEL

Assessment of the potential linkage between ground contamination sources and human or environmental receptors have been assessed based on the desk study research and the intrusive ground investigation documented in the preceding sections of this report. A generalised conceptual model, updated following the intrusive works, monitoring and testing, relative to the construction phase and completed development with no remediation undertaken, is presented below in Table 6.

Table 6: Updated Conceptual Model Relative to Development

Receptors	Pathway	Estimated Potential for Linkage with Contaminant Sources			
		Drainage	Soil Beneath Site	Soil Gas	Ground Contamination Outside Site Boundary
Human Health – site/ground workers	Ingestion and Inhalation of contaminated Soil, Dust and Vapour	NA	Very Low risk	Very Low risk	Low risk
Human Health – users of completed development	Ingestion and Inhalation of contaminated Soil, Dust and Vapour	NA	Very Low risk	Very Low risk	Low risk
Water Environment	Migration through ground into surface water or surrounding groundwater	NA	Very Low risk	Very Low risk	Low risk
Flora	Vegetation on site growing on contaminated soil	NA	Very Low risk	Very Low risk	Very Low risk
Building Materials	Contact with contaminated soil	NA	Low risk	Very Low risk	Very Low risk
Key to Table 6 Risk	**Definition**				
Very High risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, or there is evidence that severe harm to a designated receptor is currently happening. The risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.				
High risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) and remedial works may be necessary in the short term and likely over the long term.				
Moderate risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild.				
Low risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.				
Very Low risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.				
NA	Not Applicable				

COMMENTS ON GROUND CONTAMINATION IN RELATION TO PROPOSED DEVELOPMENT

The client proposes the development of the site as an individual dwelling.

This investigation may not have revealed the full depth or extent of made ground or contamination on the site and appropriate professional advice should be sought if subsequent site works reveal materials that may appear to be contaminated.

Anticipated exposure scenarios relating to the site and future use, in the context of the conceptual model, are discussed as follows.

Drainage

It is understood that there are no drains crossing the site.

Soil

The soils would be considered suitable for use within the proposed residential development.

Soil Gas

A historic landfill is indicated to be situated 20m to the north of the site and it is recorded that household waste was permitted. The suspected landfill area is estimated to lie at about 1.5mOD and the groundwater must lie within 1m of the ground surface. From a practical point of view the landfill documentation is probably a record of land raising. A dwelling is located in the north-eastern corner the suspected landfill area in the 1983 map and would suggest that it was filled over 33 years ago. There is no typical figure for the length of time that landfill gas will be evolved but at many sites significant gas generation can be expected to continue for a period, which is likely to be at least 15 to 25 years after the last deposit of waste. On this basis it would

be expected that any gas generating processes within the landfill would be well past their peak indicating a very low likelihood for gas generation based on an age exceeding 33 years.

Soil gas monitoring of the borehole installation, BH1 during return visits to site on 13, 20 and 27 April 2016, encountered soil gas concentrations of less than 0.1% by volume methane and between <0.1% and 0.8% by volume carbon dioxide. The in-situ measurements revealed flow rates from the standpipe of less than 0.1l/hr. Oxygen concentrations of between 19.7% and 20.4% by volume were measured.

The results indicate a Gas Screening Value (GSV) of 0.0001l/hr for methane and 0.0008l/hr carbon dioxide. The GSVs fall within a characteristic gas situation CS1 as defined in Table 2 of BS 8485:2015.

Overall the results of this investigation would suggest a very low hazard potential such that no specific scheme of gas protection would be considered necessary.

Human Health - Construction Workers

No special precautions would be required during the development of the site by workers who may come into contact with the soil during groundworks, providing standard precautions are adopted which should generally include the procedures given by the Health and Safety Executive (The Blue Book).

For the protection of these workers during groundworks the following is recommended:

a) Limit repeated or prolonged skin contact with soils by wearing gloves with sleeves rolled down.

b) Washing facilities should be made available to groundworkers, so as to minimise the potential for inadvertent ingestion of soil.

c) If any soils are revealed which are different to those encountered by this ground investigation, the advice of a specialist should be sought in view of classifying the material and ascertaining its risk to groundworkers.

d) Health and safety measures should be implemented to protect groundworkers from depleted oxygen concentrations and from the ingress of carbon dioxide, when entering excavations.

Human Health - Users of Completed Development

There is no historic contaminative use associated with the site and the results of the laboratory analysis indicate soils would be considered suitable for use within the proposed residential development and consequently no remedial action would be considered necessary.

Water Environment

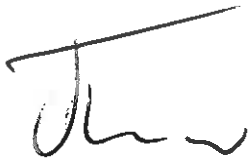
In summary the site has never been developed and lies within a rural area and has never been previously developed. The risk of soils present on the site causing pollution of controlled waters is considered to be very low.

Off-Site Disposal of Soil Arisings

The results of chemical analysis are provided in Appendix 5 and can be used within the suite of information necessary for basic characterisation of the soil destined for landfill. Excavated material and excess spoil should always be classified prior to removal from site as required by 'Duty of Care' (Environmental Protection Act, 1990) legislation. This means that material has to be given a proper description and waste classification prior to removal. Basic characterisation is the responsibility of the waste producer and compliance checking and on-site verification are generally the responsibility of the landfill operator. The landfill operator will need to liaise with the waste producer as the approach relies on the information from basic characterisation.

The clean arisings from the underlying natural soils, excluding peat and topsoil, across this site should fall under the EWC code 17 05 04 inert category.

GROUND ENGINEERING LIMITED





J. H. GIBB

B.Sc. (Hons.), M.Sc. (Eng.), C.Geol., F.G.S.

Senior Geo-Environmental Engineer

C. M. J. EBELING

M.Sc.(Eng.), M.A.E.G., C.Geol., F.G.S.

Director

Figures

Figure 1: Site Location Plan

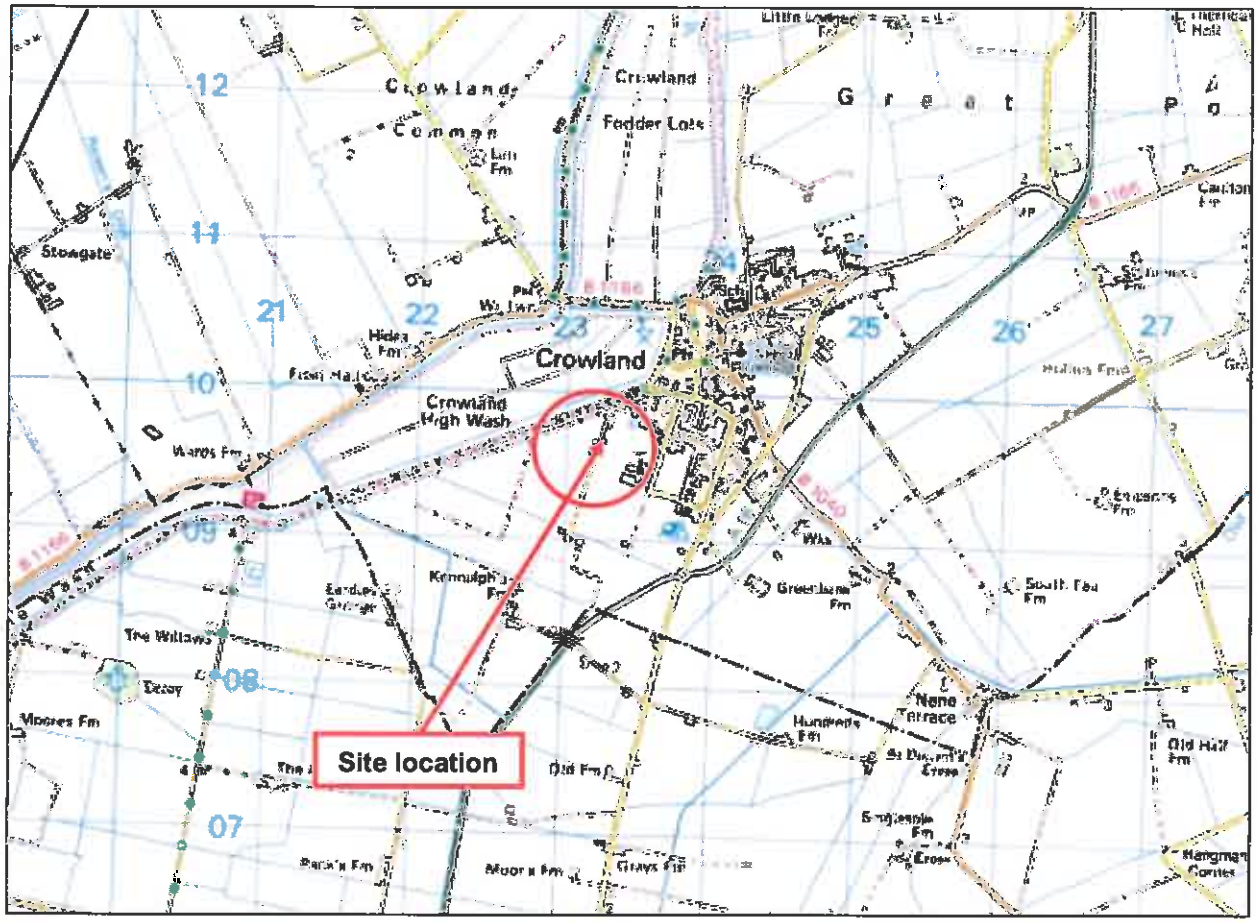
Figure 2: Exploratory Hole Location Plan

Site Location Plan

Figure 1

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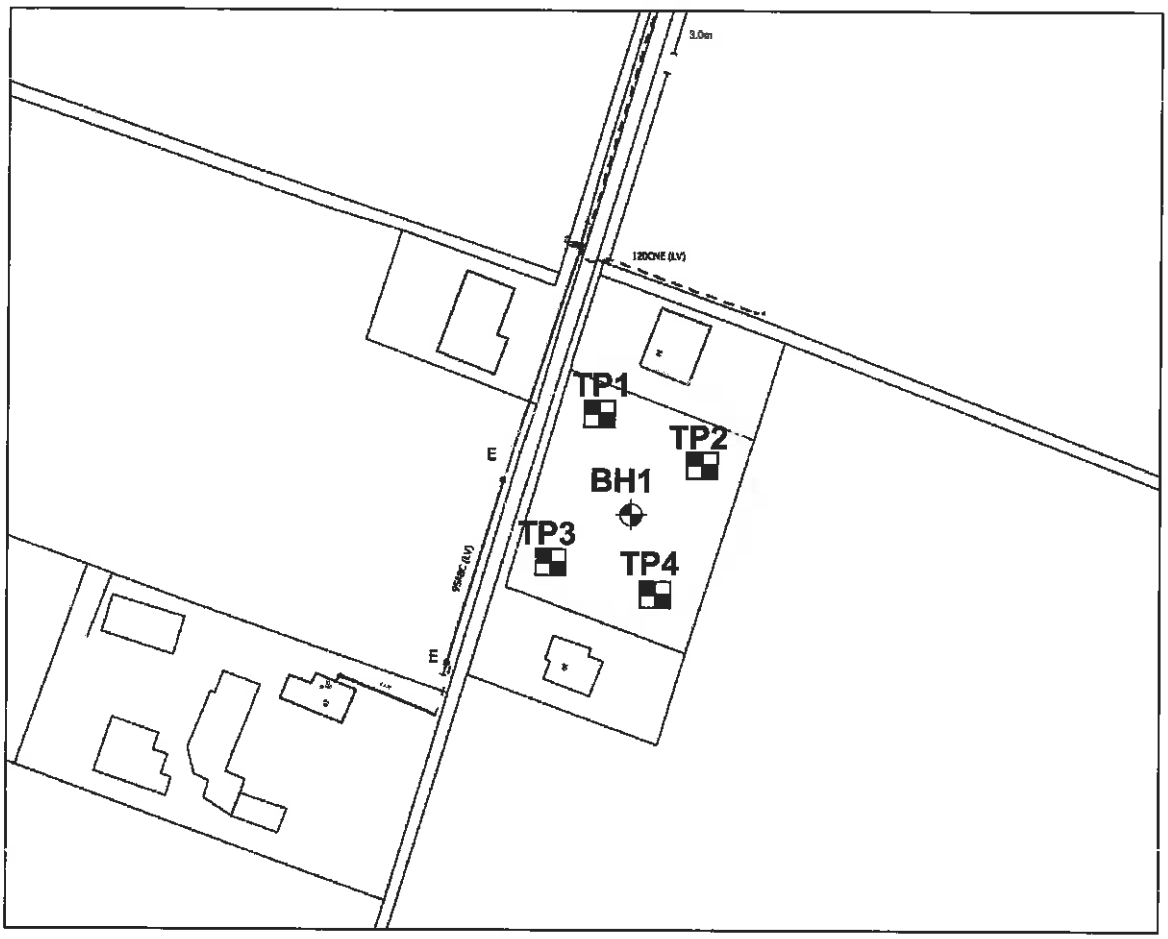
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Exploratory Hole Location Plan

Figure 2

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Scale

40m

KEY

Borehole BH1

Trial Pits TP1 to TP4

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Appendix 1

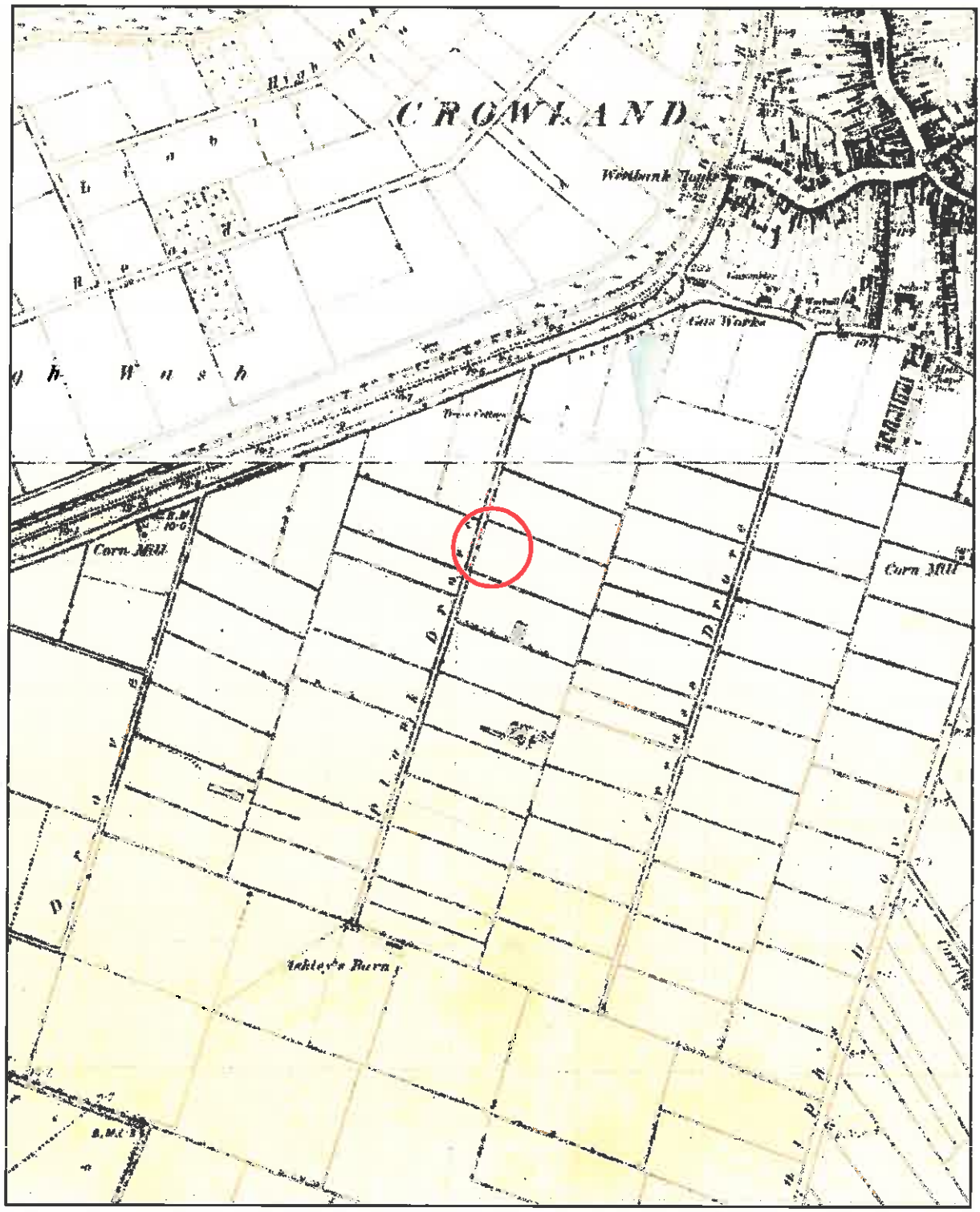
Historical Maps Extracts

Site History

Figure A

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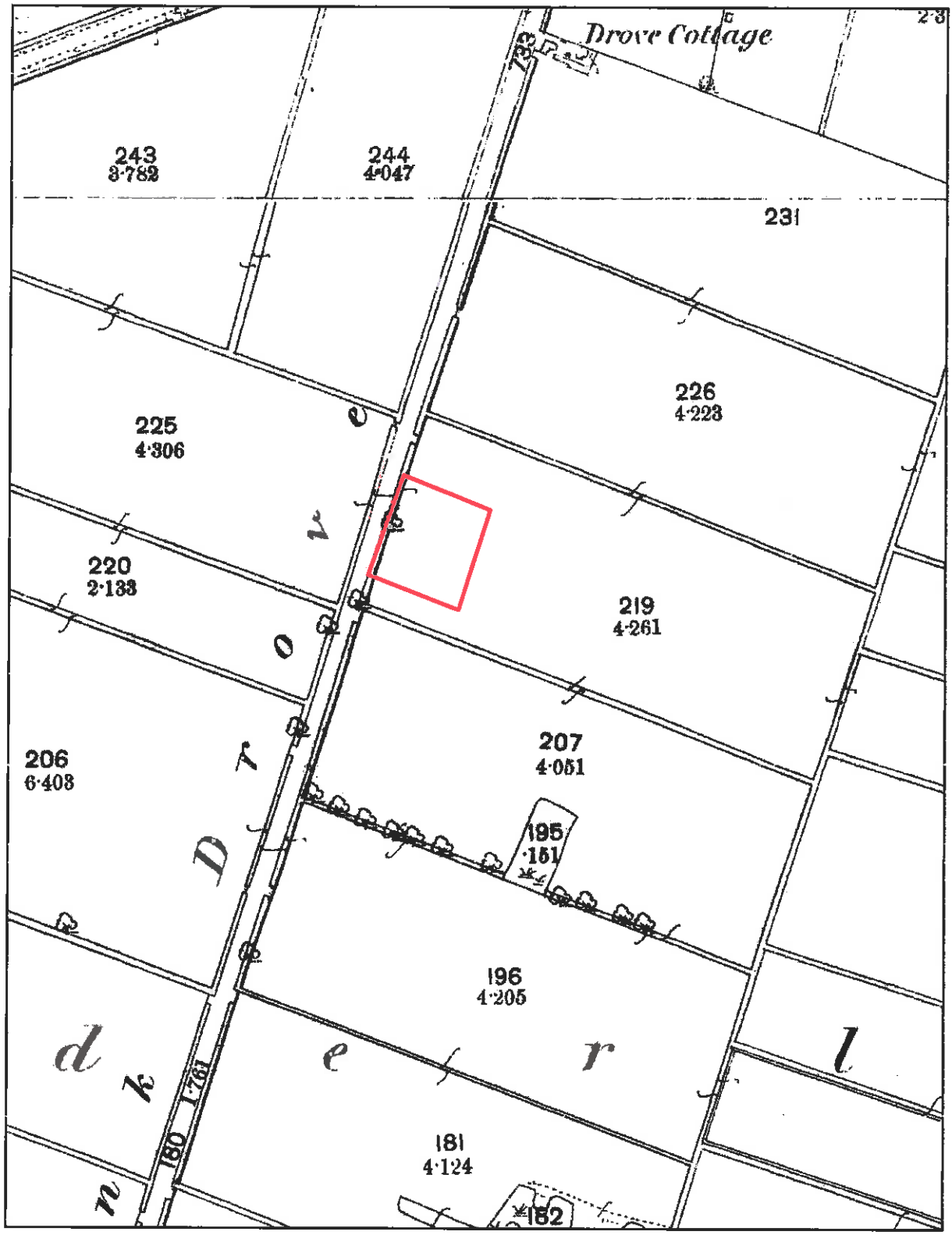
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Site History

Figure B

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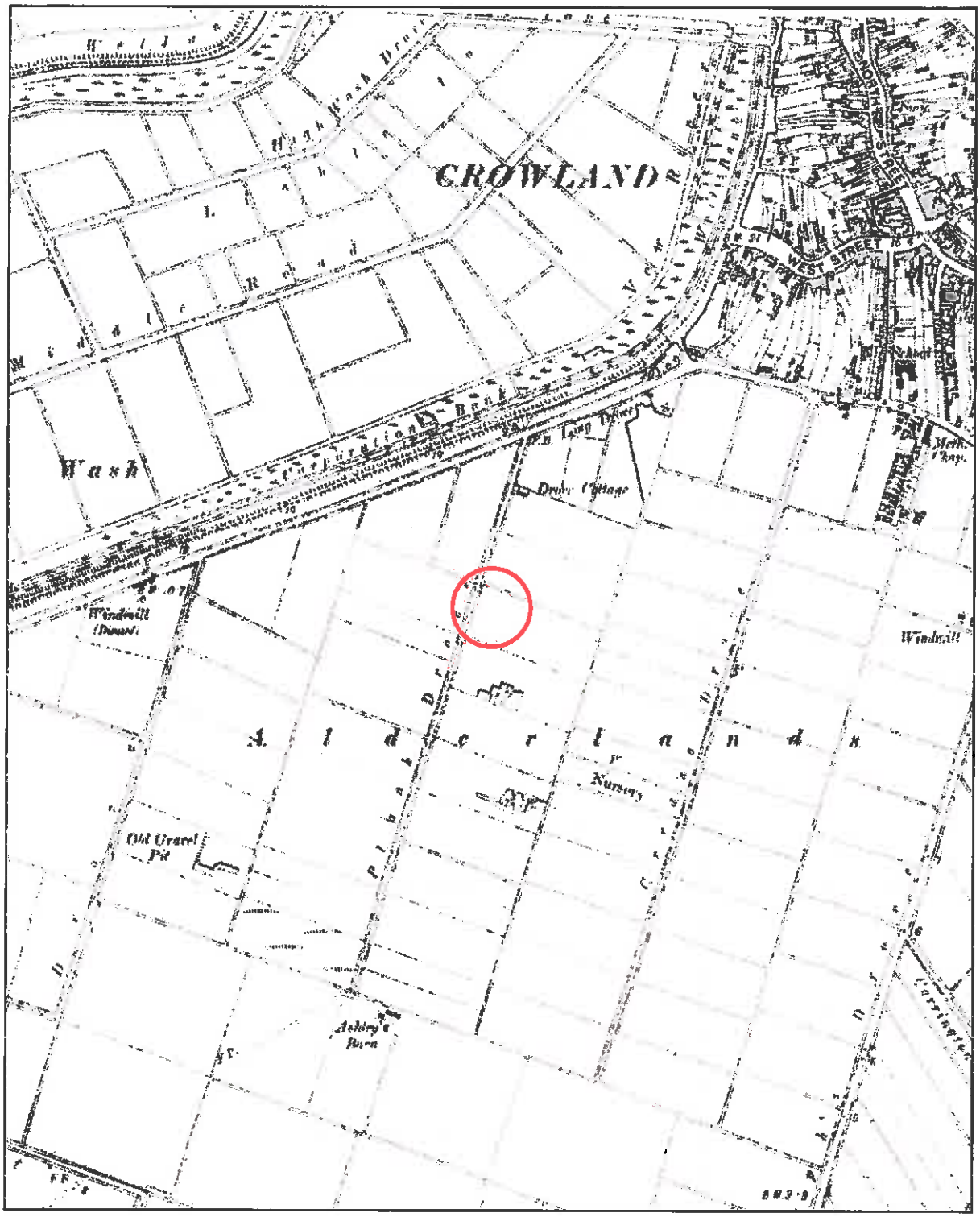
01-02

Site History

Figure C

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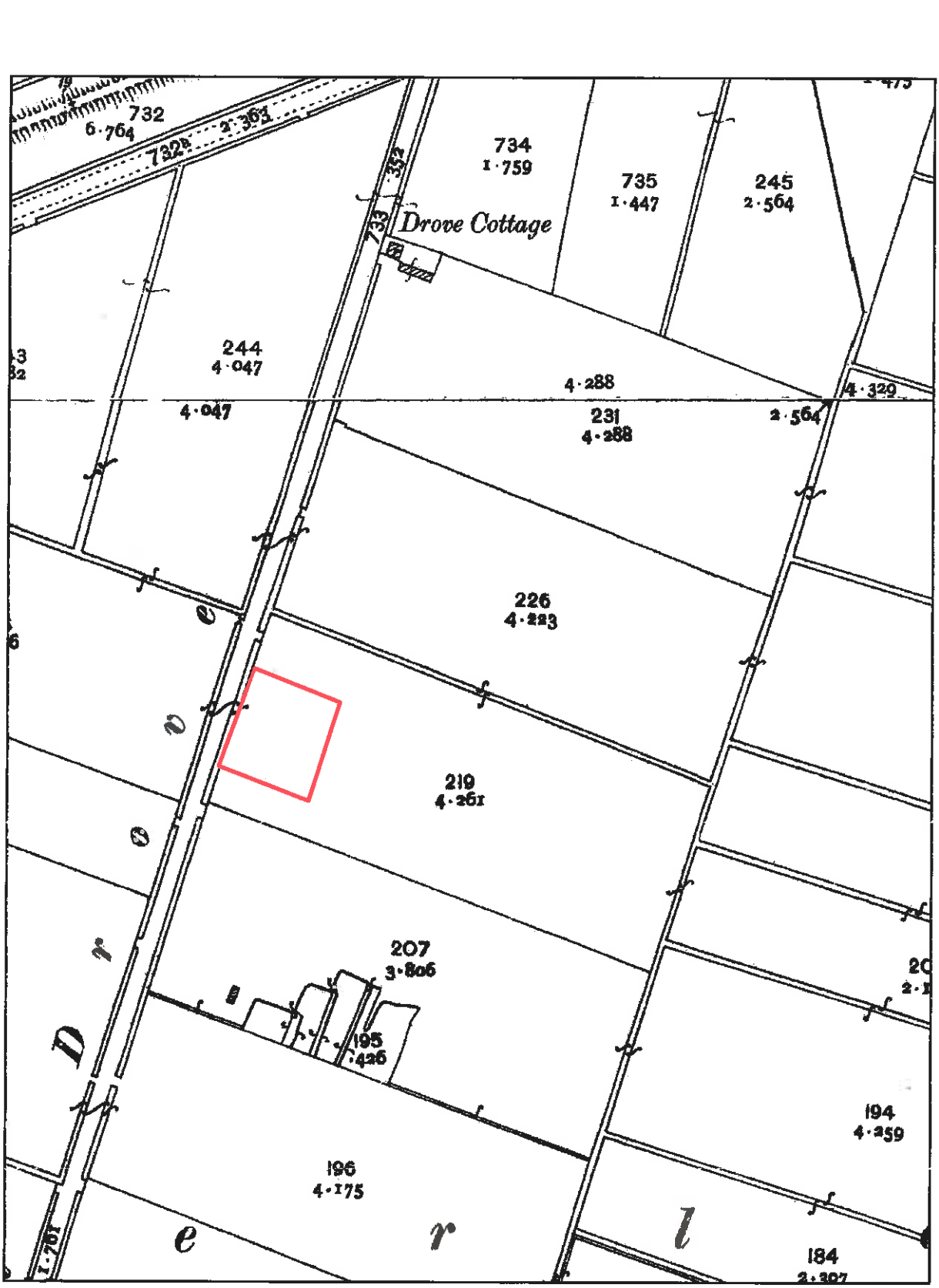


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Site History

Figure D

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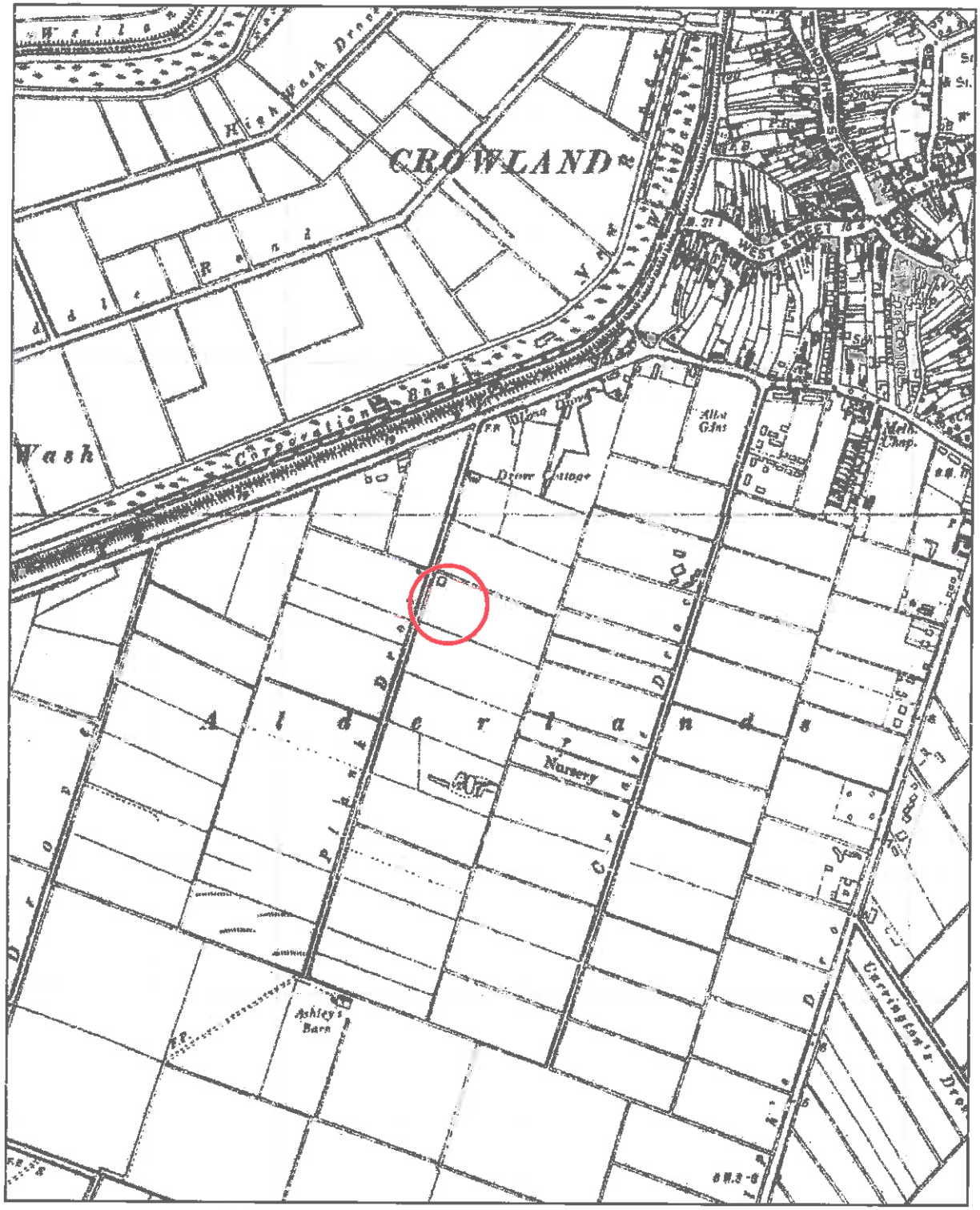
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Site History

Figure E

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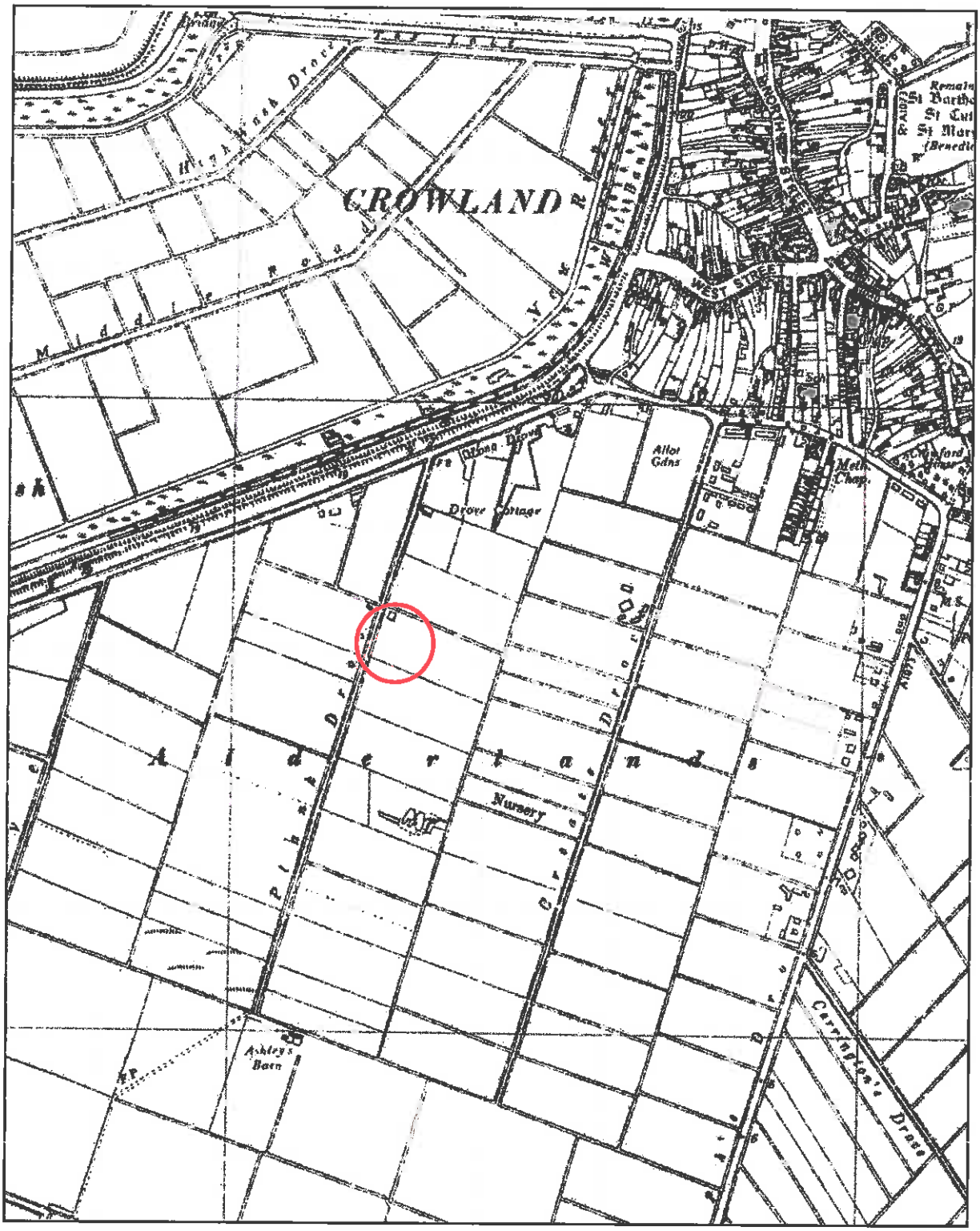
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Site History

Figure F

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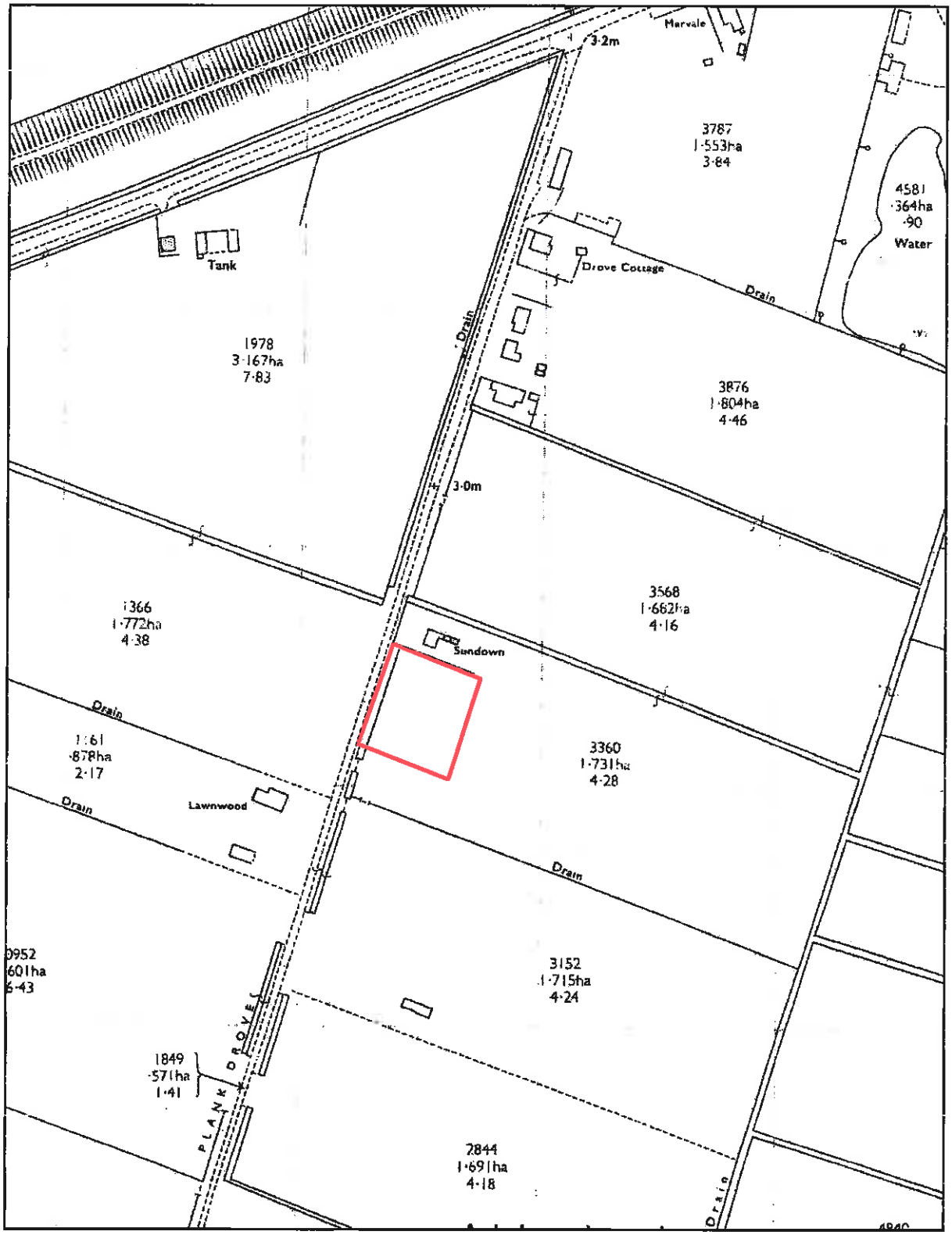
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Site History

Figure G

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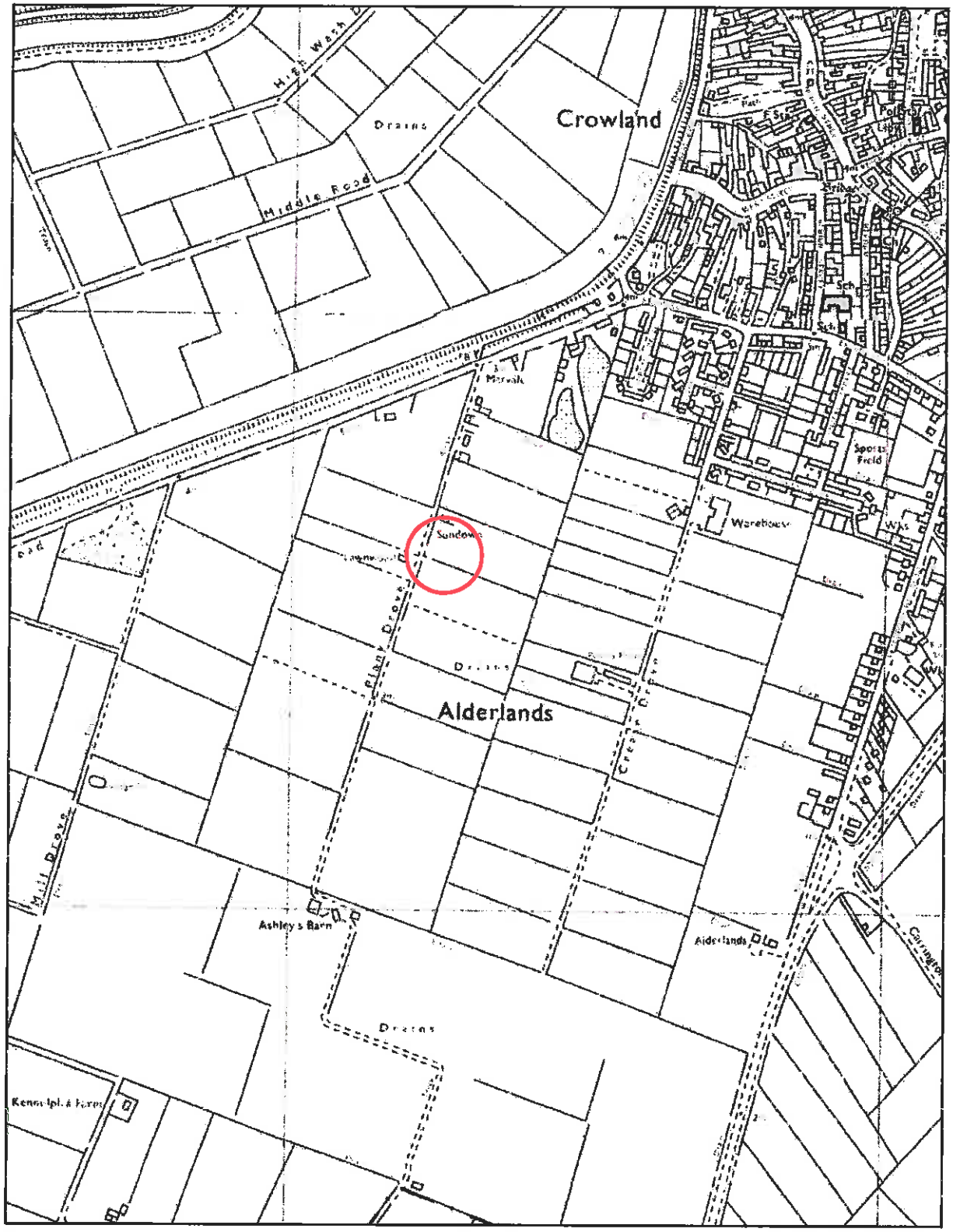
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Site History

Figure H

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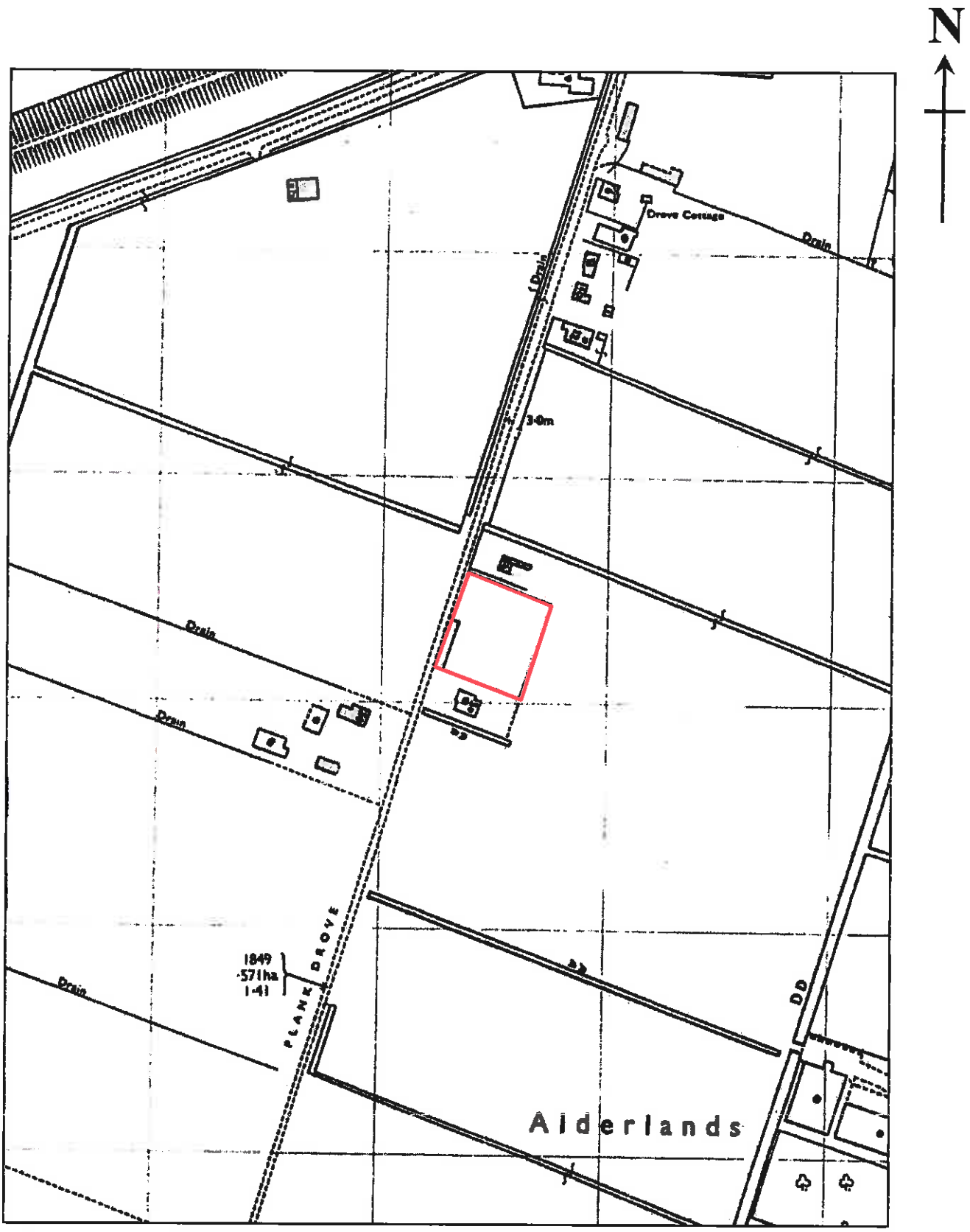


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Site History

Figure I

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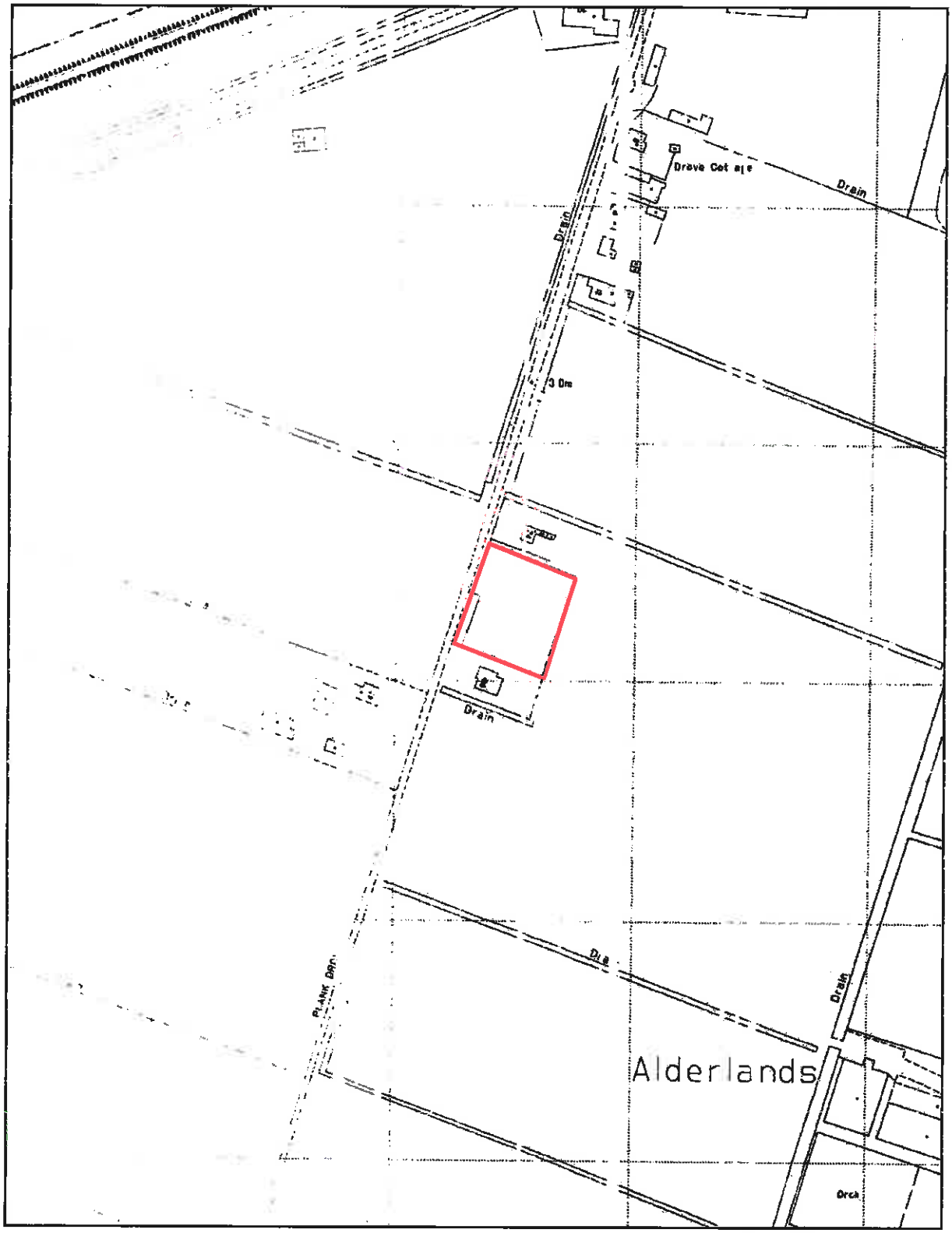
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Site History

Figure J

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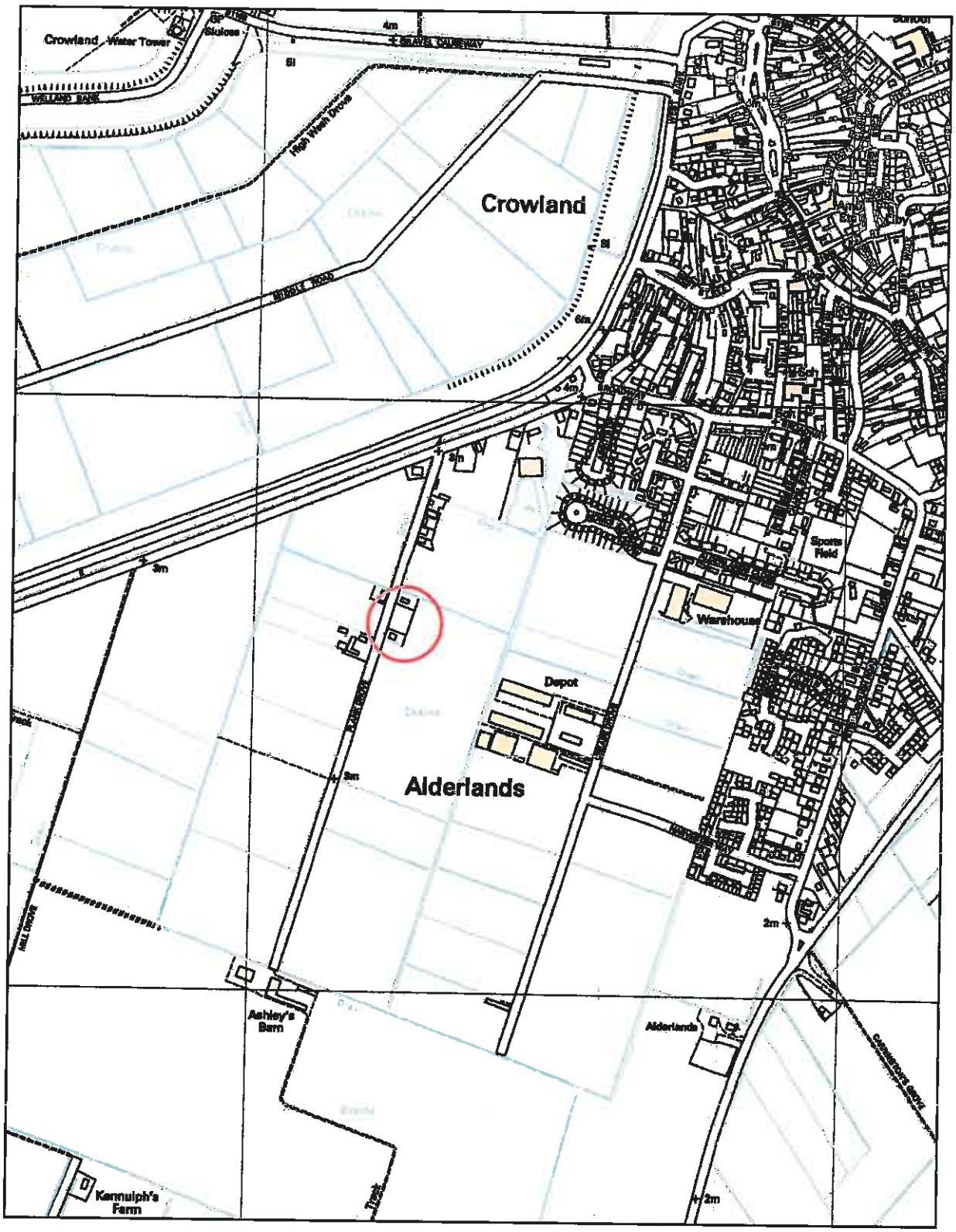
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Site History

Figure K

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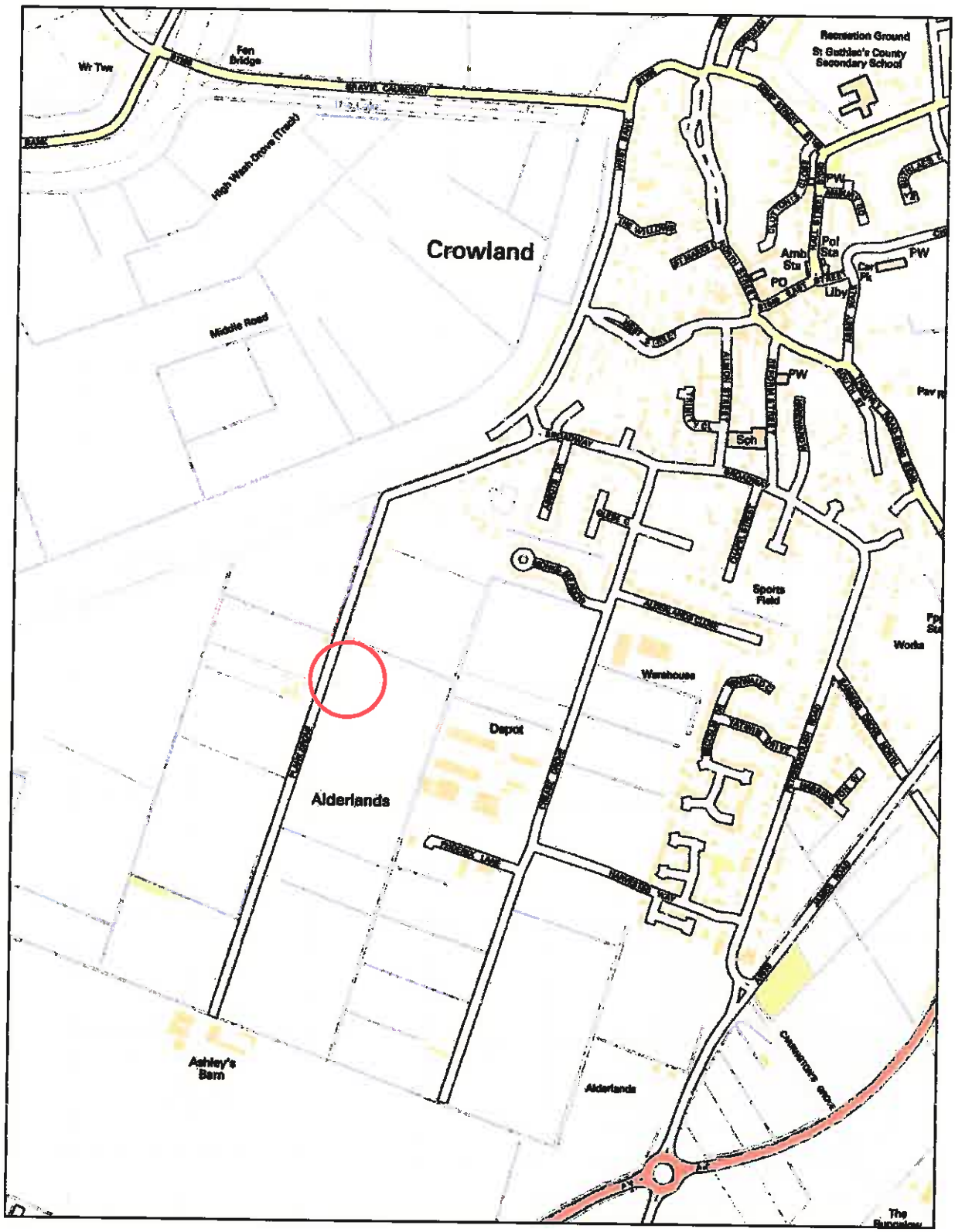
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Site History

Figure L

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Appendix 2

Environmental Database Information

Groundsure Enviroinsight

Address:	**Land between 24 & 30, PLANK DROVE, PETERBOROUGH, PE6 0BY**
Date:	**25 Apr 2016**
Reference:	**GS-2920256**
Client:	**Ground Engineering Limited**

NW N NE



W E

SW S SE

Aerial Photograph Capture date:	06-Jun-2014
Grid Reference:	523252,309631
Site Size:	0.17ha

Groundsure
LOCATION INTELLIGENCE

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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	0	0	6	4
1.2 Additional Information – Historical Tank Database	0	0	1	4
1.3 Additional Information – Historical Energy Features Database	0	0	0	0
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	0	0	0
1.6 Potentially Infilled Land	0	0	5	8

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	0	2
2.1.7 Records of Category 3 or 4 Radioactive Substances Authorisations	0	0	0	0
2.1.8 Records of Licensed Discharge Consents	0	1	0	1
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 Recorded Pollution Incidents				
2.3.1 National Incidents Recording System, List 2	0	0	0	0
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

	On-site	0-50m	51-250	251-500	501-1000	1000-1500
3.1 Landfill Sites						
3.1.1 Environment Agency Registered Landfill Sites	0	0	0	0	0	Not searched
3.1.2 Environment Agency Historic Landfill Sites	0	1	0	1	0	0
3.1.3 BGS/DoE Landfill Site Survey	0	0	0	0	1	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 Licensed Waste Sites	0	0	0	0	0	0

Section 4: Current Land Use

	On-site	0-50m	51-250	251-500
4.1 Current Industrial Sites Data	0	0	4	Not searched
4.2 Records of Petrol and Fuel Sites	0	0	0	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

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

	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	2
6.4 Surface Water Abstraction Licences (within 2000m of the study site)	0	0	0	2	0	16
6.5 Potable Water Abstraction Licences (within 2000m of the study site)	0	0	0	0	0	0
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)	1	0	1	1	Not searched	Not searched

	On-site	0-50m	51-250	251-500	501-1000	1000-1500

Section 6: Hydrogeology and Hydrology

	0-500m					
6.9 Is there any Environment Agency information on river quality within 1500m of the study site?	No	No	No	No	No	Yes
6.10 Detailed River Network entries within 500m of the site	0	0	0	0	Not searched	Not searched
6.11 Surface water features within 250m of the study site	No	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 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?	Low
7.4 Are there any Flood Defences within 250m of the study site?	Yes
7.5 Are there any areas benefiting from Flood Defences within 250m of the study site?	No
7.6 Are there any areas used for Flood Storage within 250m of the study site?	Yes
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?	Moderate

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	0
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
8.10 Records of Areas of Outstanding Natural Beauty (AONB)	0	0	0	0	0	0

Section 8: Designated Environmentally Sensitive Sites

	On-site	0-50m	51-250	251-500	501-1000	1000-2000
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	3	0	0
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?	Moderate
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?	Negligible
9.1.4 What is the maximum Compressible Ground hazard rating identified on the study site?	Negligible
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?	Very 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 not in a Radon Affected Area, as less than 1% 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?	No 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.

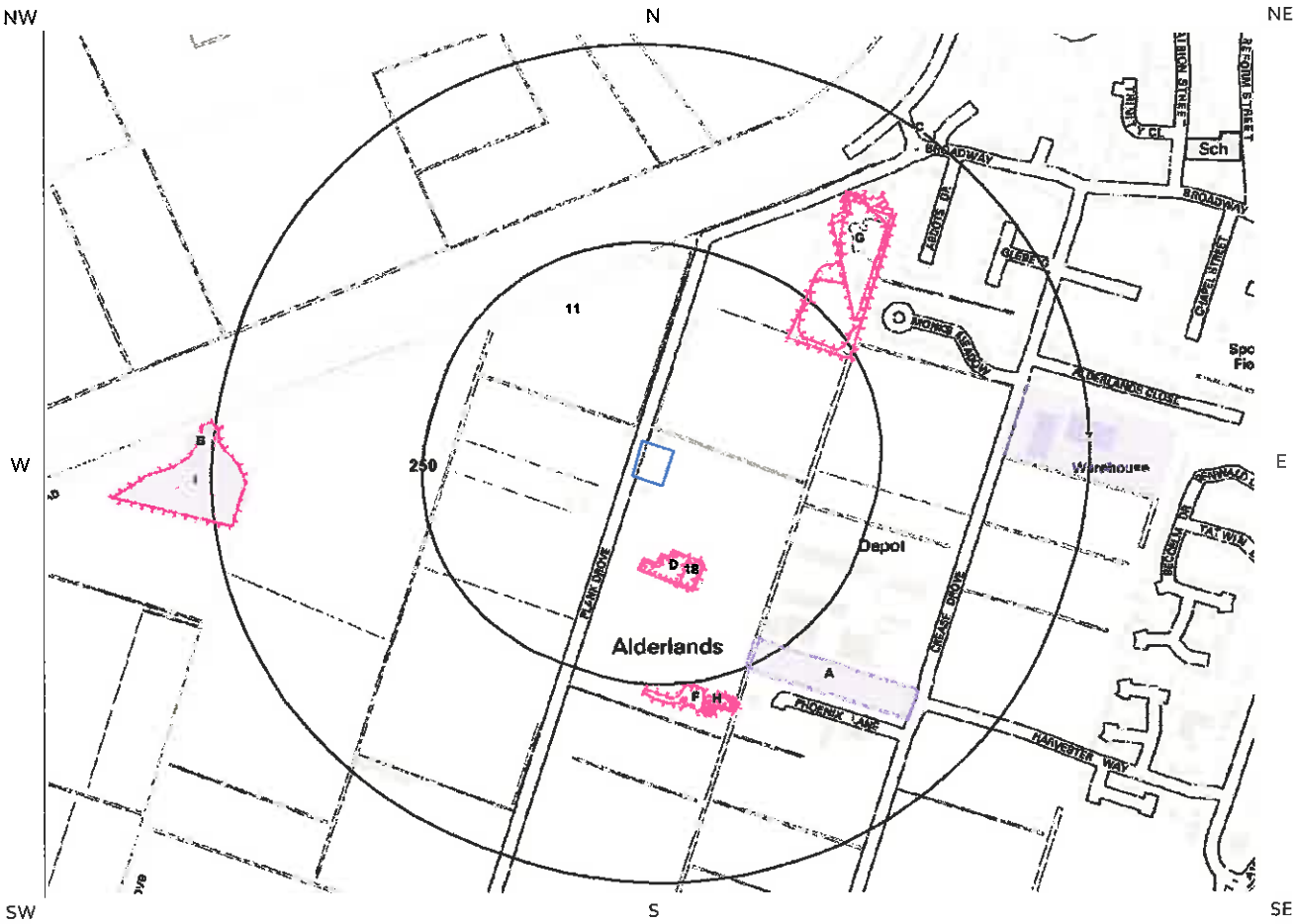
Note: Maps

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



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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

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: 10

ID	Distance [m]	Direction	Use	Date
1A	222	SE	Nursery	1958
2A	225	SE	Nursery	1900
3A	225	SE	Nursery	1900
4A	226	SE	Nursery	1901
5A	228	SE	Nursery	1900
6A	228	SE	Nursery	1950
7	394	E	Unspecified Warehouse	1976
8I	460	W	Refuse Heap	1976
9B	498	W	Disused Windmill	1900
10B	498	W	Corn Mill	1886

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: 5

ID	Distance (m)	Direction	Use	Date
11	181	NW	Unspecified Tank	1973
12C	498	NE	Unspecified Tank	1995
13C	498	NE	Unspecified Tank	1995
14C	498	NE	Unspecified Tank	1995
15C	498	NE	Unspecified Tank	1973

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: 0

Database searched and no data found.

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: 0

Database searched and no data found.

1.6 Potentially Infilled Land

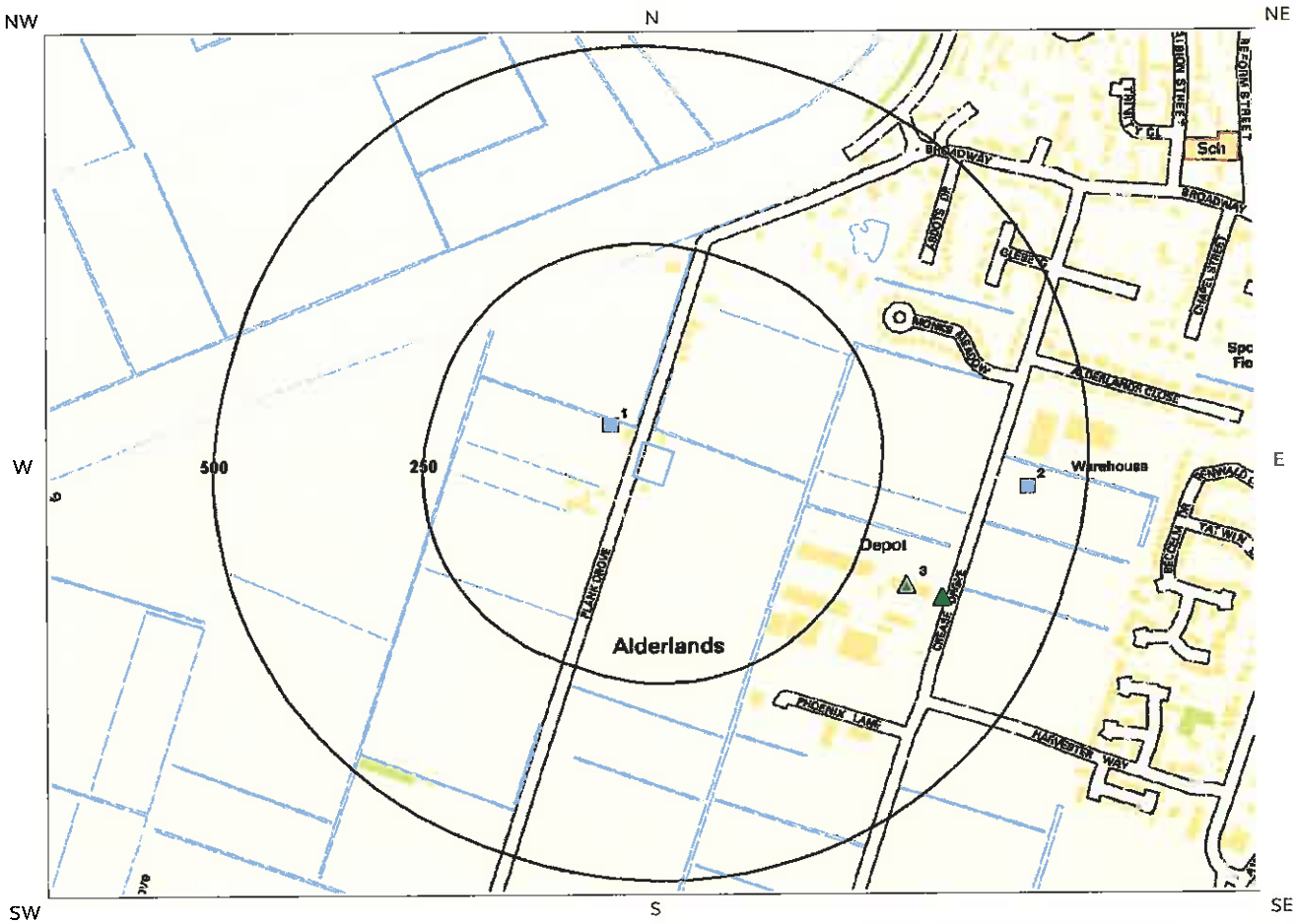
Records of Potentially Infilled Features from 1:10,000 scale mapping within 500m of the study site: 13

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

ID	Distance(m)	Direction	Use	Date
16D	83	S	Ponds	1901
17D	87	S	Ponds	1900
18	97	S	Pond	1886
19E	200	NE	Water Body	1950
20E	213	NE	Water Body	1976
21F	253	S	Ponds	1900
22F	253	S	Ponds	1886
23H	269	S	Pond	1958
24G	274	NE	Water Body	1887
25G	274	NE	Water Body	1906
26H	275	S	Pond	1901
27H	277	S	Pond	1950
28I	460	W	Refuse Heap	1976

Groundsure
LOCATION INTELLIGENCE

2. Environmental Permits, Incidents and Registers Map



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- 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 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:

2

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	
3	319	SE	523553 309474	Address: Crowland Cranes, Crease Drove, Crowland, Peterborough, Cambs, PE6 0BN Process: Vehicle Refinishers Status: Current Permit Permit Type: Part B	Enforcement: No Enforcements Notified Date of Enforcement: No Enforcements Notified Comment: No Enforcements Notified
4	364	SE	523595 309459	Address: Frosts Commercial Refinishes (Crowland), Crease Drove, Crowland, Peterborough, Cambs, PE6 0BN Process: Vehicle Refinishers Status: Historical 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:

2

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

ID	Distance (m)	Direction	NGR	Details	
1	43	NW	523200 309680	Address: BUNGALOW ON PLANK DROVE, CROWLAND Effluent Type: UNSPECIFIED Permit Number: PR5LF5081 Permit Version: 1	Receiving Water: Status: PRE NRA LEGISLATION WHERE ISSUE DATE < 01-SEP-89 (HISTORIC ONLY) Issue date: 02/10/1985 Effective Date: 02-Oct-1985 Revocation Date: 01/10/1996
2	427	E	523700 309600	Address: RES. DEV. TATWIN DRIVE, CROWLAND Effluent Type: MISCELLANEOUS DISCHARGES - SURFACE WATER Permit Number: PR5NF5156 Permit Version: 1	Receiving Water: Status: PRE NRA LEGISLATION WHERE ISSUE DATE < 01-SEP-89 (HISTORIC ONLY) Issue date: 21/05/1986 Effective Date: 21-May-1986 Revocation Date: 11/02/1992

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 Recorded Pollution Incidents

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

0

Database searched and no data found.

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

0

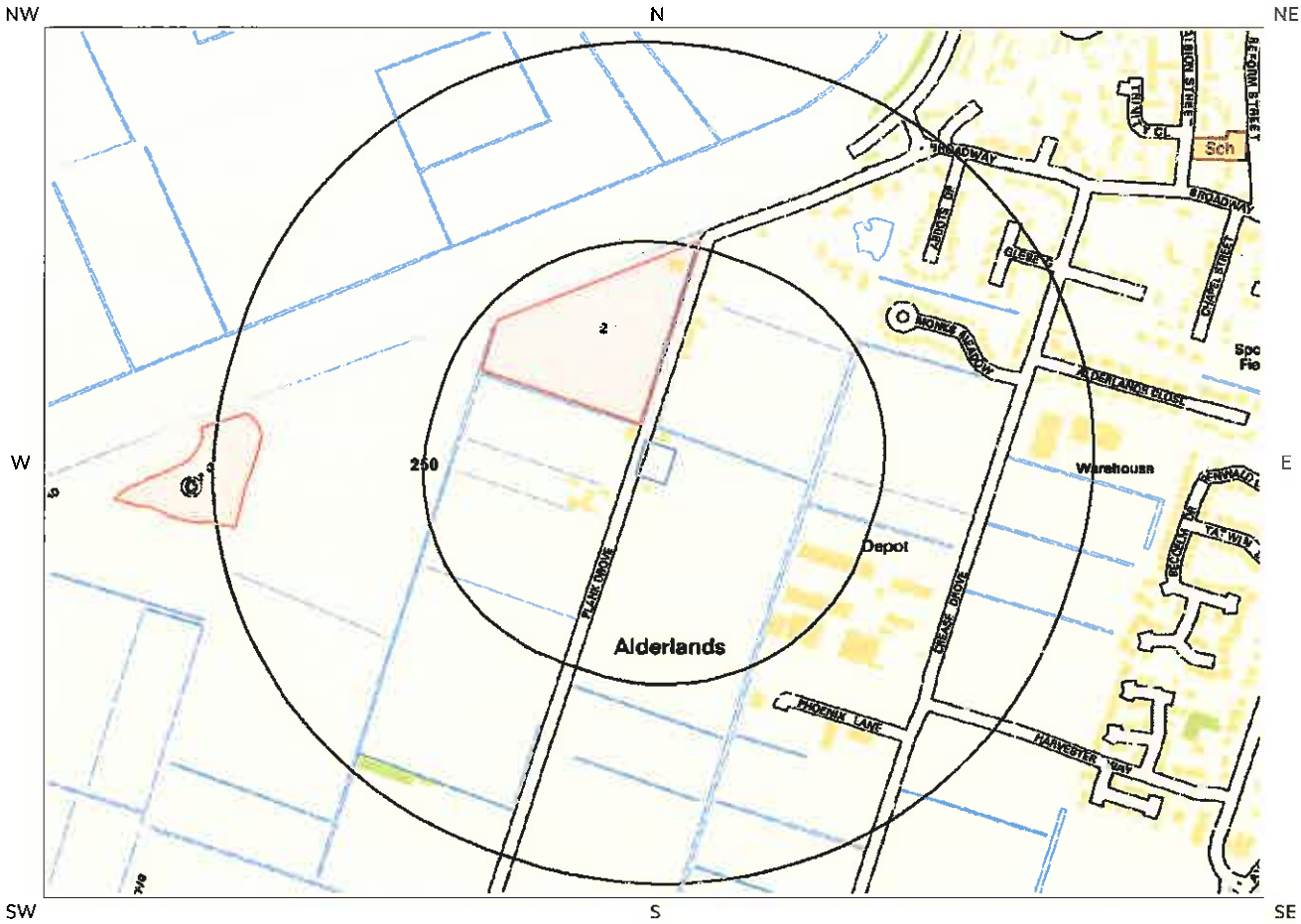
Database searched and no data found.

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



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Site Outline

250 Search Buffers (m)
500

E.A. Active Landfill

E.A. Historic Landfill

BGS / DoE Survey Landfill

Historic and Planned Waste Sites

E.A. 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 landfill data within 1000m of the study site:

0

Database searched and no data found.

3.1.2 Records of Environment Agency historic landfill sites within 1500m of the study site:

2

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	20	N	523100 309700	Site Address: Corporation Bank, Crowland Waste Licence: - Site Reference: SH-23-01/89, 2500/5070 Waste Type: Household Environmental Permitting Regulations (Waste) Reference: -	Licence Issue: Licence Surrendered: Licence Hold Address: - Operator: - First Recorded: - Last Recorded: -
3	446	W	522700 309600	Site Address: Low Road, Crowland, Lincolnshire Waste Licence: - Site Reference: RD7-4-01/89, SH-4-01/89, 2500/5314 Waste Type: Commercial, Household, Liquid sludge Environmental Permitting Regulations (Waste) Reference: -	Licence Issue: Licence Surrendered: Licence Hold Address: - Operator: Spalding Rural District Council First Recorded: 31-Dec-1952 Last Recorded: 31-Dec-1978

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

1

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

ID	Distance (m)	Direction	NGR	Details	
1	526	W	522700.0 309600.0	Address: Long Drove, Crowland, Lincs BGS Number: 2680.0	Risk: No risk to aquifer Waste Type: N/A

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

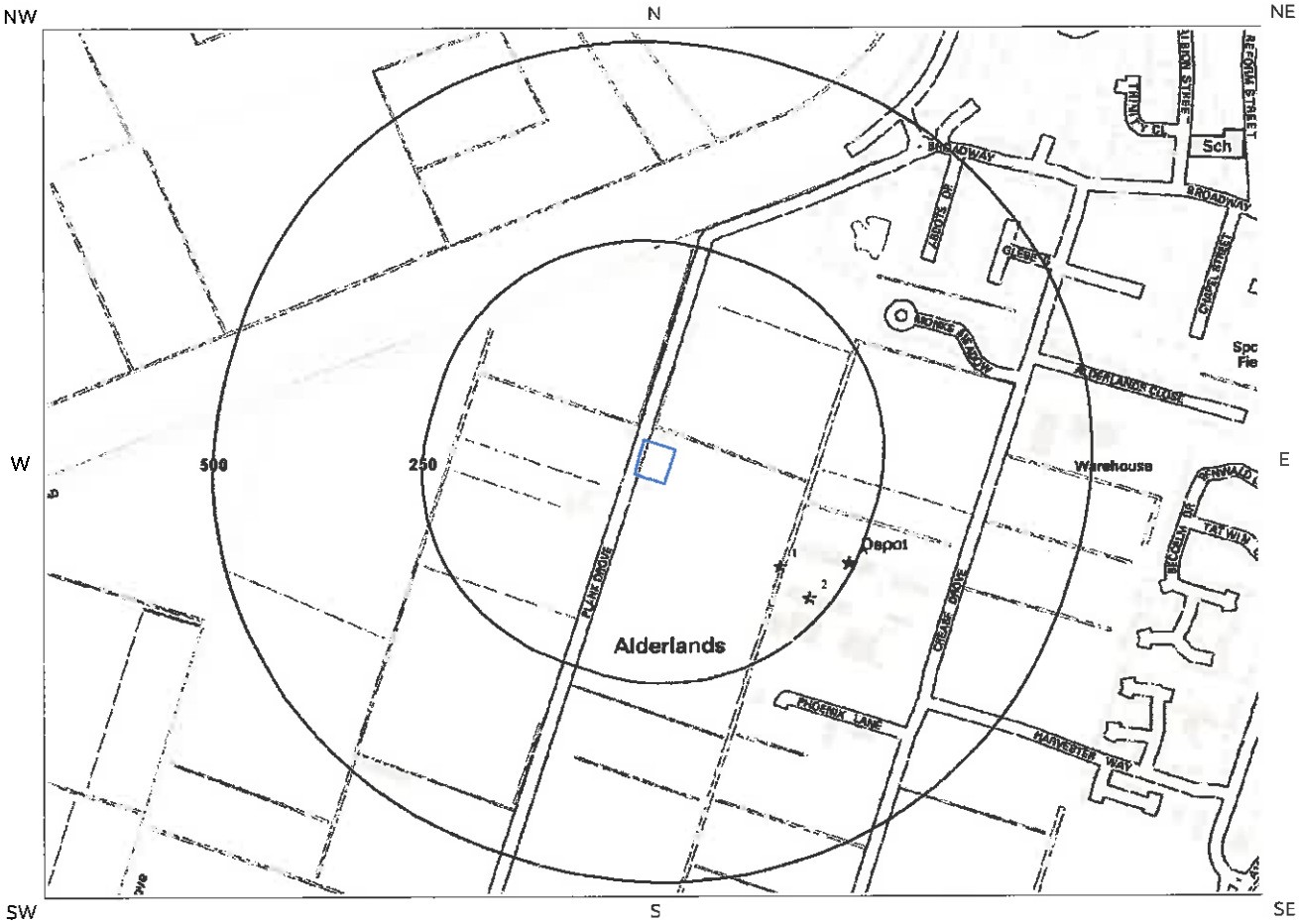
Database searched and no data found.

3.2.2 Records of Environment Agency licensed waste sites within 1500m of the study site:

0

Database searched and no data found.

4. Current Land Use Map



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Site Outline

Search Buffers (m)
250
500

Current Industrial Sites

Petrol & Fuel Sites

Electricity Transmission Cables

Gas Transmission Pipelines

4. Current Land Uses

4.1 Current Industrial Data

Records of potentially contaminative industrial sites within 250m of the study site: 4

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

ID	Distance (m)	Direction	Company	NGR	Address	Activity	Category
1	173	SE	A P B Mobile Installations Ltd	523400 309500	Unit 4, Pinnacle Close, Crowland, Peterborough, PE6 0GB	Vehicle Repair, Testing and Servicing	Repair and Servicing
2	225	SE	Blecs Global Ltd	523435 309460	Unit 4 Crowland Business Centre, Crease Drove, Crowland, Peterborough, PE6 0FB	General Purpose Machinery	Industrial Products
3A	243	SE	Fabtech Sheet Metal	523483 309503	Unit 2 Crowland Business Centre, Crease Drove, Crowland, Peterborough, PE6 0FB	Cutting, Drilling and Welding Services	Construction Services
4A	243	SE	F P & S Truck & Trailer Parts	523483 309503	Unit 1 Crowland Business Centre, Crease Drove, Crowland, Peterborough, PE6 0FB	Lifting and Handling Equipment	Industrial Products

4.2 Petrol and Fuel Sites

Records of petrol or fuel sites within 500m of the study site: 0

Database searched and no data found.

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.

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
ABSG	ABBEY SAND AND GRAVEL	SAND AND GRAVEL [UNLITHIFIED DEPOSITS CODING SCHEME]

5.3 Bedrock and Solid Geology

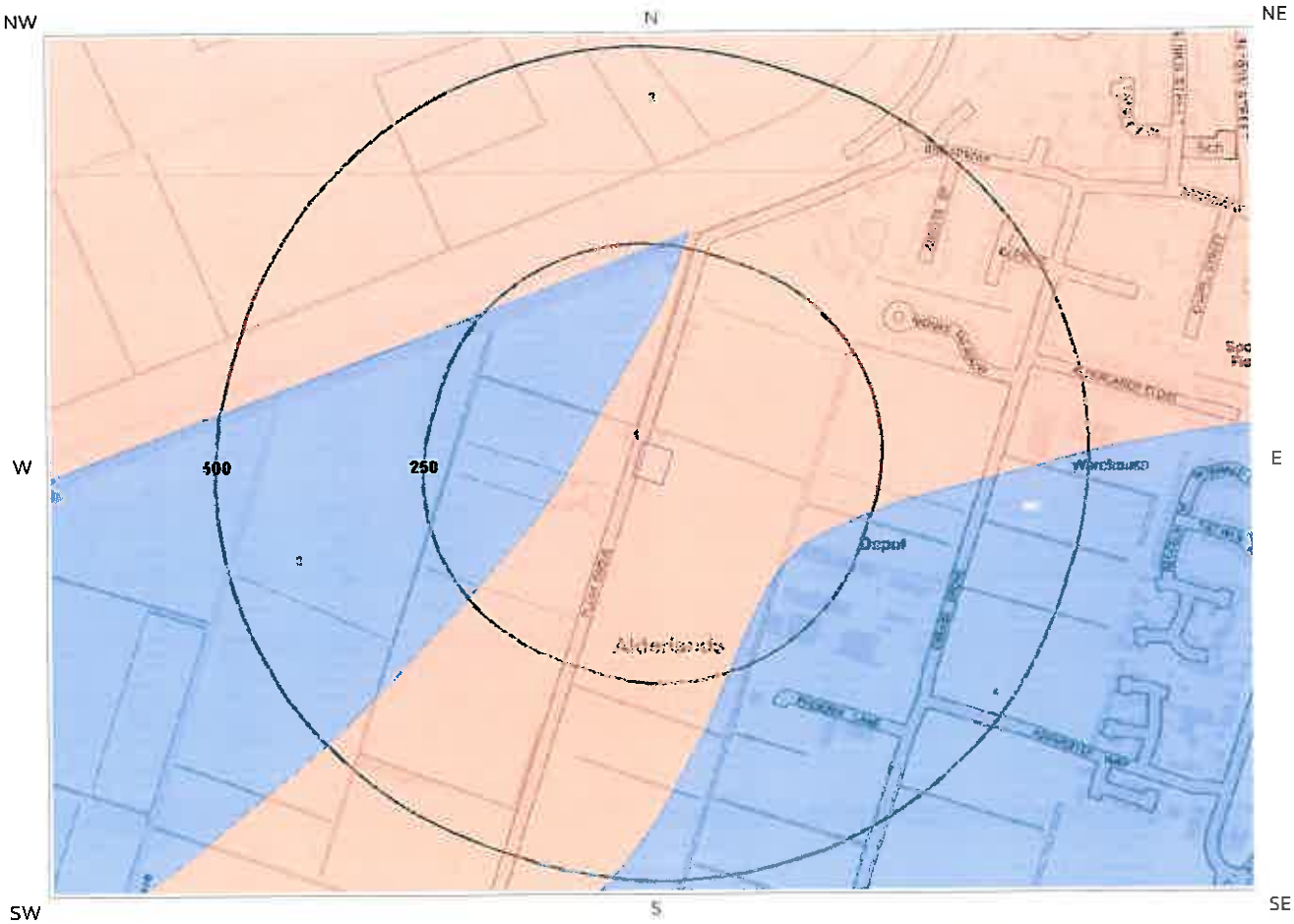
The database has been searched on site, including a 50m buffer.

Lex Code	Description	Rock Type
OXC-MDST	OXFORD CLAY FORMATION	MUDSTONE

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

6 Hydrogeology and Hydrology

6a. Aquifer Within Superficial Geology



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Site Outline

250 500 Search Buffers (m)

Principal Aquifer

Secondary (A) Aquifer - Permeable Layers

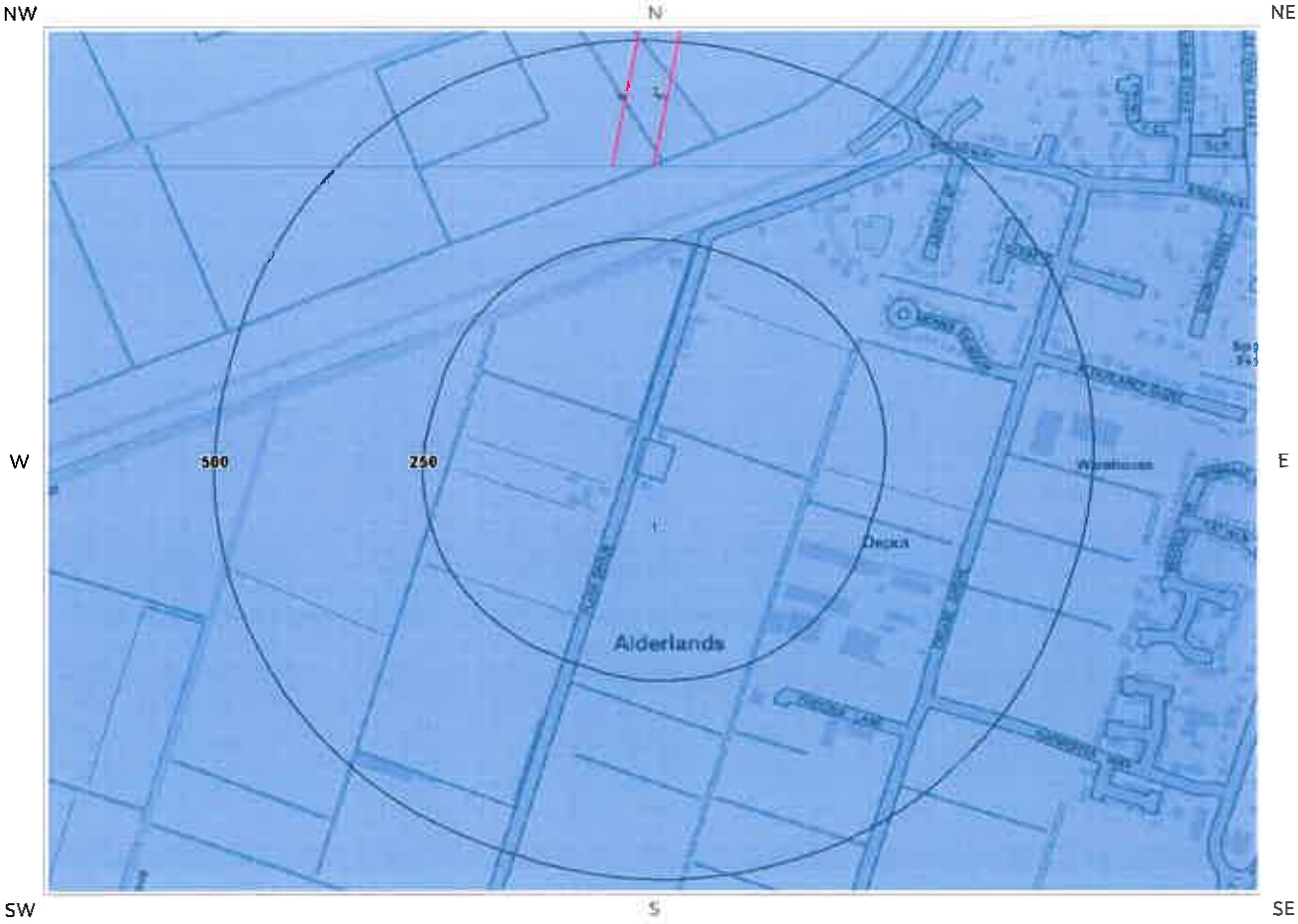
Secondary (B) Aquifer - Lower Permeability Layers

Secondary Aquifer - Undifferentiated Layers

Unproductive

Unknown (lakes and landslip)

6b. Aquifer Within Bedrock Geology and Abstraction Licenses



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Site Outline

250
500
Search Buffers (m)

Principal Aquifer

Secondary (A) Aquifer - Permeable Layers

Secondary (B) Aquifer - Lower Permeability Layers

Groundwater Abstraction Licence

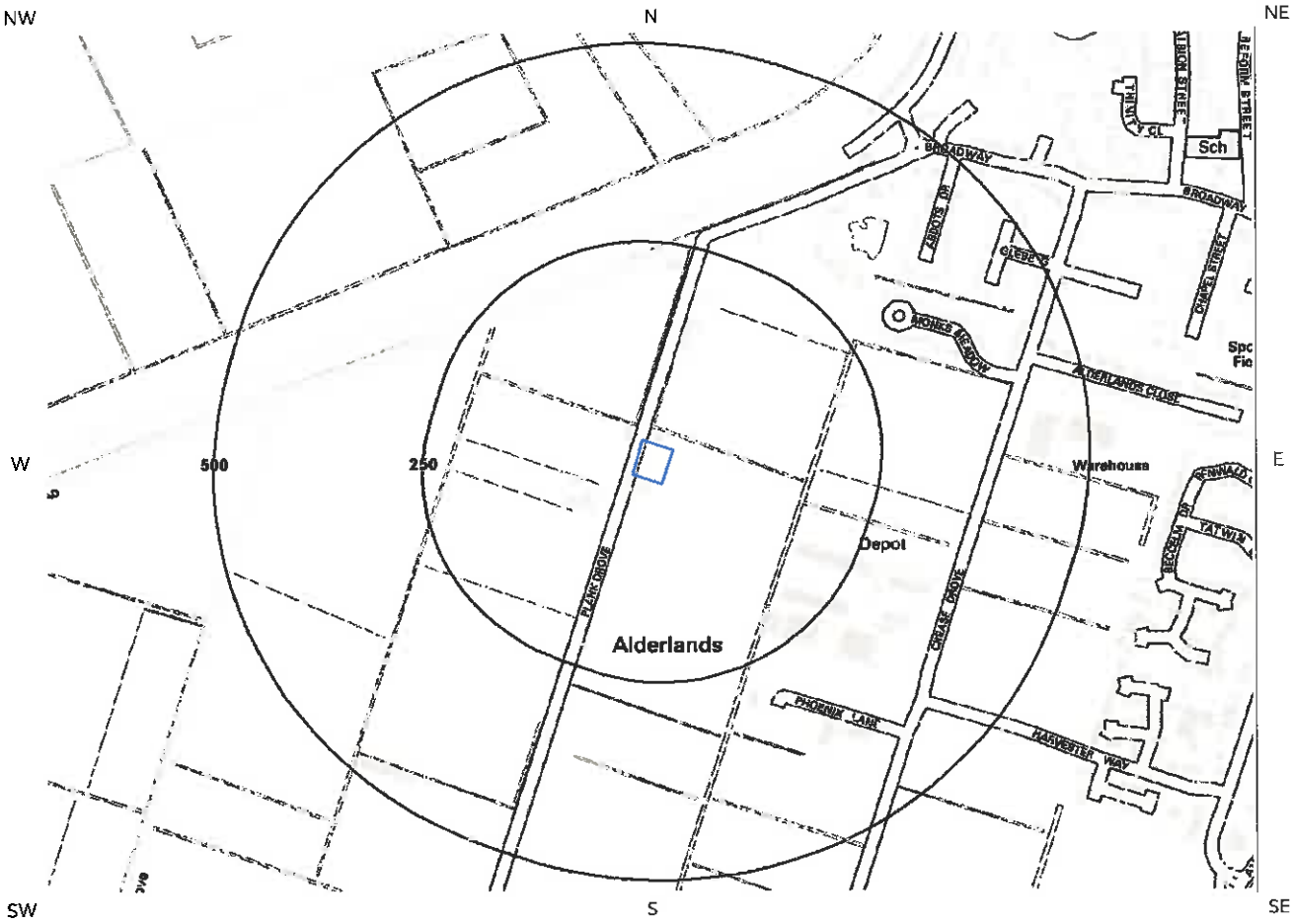
Secondary Aquifer - Undifferentiated Layers

Unproductive

Unknown (lakes and landslip)

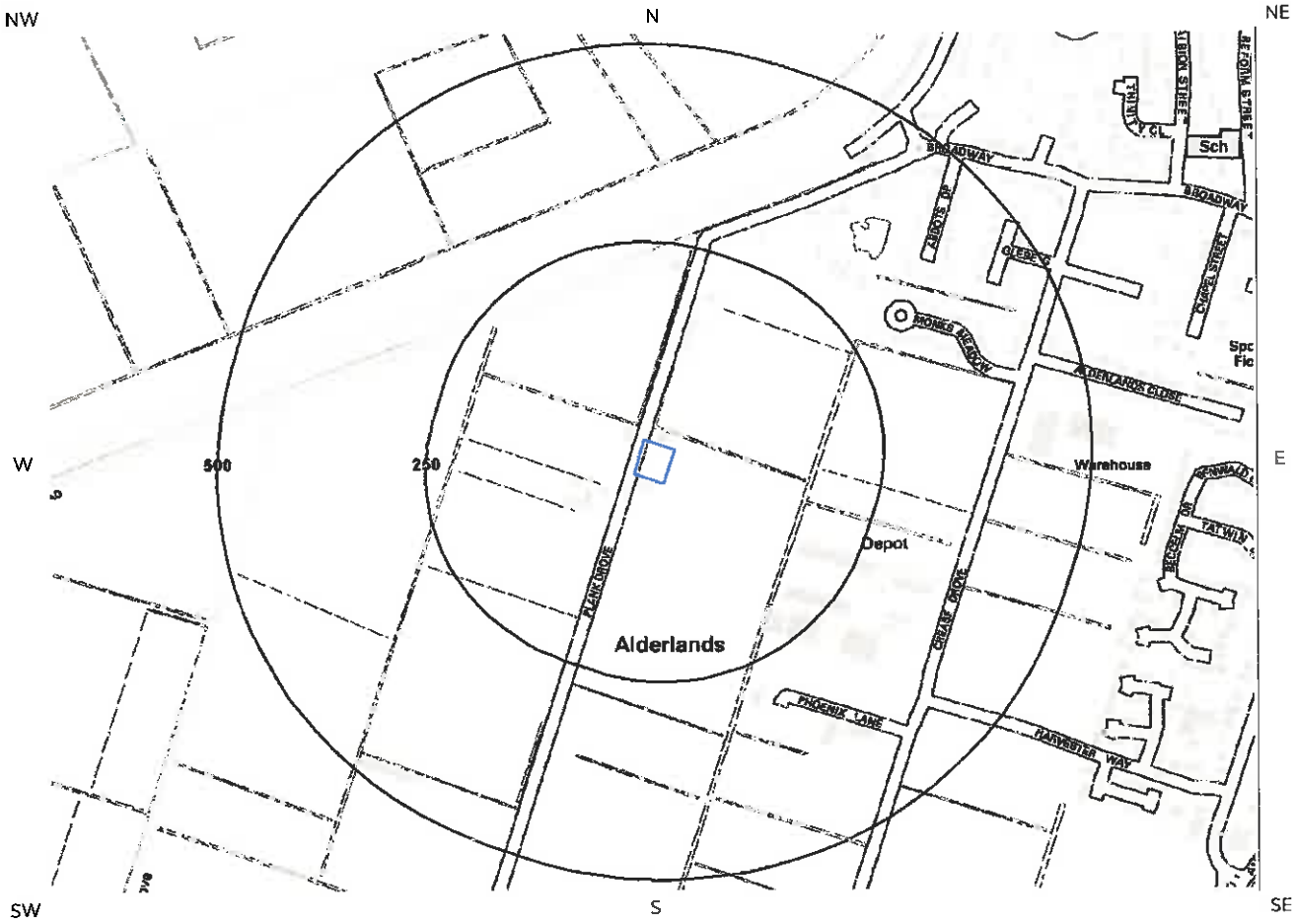
Surface Water Abstraction Licence

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



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6d. Hydrogeology – Source Protection Zones within confined aquifer



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Site Outline

250 — 500 — Search Buffers (m)

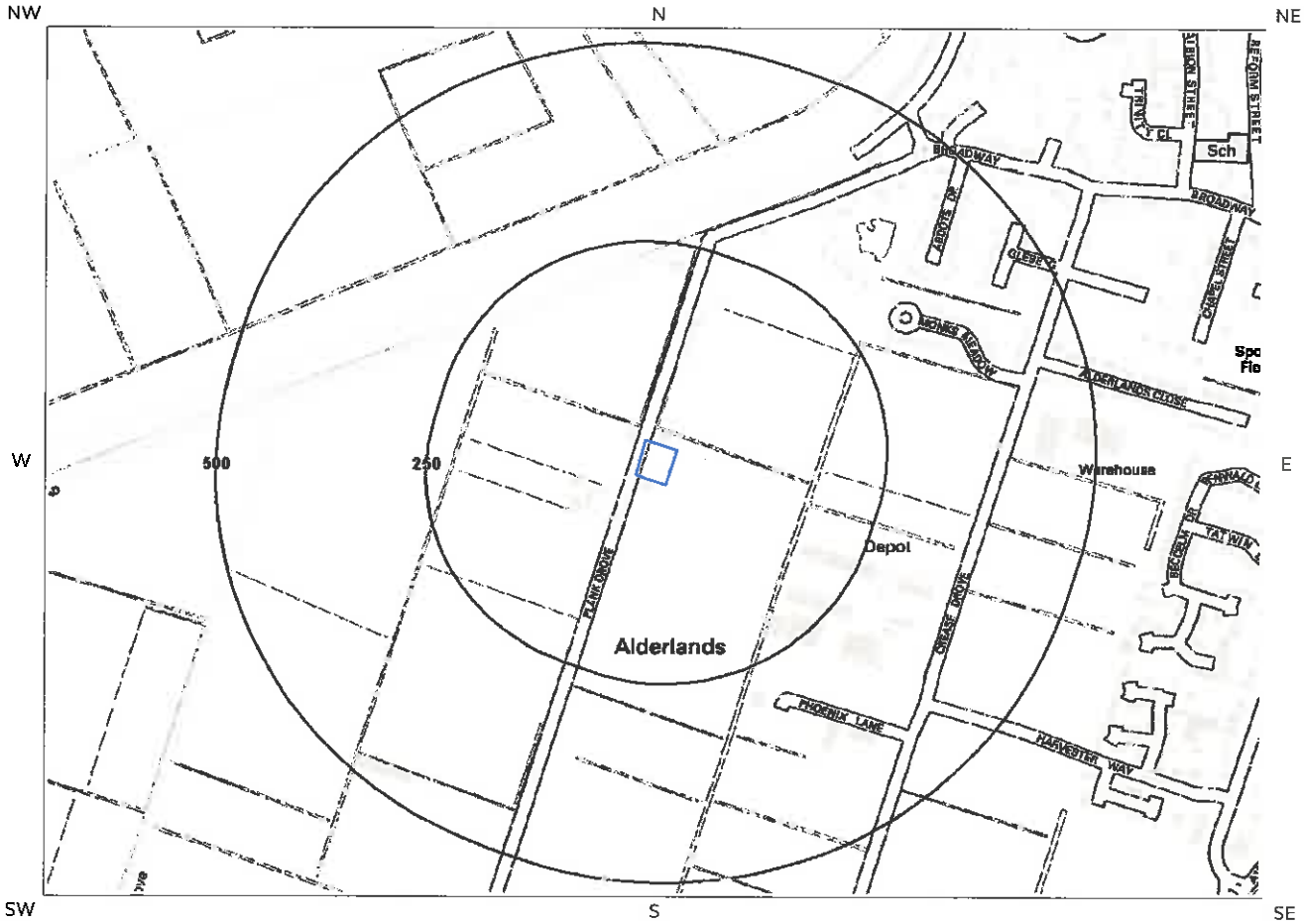
Source Protection Zone 1 - Inner Catchment

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



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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)

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'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 Enviroinsight 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
3	62	NW	Unproductive	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow
4	175	SE	Unproductive	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow
2	341	N	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'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 Enviroinsight User Guide.

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

ID	Distance (m)	Direction	Designation	Description
1	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
2	341	N	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? Yes

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

ID	Distance (m)	Direction	NGR	Details	
Not shown	1470	NE	524300 310700	Status: Historical Licence No: 5/32/11/*G/0024 Details: General Farming & Domestic Direct Source: Ground Water Source Of Supply Point: Well At 38 Postland Road Data Type: Point Name: SMEDLEY	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 1/3/1966 Expiry Date: - Issue No: 100 Version Start Date: 1/3/1966 Version End Date:
Not shown	1684	NW	522000 310800	Status: Historical Licence No: 5/31/14/*G/0156 Details: Spray Irrigation - Direct Direct Source: Ground Water Source Of Supply Point: Borehole At Crowland Data Type: Point Name: HOPKINSON	Annual Volume (m^3): 4000 Max Daily Volume (m^3): 130 Original Application No: - Original Start Date: 1/1/1981 Expiry Date: - Issue No: 100 Version Start Date: 1/4/2004 Version End Date:

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	
5	341	N	523250 310000	Status: Active Licence No: 5/31/14/*S/0254 Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: New River - Crowland Data Type: Line Name: F G TANSLEY & SON	Annual Volume (m^3): 22000 Max Daily Volume (m^3): 4000 Application No: N876 Original Start Date: 1/7/2001 Expiry Date: - Issue No: 1 Version Start Date: 1/7/2001 Version End Date:
6	343	N	523200 310000	Status: Historical Licence No: 5/31/14/*S/0178B Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: New River At Crowland Data Type: Line Name: F ADAMS & SON	Annual Volume (m^3): - Max Daily Volume (m^3): - Application No: - Original Start Date: 1/12/1984 Expiry Date: - Issue No: 100 Version Start Date: 1/11/1993 Version End Date:
Not shown	1047	N	522930 310660	Status: Active Licence No: 5/31/14/*S/0254 Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: River Welland - Crowland Data Type: Line Name: F G TANSLEY & SON	Annual Volume (m^3): 22000 Max Daily Volume (m^3): 4000 Application No: N876 Original Start Date: 1/7/2001 Expiry Date: - Issue No: 1 Version Start Date: 1/7/2001 Version End Date:

ID	Distance (m)	Direction	NGR	Details	
Not shown	1095	N	522900 310700	Status: Historical Licence No: 5/31/14/*S/0178B Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: River Welland At Crowland Data Type: Line Name: F ADAMS & SON	Annual Volume (m^3): - Max Daily Volume (m^3): - Application No: - Original Start Date: 1/12/1984 Expiry Date: - Issue No: 100 Version Start Date: 1/11/1993 Version End Date:
Not shown	1209	N	521919 312031	Status: Active Licence No: 5/31/14/*S/0160 Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: Common Drain, Crowland Data Type: Line Name: WHEAT	Annual Volume (m^3): 30000 Max Daily Volume (m^3): 2000 Application No: NPS/WR/013689 Original Start Date: 1/9/1983 Expiry Date: - Issue No: 101 Version Start Date: 18/10/2013 Version End Date:
Not shown	1238	SW	522230 308880	Status: Active Licence No: 5/32/11/*S/0169 Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: Newborough Main Drain At Crowland Data Type: Line Name: WOODROFFE	Annual Volume (m^3): 18000 Max Daily Volume (m^3): 700 Application No: N1508 Original Start Date: 18/8/2008 Expiry Date: 31/3/2020 Issue No: 1 Version Start Date: 1/4/2009 Version End Date:
Not shown	1238	SW	522230 308880	Status: Historical Licence No: 5/32/11/*S/0156 Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: Newborough Main Drain At Crowland Data Type: Line Name: WOODROFFE	Annual Volume (m^3): 18000 Max Daily Volume (m^3): 700 Application No: N1319 Original Start Date: 21/6/2004 Expiry Date: 31/10/2008 Issue No: 1 Version Start Date: 21/6/2004 Version End Date:
Not shown	1238	SW	522230 308880	Status: Historical Licence No: 5/32/11/*S/0133 Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: Newborough Main Drain-crowland Data Type: Line Name: WOODROFFE	Annual Volume (m^3): - Max Daily Volume (m^3): - Application No: - Original Start Date: 1/3/1993 Expiry Date: 31/10/2002 Issue No: 100 Version Start Date: 1/6/1998 Version End Date:
Not shown	1353	NW	522700 310900	Status: Historical Licence No: 5/31/14/*S/0178A Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: Common Drain Crowland Data Type: Line Name: F ADAMS & SON	Annual Volume (m^3): - Max Daily Volume (m^3): - Application No: - Original Start Date: 1/12/1984 Expiry Date: - Issue No: 100 Version Start Date: 1/12/1992 Version End Date:
Not shown	1388	NW	522680 310930	Status: Active Licence No: 5/31/14/*S/0253 Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: Common Drain - Crowland Common Data Type: Line Name: F G TANSLEY & SON	Annual Volume (m^3): 28000 Max Daily Volume (m^3): 4000 Application No: NS875 Original Start Date: 1/7/2001 Expiry Date: - Issue No: 1 Version Start Date: 1/7/2001 Version End Date:
Not shown	1420	E	524630 309220	Status: Active Licence No: 5/32/11/*S/0112 Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: Green Bank Drain, Crowland Data Type: Line Name: BOOR	Annual Volume (m^3): 15000 Max Daily Volume (m^3): 2000 Application No: N1281 Original Start Date: 1/6/1986 Expiry Date: - Issue No: 101 Version Start Date: 30/9/2002 Version End Date:

ID	Distance (m)	Direction	NGR	Details	
Not shown	1477	W	521300 309600	Status: Historical Licence No: 5/31/14/*S/0009 Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: Farm & S Drove Drain River Welland (2) Data Type: Line Name: DENNIS ESTATES	Annual Volume (m^3): 105000 Max Daily Volume (m^3): 6000 Application No: - Original Start Date: 1/1/1966 Expiry Date: - Issue No: 100 Version Start Date: 1/4/1989 Version End Date:
Not shown	1496	W	521300 309670	Status: Historical Licence No: 5/31/14/*S/0274 Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: Farm & S Drove Drain River Welland (2) Data Type: Line Name: DENNIS ESTATES	Annual Volume (m^3): 105000 Max Daily Volume (m^3): 6000 Application No: N1510 Original Start Date: 23/6/2008 Expiry Date: - Issue No: 1 Version Start Date: 23/6/2008 Version End Date:
Not shown	1643	SE	524530 308560	Status: Active Licence No: 5/32/11/*S/0112 Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: Field Drains, Crowland Data Type: Line Name: BOOR	Annual Volume (m^3): 15000 Max Daily Volume (m^3): 2000 Application No: N1281 Original Start Date: 1/6/1986 Expiry Date: - Issue No: 101 Version Start Date: 30/9/2002 Version End Date:
Not shown	1733	N	523018 311378	Status: Active Licence No: 5/31/14/*S/0185 Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: R Welland At Crowland Data Type: Line Name: BOOR	Annual Volume (m^3): 10000 Max Daily Volume (m^3): 2000 Application No: NPS/WR/012359 Original Start Date: 1/6/1986 Expiry Date: - Issue No: 102 Version Start Date: 18/9/2013 Version End Date:
Not shown	1735	N	523020 311380	Status: Historical Licence No: 5/31/14/*S/0185 Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: R Welland At Crowland Data Type: Line Name: BOOR	Annual Volume (m^3): 10000 Max Daily Volume (m^3): 2000 Application No: N1353 Original Start Date: 1/6/1986 Expiry Date: - Issue No: 101 Version Start Date: 23/2/2005 Version End Date:
Not shown	1757	N	523000 311400	Status: Historical Licence No: 5/31/14/*S/0185 Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: R Welland At Crowland Data Type: Line Name: BOOR	Annual Volume (m^3): - Max Daily Volume (m^3): - Application No: - Original Start Date: 1/6/1986 Expiry Date: - Issue No: 100 Version Start Date: 1/6/1986 Version End Date:
Not shown	1928	W	520900 310100	Status: Active Licence No: 5/31/14/*S/0171 Details: Spray Irrigation - Direct Direct Source: Surface Water Source Of Supply Point: Stowgate North Drain Data Type: Line Name: JOHNSON	Annual Volume (m^3): 17000 Max Daily Volume (m^3): 2000 Application No: - Original Start Date: 1/10/1984 Expiry Date: - Issue No: 100 Version Start Date: 1/1/1998 Version End Date:

6.5 Potable Water Abstraction Licences

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

Database searched and no data found.

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 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/Intermediate Leaching Potential	I2	Soils which can possibly transmit non – or weakly adsorbed pollutants and liquid discharges but are unlikely to transmit adsorbed pollutants.
199	NW	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.
341	N	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.

6.9 River Quality

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

6.9.1 Biological Quality:

Database searched and no data found.

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):

					Chemical Quality Grade				
ID	Distance (m)	Direction	NGR	River Quality Grade	2005	2006	2007	2008	2009
Not shown	1039	N	522951 310658	River Name: Welland Reach: Folly River New River Spalding End/Start of Stretch: Sample Point NGR	B	C	B	B	B

6.10 Detailed River Network

Are there any Detailed River Network entries within 500m of the study site? No

Database searched and no data found.

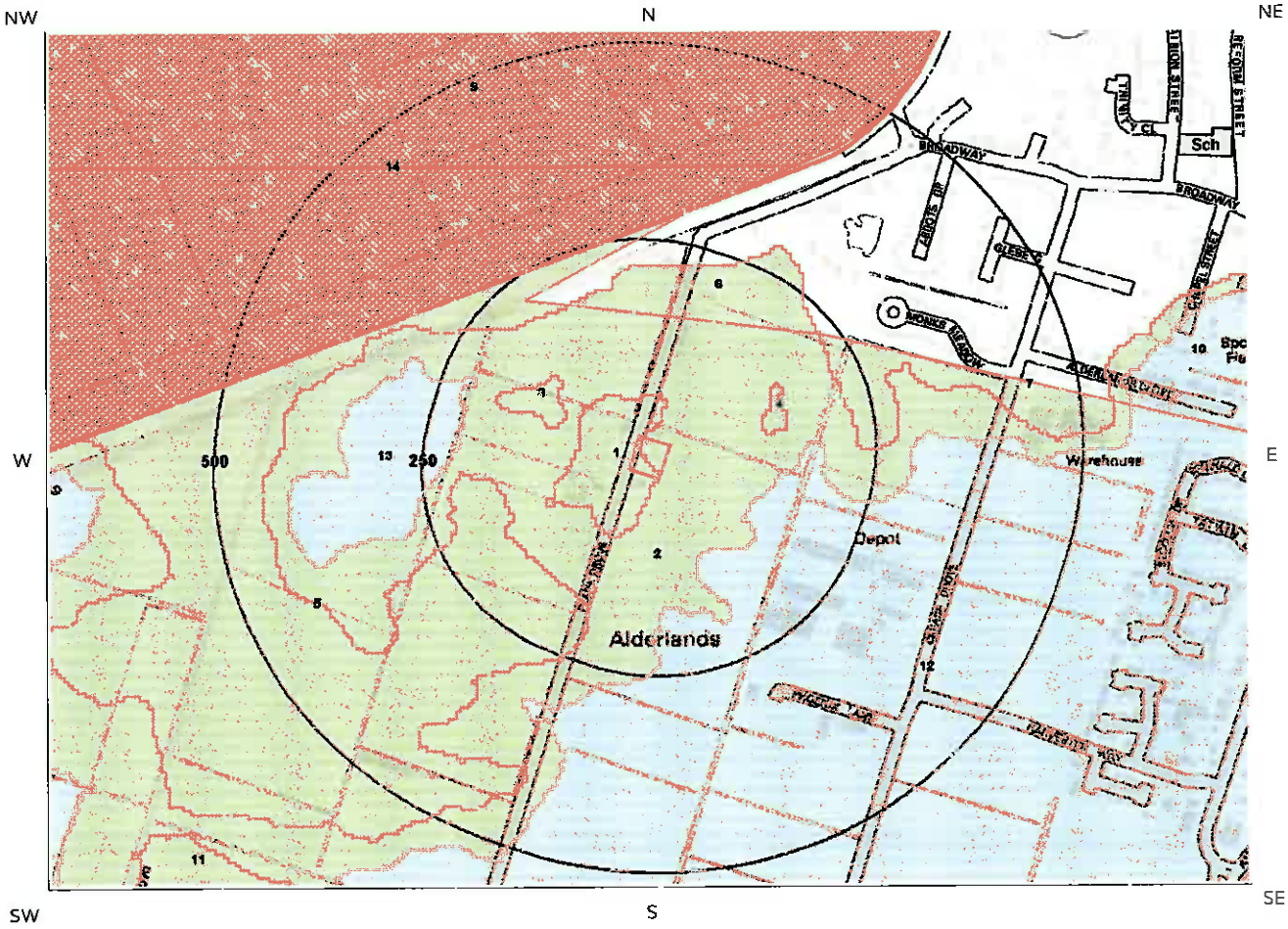
6.11 Surface Water Features

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
17	N
19	N
23	N
25	N
43	W
67	N
86	SW
163	E
176	E
188	N
193	S
197	SE
204	N
217	N
239	NE

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



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Site Outline

100
250
Search Buffers (m)

Zone 2 Floodplain

Zone 3 Floodplain

Flood Defences

Area used for Flood Storage

Area Benefiting from Flood Defences

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



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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 Zone 2 floodplain? Yes

Environment Agency 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	08-Feb-2016	Zone 2 - (Fluvial /Tidal Models)
2	0	On Site	08-Feb-2016	Zone 2 - (Fluvial /Tidal Models)
3	90	W	08-Feb-2016	Zone 2 - (Fluvial /Tidal Models)
4	112	E	08-Feb-2016	Zone 2 - (Fluvial /Tidal Models)
5	152	W	08-Feb-2016	Zone 2 - (Fluvial /Tidal Models)
6	154	N	08-Feb-2016	Zone 2 - (Fluvial /Tidal Models)
7	212	NE	08-Feb-2016	Zone 2 - (Fluvial /Tidal Models)

7.2 River and Coastal Zone 3 Flooding

Is the site within 250m of an Environment Agency 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	106	SE	23-Feb-2016	Zone 3 - (Fluvial Models)
2	207	W	23-Feb-2016	Zone 3 - (Fluvial Models)
3	243	N	23-Feb-2016	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? Low

The Environment Agency 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 Low (greater than 1 in 1000 but less than 1 in 100) 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

7.4 Flood Defences

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

The following flood defence records are represented as lines on the Flood Map:

ID	Distance (m)	Direction	Update
16	245	N	04-Feb-2016

7.5 Areas benefiting from Flood Defences

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

7.6 Areas benefiting from Flood Storage

Are there any areas used for Flood Storage within 250m of the study site? Yes

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.

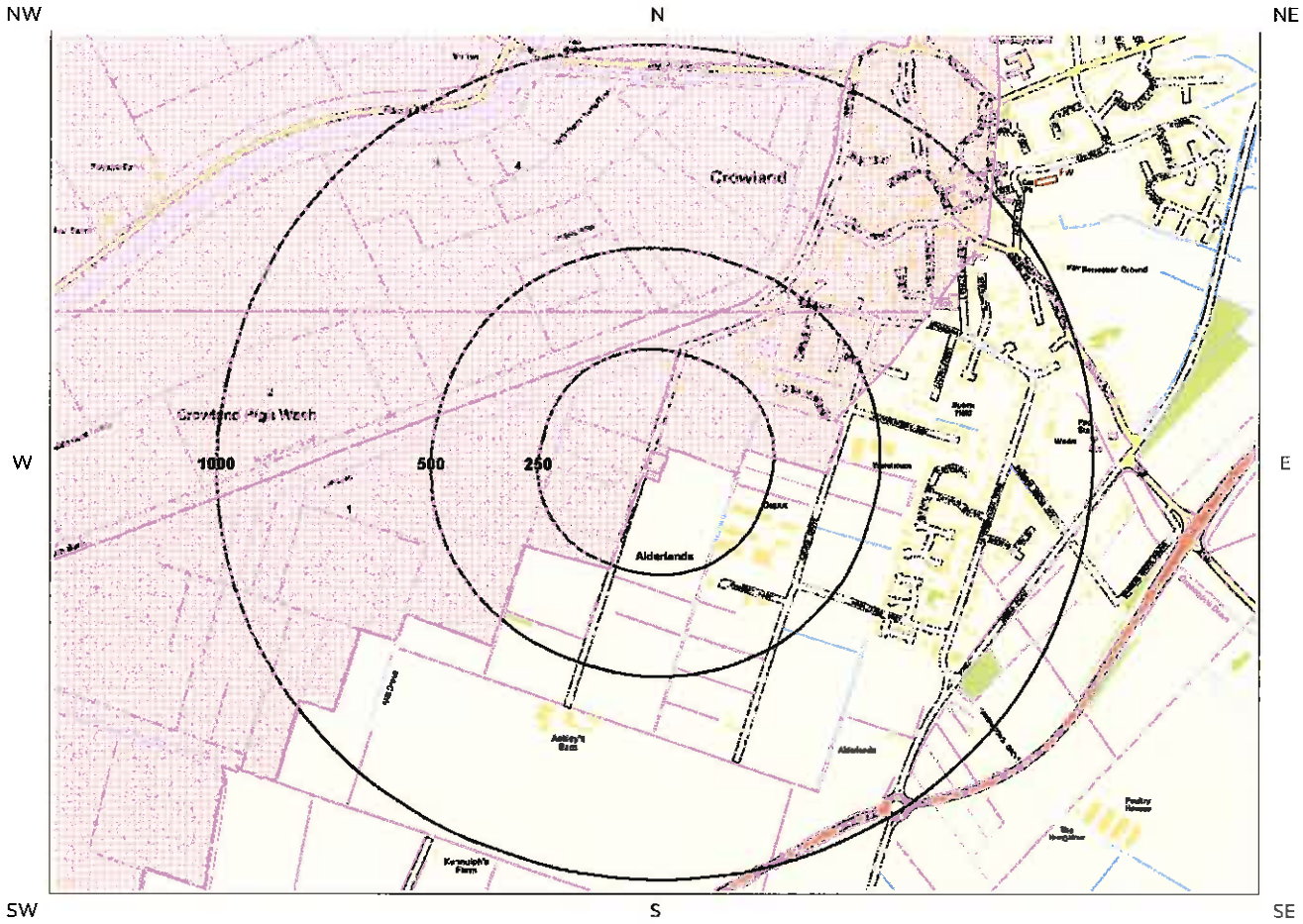
7.8 Groundwater Flooding Confidence Areas

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

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



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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:

0

Database searched and no data found.

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:

4

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
1	0	On Site	New	DEFRA
2	260	N	Existing	DEFRA
3	341	N	Existing	DEFRA
4	341	N	New	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 GeoInsight, 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? Moderate

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

Hazard
Ground conditions predominantly high plasticity. Do not plant or remove trees or shrubs near to buildings without expert advice about their effect and management. 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 probable increase in construction cost to reduce potential shrink-swell problems. For existing property, there is a probable increase in insurance risk 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? Negligible

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

Hazard
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.

* 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? Negligible

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

Hazard
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.

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? Very Low

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

Hazard
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.

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 not in a Radon Affected Area, as less than 1% 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?	No 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? No
Guidance: No Guidance Required.

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.
Email:
Web:**www.bgs.ac.uk**
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: 08708 506 506
Web:**www.environment-agency.gov.uk**
Email:**enquiries@environment-agency.gov.uk**

Public Health England
Public information access office
Public Health England, Wellington House
133-155 Waterloo Road, London, SE1 8UG
www.gov.uk/phe
Email:**enquiries@phe.gov.uk**
Main switchboard: **020 7654 8000**

The Coal Authority
200 Lichfield Lane
Mansfield
Notts NG18 4RG
Tel: 0345 7626 848
DX 716176 Mansfield 5
www.coal.gov.uk

Ordnance Survey
Adanac Drive, Southampton
SO16 0AS
Tel: 08456 050505

Local Authority
Authority: South Holland District Council
Phone: 01775 761 161
Web: http://www.sholland.gov.uk/
Address: Council Offices, Priory Road, Spalding, Lincolnshire, PE11

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.
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Appendix 3

Records of
Borehole BH1
Trial Pits TP1 to TP4
Results of Gas/Water Monitoring

GROUND ENGINEERING
L I M I T E D
Tel: 01733-566566
www.groundengineering.co.uk

Site: **PLANK DROVE, CROWLAND**

BOREHOLE BH1

Date: 24/03/16

Hole Size: 150mm dia to 15.00m

Ground Level:

Samples and in-situ Tests			(Date) Casing	Inst.	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Blows						
0.00-0.40	B1				MADE GROUND - Soft, dark brown, slightly gravelly CLAY. Gravel of angular to sub-angular flint and brick.			
0.40-0.80	B2						0.40	
0.80-1.20	B3				Soft, brown and grey brown mottled, slightly sandy, slightly gravelly CLAY. Gravel of sub-angular to sub-rounded flint. (ABBEY GRAVEL)		0.80	
1.35-1.65	S	N13			Soft, orange brown and grey brown, slightly sandy, slightly gravelly, locally organic CLAY. (ABBEY GRAVEL)			
1.50-2.00	B4						1.50	
1.65	D1				Medium dense, orange brown, clayey SAND AND GRAVEL of sub-angular to sub-rounded flint.			
1.70	W1							
2.00-2.20	B5				(ABBEY GRAVEL)			
2.15-2.45	C	N11	1.60				2.20	
2.20-2.70	B6				Firm, grey, slightly gravelly, silty CLAY. Gravel of sub-angular to sub-rounded flint. (ABBEY GRAVEL)			
2.80-3.00	B7						2.80	
2.80	W2				Brown, silty SAND AND GRAVEL of sub-angular to sub-rounded flint. (ABBEY GRAVEL)		3.00	
3.10-3.50	B8							
3.15-3.45	C	N19	3.00		Medium strength, stiff, fissured, grey CLAY.			
4.00-4.45	U1	45	3.50		(OXFORD CLAY FORMATION)			
4.45	D2							
5.00-5.45	U2	60	3.50					
5.45	D3						5.50	
6.00-6.45	U3	60	3.50		High strength, stiff, fissured, grey CLAY with occasional fossil shell fragments.			
6.45	D4				(OXFORD CLAY FORMATION)			
7.00-7.45	U4	70	3.50				7.00	
7.45	D5				Very high strength, very stiff, fissured, grey CLAY.			
8.00	D6							
8.50-8.95	U5	85	3.50		(OXFORD CLAY FORMATION)			
8.95	D7							
9.50	D8							
10.00-10.40	U6	85	3.50				10.00	

BENEATH INSTALLATION

REMARKS
1. Excavating a pit from 0.00m to 1.20m for 1 hour
2. Water added from 1.70m to 2.20m
3. Borehole cased to 3.50m depth
4. Gas monitoring standpipe installed to 5.00m depth

Project No 13802

Scale 1:50 | Page 1/2

KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise
N/*- SPT Blows for 0.3m or given penetration
ES - Environmental Sample
V - Vane Shear Test Cohesion ( ) kPa
▽c Level on completion
c▽w Level casing withdrawn
▽s Standpipe Level

Groundwater Strikes

No	Depth m Struck	Rose to	Rate	Cased	Sealed
1	1.50	1.50	slow		2.20
2	2.80	1.30	steady	2.50	3.00

Groundwater Observations

Date	Depth m Hole	Casing	Water
24/03/16	15.00	3.50	dry
24/03/16	15.00	0.00	dry
13/04/16	5.00		0.80
20/04/16	5.00		0.83
27/04/16	5.00		0.92

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Site: PLANK DROVE, CROWLAND

BOREHOLE BH1

Date: 24/03/16

Hole Size: 150mm dia to 15.00m

Ground Level:

Samples and in-situ Tests			(Date) Casing	Inst.	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Blows						
				BENEATH INSTALLATION	Extremely weak grey MUDSTONE.		10.00	
10.40	D9			BENEATH INSTALLATION				
11.00	D10			BENEATH INSTALLATION	(OXFORD CLAY FORMATION)			
11.45	D11		3.50	BENEATH INSTALLATION			11.50	
11.50-11.95	U7	90		BENEATH INSTALLATION	Very stiff, fissured, grey CLAY.			
				BENEATH INSTALLATION	(OXFORD CLAY FORMATION)			
				BENEATH INSTALLATION				
12.80	D12			BENEATH INSTALLATION			12.80	
13.10-13.50	U8	90	3.50	BENEATH INSTALLATION	Extremely weak, grey MUDSTONE. (OXFORD CLAY FORMATION)		13.00	
13.50	D13			BENEATH INSTALLATION	Very stiff, grey CLAY with occasional fossil shell fragments.			
14.00	D14			BENEATH INSTALLATION	(OXFORD CLAY FORMATION)			
14.50-14.95	U9	90	3.50	BENEATH INSTALLATION				
15.00	D15			BENEATH INSTALLATION			15.00	
					Borehole completed at 15.00m depth			

REMARKS

Project No 13802

Scale 1:50

Page 2/2

KEY
D - Disturbed Sample
B - Bulk Sample
U - Undisturbed Sample
W - Water Sample
S/C - SPT Spoon/Cone
▽ Water Strike
▼ Water Rise
N/*- SPT Blows for 0.3m or given penetration
ES - Environmental Sample
V - Vane Shear Test Cohesion ( ) kPa
▼c Level on completion
c▽w Level casing withdrawn
▼s Standpipe Level

Groundwater Strikes						Groundwater Observations			
	Depth m						Depth m		
No	Struck	Rose to	Rate	Cased	Sealed	Date	Hole	Casing	Water

GROUND ENGINEERING LIMITED

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Site: PLANK DROVE, CROWLAND

TRIAL PIT
TP1

Date: 23/03/16

Pit Size: 1.60m L x 0.60m W x 2.50m D.

Ground Level:

Samples and in-situ Tests			(Date) Water	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Result					
0.20	D1			MADE GROUND - Firm, dark brown, slightly gravelly, slightly sandy CLAY. Gravel consists of angular to sub-rounded flint, quartzite and brick. (TOPSOIL)			
0.20	J1						
0.50	D2						
0.50	J2					0.60	
0.80	D3			Soft, orange brown and grey brown, slightly gravelly, sandy CLAY. Gravel consists of angular to sub-angular flint. (ABBEY GRAVEL)			
0.80	J3					1.00	
1.10-1.40	B1			Medium dense, orange brown, slightly silty SAND AND GRAVEL. Gravel consists of sub-angular to sub-rounded flint.			
1.20-1.42	MP1	100	▽ 1	(ABBEY GRAVEL)		1.60	
				Soft, grey brown, slightly gravelly, silty CLAY. Gravel consists of angular to sub-rounded flint. (ABBEY GRAVEL)		1.90	
2.00-2.20	B2			Orange brown, slightly silty SAND AND GRAVEL. Gravel consists of sub-angular to sub-rounded flint. (ABBEY GRAVEL)			
2.10	D4					2.30	
2.40	D5			Soft, grey, slightly gravelly, silty CLAY. Gravel consists of sub-angular to sub-rounded flint. (ABBEY GRAVEL)			
2.40	V1	(46)				2.50	
				Hole completed at 2.50m depth			

KEY

- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- ES - Environmental Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS

1. Live roots observed to 1.10m depth
2. Groundwater met at 1.40m depth
3. Pit sides unstable from 0.80m depth

Project No	
13802	
Scale	Page
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Site: PLANK DROVE, CROWLAND

TRIAL PIT
TP2

Date: 23/03/16

Pit Size: 1.50m L x 0.60m W x 2.50m D.

Ground Level:

Samples and in-situ Tests			(Date) Water	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Result					
0.10	D1			MADE GROUND - Firm, dark brown, slightly gravelly, slightly sandy CLAY. Gravel consists of angular to sub-rounded flint, quartzite and brick. (TOPSOIL)			
0.10	J1						
0.40	D2						
0.40	J2					0.50	
0.80	D3			Soft, orange brown and grey brown, slightly gravelly, sandy CLAY. Gravel consists of angular to sub-angular flint.			
0.80	J3			(ABBEY GRAVEL)			
						1.10	
1.20-1.40	B1			Medium dense, orange brown, slightly silty SAND AND GRAVEL. Gravel consists of sub-angular to sub-rounded flint.			
1.40-1.60	MP1	100	▽1				
1.60-1.80	B2			(ABBEY GRAVEL)			
			▼c				
						2.00	
2.10-2.30	B3			Firm, grey and orange brown, slightly sandy, slightly gravelly CLAY. Gravel with abundant root fragments interbedded with flint.			
2.10	D4						
2.30	V1	(53)		(ABBEY GRAVEL)			
2.50	D5					2.50	
				Pit completed at 2.50m depth			

KEY

- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- ES - Environmental Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS

1. Live roots observed to 1.00m depth
2. Groundwater seepage at 1.40m depth and standing at 1.80m depth on completion
3. Pit sides unstable from 0.80m depth

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Site: PLANK DROVE, CROWLAND

TRIAL PIT
TP3

Date: 23/03/16

Pit Size: 1.60m L x 0.60m W x 2.30m D.

Ground Level:

Samples and in-situ Tests			(Date) Water	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Result					
0.20	D1			MADE GROUND - Firm, dark brown, slightly gravelly, slightly sandy CLAY. Gravel consists of angular to sub-rounded flint, quartzite and brick. (TOPSOIL)			
0.20	J1						
0.50	D2						
0.50	J2					0.60	
0.80-1.10	B1			Soft, orange brown and grey brown, slightly gravelly, sandy CLAY. Gravel consists of angular to sub-angular flint.			
0.80	D3						
0.80	J3						
1.20	D4			(ABBEY GRAVEL)			
1.30-1.60	B2						
1.60	D5		▽1				
1.70	W1						
1.80-2.00	B3					1.80	
2.00-2.20	MP1	100		Medium dense, orange brown, slightly silty SAND AND GRAVEL. Gravel consists of sub-angular to sub-rounded flint.			
2.10-2.30	B4			(ABBEY GRAVEL)			
						2.30	
				Pit completed at 2.45m depth			

KEY

- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- ES - Environmental Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS

1. Live roots observed to 1.00m depth
2. Groundwater met at 1.70m depth
3. Pit sides unstable from 1.50m depth

Project No	
13802	
Scale	Page
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Site: PLANK DROVE, CROWLAND

TRIAL PIT
TP4

Date: 23/03/16

Pit Size: 1.60m L x 0.60m W x 2.10m D.

Ground Level:

Samples and in-situ Tests			(Date) Water	Description of Strata	Legend	Depth m	O.D. Level m
Depth m	Type	Result					
0.20	D1			MADE GROUND - Firm, dark brown, slightly gravelly, slightly sandy CLAY. Gravel consists of angular to sub-rounded flint, quartzite and brick. (TOPSOIL)			
0.20	J1					0.30	
0.50	D2			Grey brown, slightly clayey, gravelly SAND. Gravel consists of angular to sub-angular flint. (ABBEY GRAVEL)			
0.50	J2					0.60	
0.80-1.10	B1			Soft, orange brown and grey brown, slightly gravelly, sandy CLAY. Gravel consists of angular to sub-angular flint.			
0.80	D3						
1.10	D4			(ABBEY GRAVEL)			
1.30-1.60	B2					1.30	
1.50	W1		1 ▽	Orange brown, slightly silty SAND AND GRAVEL. Gravel consists of sub-angular to sub-rounded flint.			
				(ABBEY GRAVEL)			
						2.10	
				Pit abandoned at 2.10m depth			

KEY

- D - Disturbed Sample
- B - Bulk Sample
- U - Undisturbed Sample
- R - Root Sample
- W - Water Sample
- ES - Environmental Sample
- ▽ Water Strike
- ▼ Water Rise
- ▼c Level on completion
- MP - Mackintosh Probe
- P( ) - Hand Penetrometer Cohesion ( ) kPa
- V - Vane Shear Test Cohesion ( ) kPa

REMARKS

1. Live roots observed to 1.20m depth
2. Groundwater met at 1.50m depth
3. Pit sides unstable from 0.90m depth
4. No maccy probe due to unstable hole
5. Pit abandoned at 2.40m depth due to running sand conditions

Project No	
13802	
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SOAKAWAY TEST RESULTS

BRE DIGEST 365 - SOIL INFILTRATION RATE

Project: Land Between 24 and 30 Plank Drove, Crowland
Client: Switch Electrical Wholesale Ltd

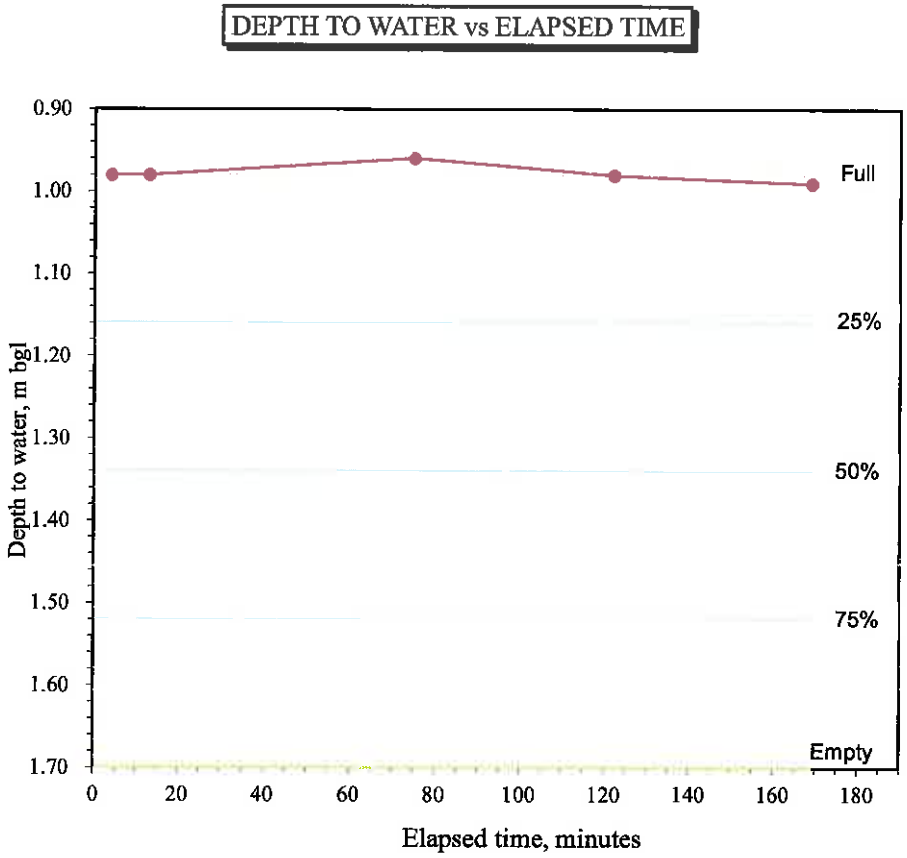
Project No: C13802
Sheet No: 1/1

Trial Pit: TP2 FIRST FILLING
Depth: 2.30
Length: 1.60
Width: 0.60

Description of Stratum under test: Soft, brown and orange brown, slightly gravelly, sandy CLAY & SAND AND GRAVEL.

Depth to water prior to test: 1.70m
(below ground level)

Elapsed Time min	Depth to Water m	
0	0.98	
4	0.98	
13	0.98	
75	0.96	Side collapse
122	0.98	
169	0.99	



All dimensions given in metres

f = **(V75-V25)/A50(T75-T25)**
V75-V25 = 0.346
A50 = 2.544
T75-T25 = 1700

Extrapolated Soil Infiltration f = **1.33E-06** **m/s**

GROUND ENGINEERING LIMITED, Peterborough

SOAKAWAY TEST RESULTS

BRE DIGEST 365 - SOIL INFILTRATION RATE

Project: Land Between 24 and 30 Plank Drove, Crowland
Client: Switch Electrical Wholesale Ltd

Project No: C13802
Sheet No: 1/1

Trial Pit: TP3 FIRST FILLING
Depth: 2.30
Length: 1.60
Width: 0.60

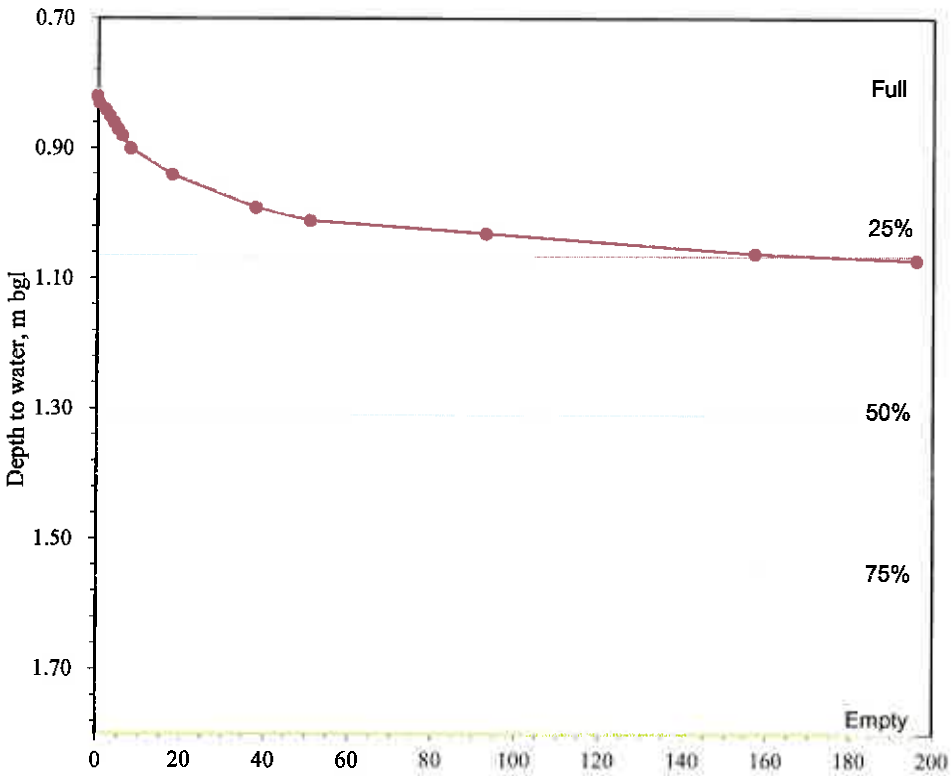
Description of Stratum under test: Soft, brown and orange brown, slightly gravelly, sandy CLAY & SAND AND GRAVEL

Depth to water prior to test: (below ground level) 1.80m

Elapsed Time min	Depth to Water m
0	0.82
1	0.83
2	0.84
3	0.85
4	0.86
5	0.87
6	0.88
8	0.90
18	0.94
38	0.99
51	1.01
93	1.03
157	1.06
196	1.07

All dimensions given in metres

DEPTH TO WATER vs ELAPSED TIME



f = (V75-V25)/A50(T75-T25)
V75-V25 = 0.470
A50 = 3.116
T75-T25 = 1150

Extrapolted Soil Infiltration] f = **2.19E-06** m/s

Groundwater/Gas Monitoring Record
GROUND ENGINEERING LIMITED

Site: Land between 24 & 30 Plank Drove, Crowland, Peterborough

Report Ref: C13802

Date	Borehole No.	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Flow Rate (l/hr)	Atmosph. Pressure (mb)	Depth of Well (m bgl)	Depth to Groundwater (m bgl)
		Peak	Steady	Peak	Steady	Min.	Max.				
13/04/16	BH1	<0.1	<0.1	0.8	0.8	19.7	19.7	<0.1	1009	5.00	0.80
20/04/16	BH1	<0.1	<0.1	<0.1	<0.1	20.4	20.4	<0.1	1033	5.00	0.83
27/04/16	BH1	<0.1	<0.1	0.2	0.2	20.1	20.1	<0.1	1010	5.00	0.92

Appendix 4

Laboratory Geotechnical Test Results

LABORATORY TEST RESULTS

CONTRACT PLANK DROVE, CROWLAND

Bore-hole	Sample	Depth m	Classification				Density		Triaxial Compression					Sulphates (SO_4)				Remarks
			Liquid Limit %	Plastic Limit %	Plasticity Index %	Moisture Content %	Bulk Mg/m^3	Dry Mg/m^3	Type	Principal Stress Difference kPa	Cell Pressure kPa	Shear Strength kPa	Angle of Shear Resistance degrees	Soil: Total % Dry Wt.	Soil: Aqueous Extract mg/l	Water mg/l	pH	
BH1	B3	0.80 - 1.20	41	15	26	25												SOIL CLASSIFICATION = CI 8% retained on 425μm sieve
	B4	1.50 - 2.00	31	13	18	15												SOIL CLASSIFICATION = CL 20% retained on 425μm sieve
	W1	1.70														222	7.2	
	U1	4.00 - 4.45				24	2.09	1.68	Q	119	70	60	0		845		7.3	
	U2	5.00 - 5.45				23	2.07	1.68	Q	86	90	43	0					
	U3	6.00 - 6.45				21	2.11	1.74	Q	227	110	114	0					
	U4	7.00 - 7.45				19	2.15	1.82	Q	372	120	186	0					
	U5	8.50 - 8.95				19	2.14	1.80	Q	427	150	214	0		659		7.7	
	U6	10.00 - 10.40				17	2.19	1.87	Q	902	180	451	0					
	U7	11.50 - 11.95				18	2.17	1.84	Q	622	205	311	0		592		7.8	

U - UNDISTURBED SAMPLE
D - DISTURBED SAMPLE
B - BULK SAMPLE
W - WATER SAMPLE

C.U. - CONSOLIDATED UNDRAINED
C.D. - CONSOLIDATED DRAINED
Q. - IMMEDIATE UNDRAINED
Q.M. - IMMEDIATE UNDRAINED MULTISTAGE

Aqueous Extract 2:1 Water:Soil

13802

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LABORATORY TEST RESULTS

CONTRACT PLANK DROVE, CROWLAND

Bore-hole	Sample	Depth m	Classification				Density		Triaxial Compression					Sulphates (SO_4)				Remarks
			Liquid Limit %	Plastic Limit %	Plasticity Index %	Moisture Content %	Bulk Mg/m^3	Dry Mg/m^3	Type	Principal Stress Difference kPa	Cell Pressure kPa	Shear Strength kPa	Angle of Shear Resistance degrees	Soil: Total % Dry Wt.	Soil: Aqueous Extract mg/l	Water mg/l	pH	
BH1	U8	13.10 - 13.50				20	2.12	1.78	Q	460	230	230	0					

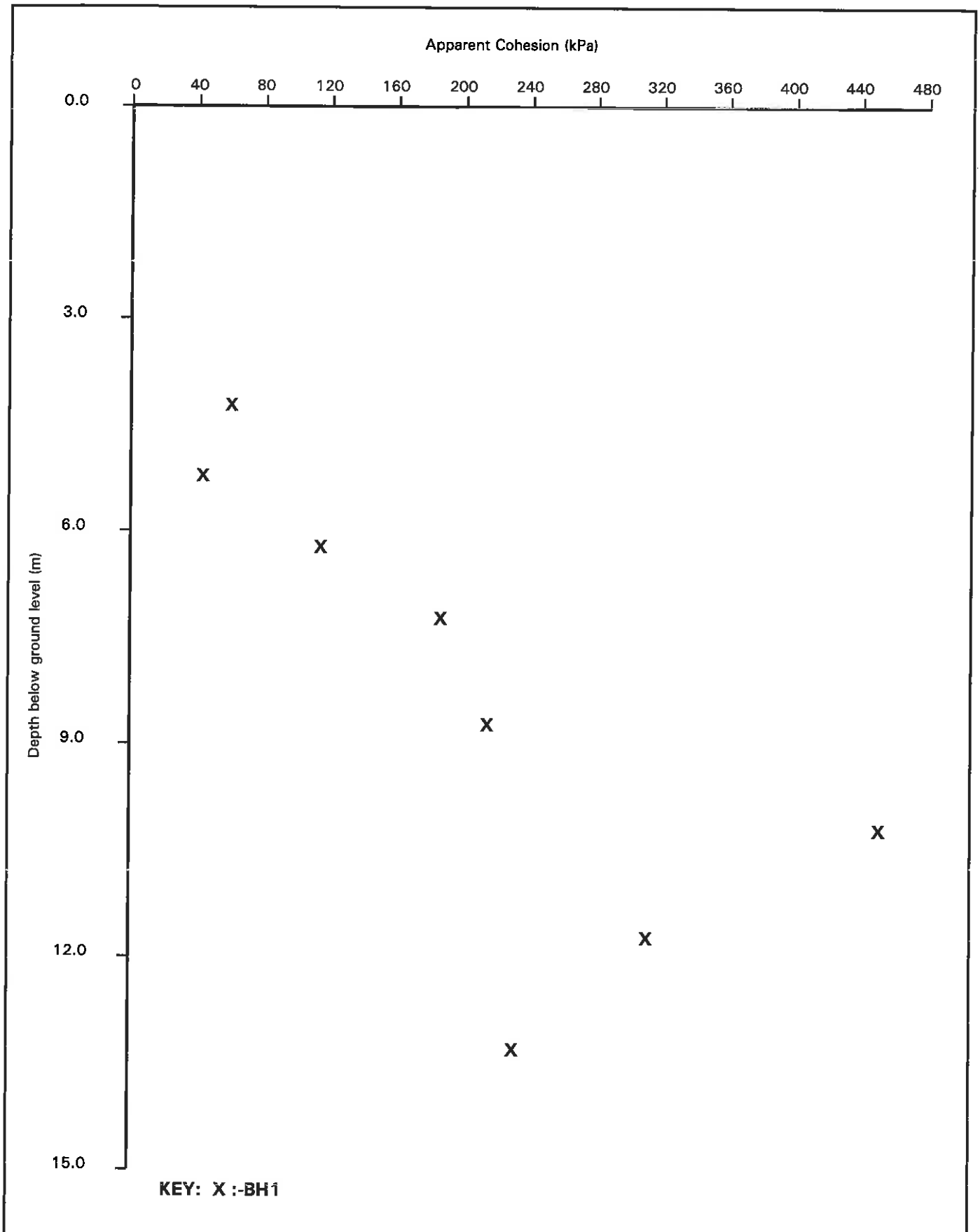
U - UNDISTURBED SAMPLE
D - DISTURBED SAMPLE
B - BULK SAMPLE
W - WATER SAMPLE

C.U. - CONSOLIDATED UNDRAINED
C.D. - CONSOLIDATED DRAINED
Q. - IMMEDIATE UNDRAINED
Q.M. - IMMEDIATE UNDRAINED MULTISTAGE

Aqueous Extract 2:1 Water:Soil

13802

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Apparent Cohesion (kPa) vs Depth below ground level (m).

SITE	PLANK DROVE, CROWLAND	
CLIENT	SWITCH ELECTRICAL WHOLESALE LIMITED	Contract Number 13802
GROUND ENGINEERING LIMITED Tel: 01733-566566 www.groundengineering.co.uk	Date 19/05/16	Figure

Appendix 5

Laboratory Chemical Test Results

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.co.uk

UKAS TESTING
2183

Final Report

Report No.:	16-07372-1
Initial Date of Issue:	05-Apr-2016
Client	Ground Engineering Limited
Client Address:	Newark Road Peterborough Cambridgeshire PE1 5UA
Contact(s):	John Gibb
Project	C13802 - Land Between 24+30 Plank Drove, Crowland

Quotation No.:		**Date Received:**	31-Mar-2016
Order No.:	C13802	**Date Instructed:**	31-Mar-2016
No. of Samples:	2		
Turnaround (Wkdays):	5	**Results Due:**	06-Apr-2016
Date Approved:	05-Apr-2016		

Approved By:



Details: Robert Monk, Technical Development Chemist

Chemtest
The right chemistry to deliver results

Results - Soil

Project: C13802 - Land Between 24+30 Plank Drove, Crowland

Client: Ground Engineering Limited			Chemtest Job No.:		16-07372	16-07372
Quotation No.:			Chemtest Sample ID.:		274341	274342
Order No.: C13802			Client Sample Ref.:		TP2	TP4
			Client Sample ID.:		D2	D1
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.40	0.20
			Date Sampled:		24-Mar-2016	24-Mar-2016
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
pH	U	2010		N/A	7.7	5.4
Moisture	N	2030	%	0.020	22	18
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	2.3	1.6
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.012	0.021
Cyanide (Free)	U	2300	mg/kg	0.50	< 0.50	< 0.50
Cyanide (Total)	U	2300	mg/kg	0.50	1.0	1.1
Sulphide (Easily Liberatable)	U	2325	mg/kg	0.50	1.4	2.0
Arsenic	U	2450	mg/kg	1.0	31	19
Cadmium	U	2450	mg/kg	0.10	0.34	0.25
Chromium	U	2450	mg/kg	1.0	54	35
Copper	U	2450	mg/kg	0.50	30	19
Mercury	U	2450	mg/kg	0.10	0.24	0.12
Nickel	U	2450	mg/kg	0.50	37	23
Lead	U	2450	mg/kg	0.50	74	35
Selenium	U	2450	mg/kg	0.20	0.79	0.77
Zinc	U	2450	mg/kg	0.50	100	67
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	9.0	12
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Chrysene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.10	0.26	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Naphthalene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Pyrene	U	2700	mg/kg	0.10	0.32	< 0.10
Total Of 16 PAH's	U	2700	mg/kg	2.0	< 2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30

Chemtest
The right chemistry to deliver results

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at our Coventry laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.co.uk

Appendix 6

Concrete Requirements Against Sulphate Attack

TABLE C1 – AGGRESSIVE CHEMICAL ENVIRONMENT FOR CONCRETE (ACEC) CLASSIFICATION FOR NATURAL GROUND LOCATIONS[a]

Table C1 Aggressive Chemical Environment for Concrete (ACEC) classification for natural ground locations[a]

Sulfate				Groundwater		ACEC
Design Sulfate Class for location	2:1 water/soil extract[b]	Groundwater	Total potential sulfate[c]	Static water	Mobile water	Class for location
1	2 (SO_4 mg/l)	3 (SO_4 mg/l)	4 (SO_4 %)	5 (pH)	6 (pH)	7
DS-1	< 500	< 400	< 0.24	≥ 2.5		AC-1s
					> 5.5[d]	AC-1[d]
					2.5–5.5	AC-2z
DS-2	500–1500	400–1400	0.24–0.6	> 3.5		AC-1s
					> 5.5	AC-2
				2.5–3.5		AC-2s
					2.5–5.5	AC-3z
DS-3	1600–3000	1500–3000	0.7–1.2	> 3.5		AC-2s
					> 5.5	AC-3
				2.5–3.5		AC-3s
					2.5–5.5	AC-4
DS-4	3100–6000	3100–6000	1.3–2.4	> 3.5		AC-3s
					> 5.5	AC-4
				2.5–3.5		AC-4s
					2.5–5.5	AC-5
DS-5	> 6000	> 6000	> 2.4	> 3.5		AC-4s
				2.5–3.5	≥ 2.5	AC-5

Notes

a Applies to locations on sites that comprise either undisturbed ground that is in its natural state (ie is not brownfield – Table C2) or clean fill derived from such ground.

b The limits of Design Sulfate Classes based on 2:1 water/soil extracts have been lowered relative to previous Digests (Box C7).

c Applies only to locations where concrete will be exposed to sulfate ions (SO_4) which may result from the oxidation of sulfides (eg pyrite) following ground disturbance (Appendix A1 and Box C8).

d For flowing water that is potentially aggressive to concrete owing to high purity or an aggressive carbon dioxide level greater than 15 mg/l (Section C2.2.3), increase the ACEC Class to AC-2z.

Explanation of suffix symbols to ACEC Class

- Suffix 's' indicates that the water has been classified as static.
- Concrete placed in ACEC Classes that include the suffix 'z' primarily have to resist acid conditions and may be made with any of the cements or combinations listed in Table D2 on page 42.

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